11TH INTERNATIONAL DEEP-SEA BIOLOGY SYMPOSIUM

NATIONAL OCEANOGRAPHY CENTRE, SOUTHAMPTON, UK
9 - 14 JULY 2006

BOOK OF ABSTRACTS

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11th International Deep-Sea Biology Symposium

National Oceanography Centre, Southampton
Southampton Solent University Conference Centre
Southampton UK
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Symposium Organising Committee

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- Dr Martin Sheader, NOC DEEPSEAS Group, UK.
- Miss Michelle Sterckx, Southampton Solent University Conference Centre, UK.
- Dr Ben Wigham, OceanLab, University of Aberdeen, UK.
- Supported by the DEEPSEAS post-graduate/doctorate team: Lis Maclaren, Sarah Murty, Nina Rothe, Tania Smith, John Dinley, Chris Hauton, Jon Copley, Hannah Flint, Abigail Pattenden, Emily Dolan, Teresa Madurell, Teresa Amaro, Janne Kaariainen, Daniel Jones, Kate Larkin, Eulogio Soto.

Front cover showing images from the BP Kongsberg underwater image competition

Cover legend (from left to right; 1-3, upper images, 4-6, lower images)

1. Half a millimeter full of spikes and spines, this deep-sea copepod of the family Stenocopiinae has the gut full of food and detritus agglutinated to the body. We do not know much about the feeding of copepods in the deep sea, but we can correlate their abundance to the primary production 5000m above their head. The animal has been collected in the Guinea Basin, a region where 99% of the species are expected to be new to science (Expedition DIVA 2, RV Meteor, CeDAMar, CoML). The specimen is stained with Rose-Bengal and photographed with a Leica-DMR-microscope. By: Gritta Veit-Köhler and Viola Siegler, Senckenberg Research Institute – DZMB, Germany.

2. A galatheid crab perched on a gorgonian coral, location: Gulf of Mexico. By: Derk Bergquist, University of Florida, USA.

3. *Bathykurila guaymasensis* (Annelida: Polynoidae) Pettibone, 1989, a species of polychaete that has been recorded from both hydrothermal vents and whale-falls, shown here shortly after being recovered from the remains of a Gray Whale skeleton in the Santa Cruz Basin at 1600m using the ROV Tiburon. The specimen was maintained alive for several hours aboard the ship, and photographed through a microscope. This ventral view of a male shows the large sperm-carrying nephridial papillae. By: Adrian Glover, Natural History Museum.

4. Blackbelly Rosefish (*Helicolenus dactylopterus*), Gulf of Mexico, Viosca Knoll - depth 500m By: Kirsten Luke, USGS

5. A *Stauroteuthis syrtensis* specimen. The importance of the images is that they are of specimens that were collected as live, individual and undamaged animals using ROVs and submersibles. All from recent cruises to the Mid-Atlantic Ridge on the GO Sars and to the Gulf of Maine on the Seward Johnson. By: David Shale, Freelance.

6. Venus Flytrap Anemone (*Actinosctyphia saginata*), Gulf of Mexico, Viosca Knoll - depth 500m. By: Michael Randall, USGS

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Every three years the international deep-sea biology research community gets together to discuss the latest research, make new plans, meet old friends and make new acquaintances. In 2006 it is the turn of Southampton to host the International Deep-Sea Biology Symposium. Previous conferences have been held in Kristineberg, Sweden (1977), La Jolla, California, USA (1981), Hamburg, Germany (1985), Brest, France (1988), Copenhagen, Denmark (1991), Heraklion, Crete, Greece (1994), Monterey Bay, California, USA (1997), Galway, Ireland (2000) and Coos Bay, Oregon, USA (2003). You may notice this list has only 9 locations. The early history of the Deep-Sea Biology Symposium is a bit murky and several venues, including Copenhagen 1953, may have a claim in starting off the symposium series.

The 11th International Deep-Sea Biology Symposium is being hosted by the National Oceanography Centre, Southampton (NOCS) (formerly known as the Southampton Oceanography Centre) and will be held at the Southampton Solent University Conference Centre in the heart of the city. We would like to thank the OceanLab (University of Aberdeen), the Scottish Association for Marine Science, the Natural History Museum, the University of Liverpool, the University of Plymouth, the British Antarctic Survey and the Joint Nature Conservation Committee, for additional help.

We are grateful for the sponsorship of the International Seabed Authority, BP, Transocean, Kongsberg Maritime, Southampton City Council, ChEss (Chemosynthetic Environments - Census of Marine Life), the Southampton Solent University, and the National Oceanography Centre, Southampton.

The sponsorship of the Symposium by several commercial companies and by the International Seabed Authority is indicative of the growing interest and importance of deep-sea living and non-living resources. Whether it is deep-sea fishing, the extraction of hydrocarbon reserves, or the future exploitation of mineral and genetic resources, the deep ocean offers many opportunities for wealth creation. This presents a problem, because together with the excitement of developing new resources in frontier areas comes the responsibility of exploiting those resources in a sustainable way, so that we can have riches and a healthy environment not only today but also for our sons, daughters and grandchildren.

How do we plan the use of ocean resources sensibly over such a vast area and in a coordinated and regulated way? Most ocean space falls outside the Exclusive Economic Zones of nation states, and even resources within EEZs are linked one to another and with the High Seas. A global vision is needed for ocean management and the key to making a successful plan is knowledge.

This Symposium brings together the vast majority of scientists engaged in deep-sea biology research around the World today. The prime aims are to highlight the latest research being carried out and to act as a melting pot for new ideas, hypotheses and strategies. With the growing need for good science in informing international ocean policy a significant part of the Symposium will focus on ocean management issues; how can scientific research inform policy formation and international legislation and what new research must be created to fill in the gaps?

Many of the pressing questions in deep-sea biology are large in scale and so early results from the various field projects of the international Census of Marine Life (CoML) programme feature, notably from ChEss (Biogeography of Chemosynthetic Environments), MAR-ECO (Mid Atlantic Ridge Ecosystems), CeDAMar (Census of the Diversity of Abyssal Marine Life), CenSeam (Census of Seamount Biodiversity), COMARGE (Continental Margin Ecosystems on a Worldwide Scale), CAML (Census of Antarctic Marine Life) and ArcOD (Artic Ocean Diversity).

We welcome to Southampton and we hope you have a fascinating, informative and social experience.

David Billett and Paul Tyler
National Oceanography Centre, Southampton
July 2006

PROGRAMME OF ORAL PRESENTATIONS

Sunday 9th July

17.00 Initial welcome and registration begins at National Oceanography Centre, Southampton

18.00 to 20.00 Welcome food and drinks at NOC

22.00 Registration ends

Monday 10th July

08.00 Registration continues at Southampton Solent University Conference Centre

08.45 Welcome

Setting the scene **Chair: Paul Tyler**

09.00 Heger A., King N., Wigham B.D., Jamieson A.J., Bagley P.M., Pfannkuche O. & Priede I.G. Profiles of pelagic bioluminescence in the water column over the Mid-Atlantic Ridge.

09.20 France S. C., Watling, L. E., Auster P.J., Babb I.G., Moore J.A., Mullineaux L.S., Adkins J.F., Shank T. & Waller R. Observations of deep-water coral communities on the New England and Corner Rise Seamount Chains (Western North Atlantic).

09.40 Schlacher T. A., Schlacher-Hoenlinger M.A., Williams A. & Althaus F. Megabenthos diversity in submarine canyons: aspects of sponge richness and distributions in deep-sea canyons off Tasmania (Australia).

10.00 Erickson K.L. & Van Dover C.L. Inactive sulphide mounds of Manus Basin: the invertebrate community and the potential for chemoautotrophic food web.

10.20 Thistle D., Sedlacek L., Carman K.R., Fleeger J.W., Brewer P.G. & Barry J.P. Simulated sequestration of industrial carbon dioxide at a deep-sea site: effects on species of harpacticoid copepods.

10.40 Coffee and Posters

From morphology to modelling

11.20 Krylova E. & Sahling H. Recent bivalve molluscs of the genus *Calyptogena*: morphology and distribution.

11.40 Brandao S.N. Cosmopolitan deep-sea Ostracoda (Crustacea)

12.00 Cubelio S.S., Tsuchida S. & Watanabe S. New species records, distribution and phylogenetic relationships of *Munidopsis* (Anomura: Galatheidae) from deep-sea hydrothermal vents of the Indian and Pacific Oceans.

12.20 McClain C.R., Boyer A.G. & Rosenberg G. The island rule and the evolution of body size in the deep sea.

12.40 Lunch

John Gage Tribute **Chair: Bhavani Narayanaswamy**

14.00 Paul Tyler: some reflections on John Gage.

14.10 Jeffreys R., Wolff G., Levin L.A., Whitcraft C., Gooday A.J. & Lamont P. Temporal and spatial changes in trophic patterns of benthos across the Pakistan Margin: a response to oxygen?

14.30 Shields M.A. & Hughes D.J. Gradients in macrofauna community structure along a latitudinal transect within the Northern Seas region.

14.50 Lambshead P.J.D., Lunt D.H., Floyd R.M., Elce B., Smith C.R. & Rogers A.D. Unexpected novel lineages in abyssal metazoan.

15.10 Oliver P.G. & Holmes A.M. Bivalvia of the oxygen minimum zone of the Oman margin.

15.30 Tea and Posters

16.10 Sumida P.Y.G., Bernadino A.F. & Smith C.R. Dynamics of epibenthic megafauna on the deep West Antarctic Peninsula shelf viewed from time-lapse photography.

16.30 Campos L. S., Alcântara P.F., Lavrado H.P., Carvalho A.L.P.S. & Vasconcelos R. F. Asteroidea (Echinodermata) from the Campos Basin Continental Margin, SE Brazil.

16.50 Aranda de Silva A., Larkin K.E., Pawlowski J., Bowser S.S. & Gooday A.J. Gromiids: an important group of large protists on bathyal continental margins in the Arabian and Weddell Seas.

17.10 Corliss B.H., Sun X., Brown C.W. & Showers W.J. The influence of primary productivity and seasonality of productivity on the North Atlantic benthos: benthic foraminiferal faunal and carbon isotope results.

17.30 Rowe G.T., Deming J., Montagna J., Baguley J., Bernhard J., Escobar E., Haedrich R., Wei C., Nunnally C., Soliman Y., Wicksten M. & Ammons A. Carbon cycling by deep, northern Gulf of Mexico food webs.

Evening at leisure in Southampton!

Tuesday 11th July: Parallel Session #1

Bacterial ecology **Chair: Martin Sheader**

09.00 Patching J.W., McCarthy D.M., Egan S.J. & Fleming G.T. Procaryotic community structure in the benthic boundary layer.

09.20 Oliveira Fernandes S., Krishnan K.P., Loka Bharathi P.A., Mirza I., Ray D., Kaisary S., Rao B.R. & Kamesh Raju K.A. Bacteria orchestrate methane and metal concentrations in seawater: examples from the Central Indian Ridge.

09.40 Polymenakou P.N. & Tselepides A. The magnitude of prokaryotic diversity in deep-sea sediments.

10.00 Kanzog C. & Quéric N.V. Impact of organic enrichment on the hydrolytic potential, growth, and diversity of benthic bacterial communities in the deep Arctic Ocean: laboratory and *in situ* experiments.

10.20 Coffee

Conservation

11.00 Mincks S., Smith C.R. & Morgan C.L. Using biological parameters in a geological model of the Pacific manganese nodule province: applications for biodiversity preservation.

11.20 Radziejewska T., Thistle D., Galtsova V.V., Kulangieva L., Drzycimski I., Trueblood D.D. & Ozturgut E. Benthic impact experiments in the Clarion-Clipperton Fracture Zone (equatorial NE Pacific): a comparison of meiofaunal responses to seafloor disturbance in two nodule-bearing areas.

11.40 Blake J.A., Maciolek N.J. & Williams I.P. Long-term benthic infaunal monitoring at the San Francisco Deep-Ocean Dredged Material Disposal Site (SF-DODS).

12.00 Cavanagh R.D., Kyne P.M., Fowler S.L., Pogonoski J.J. & Valenti S.V. Conservation status of deep-sea chondrichthyans.

12.20 Gianni M. Momentum toward protection of deep-sea biodiversity: fisheries and oceans negotiations in the UN General Assembly in 2006 and beyond.

12.40 Lunch

Management of the Deep Ocean (invited session) **Chair: Kerry Howell**

14.00 Rogers A.D. Management of the deep-oceans: moving from reactive to proactive.

14.20 Gjerde K. Progress and priorities for high seas MPAs.

14.40 von Nordheim H. The OSPAR network of MPAs in the North-East-Atlantic.

15.00 Johnston C. Information and data needs to implement conservation of deep sea biodiversity.

15.20 George R.Y. Conservation and governance of seamounts and deep-sea coral ecosystems: Primer from Miami 2005.

15.40 Thiel H. Protection of scientific investments: science priority areas.

16.00 Tea

16.30 Structured discussion on high seas MPAs – Chairman & Discussion Moderator: Craig Smith

18.00 End

19.00 National Oceanography Centre, Southampton Reception and Media Event

Tuesday 11th July: Parallel Session #2

***Seamounts* Chair: Brian Bett**

09.00 Brewin P.E., Stocks K.I. & Haidvodel D.B. Does oceanographic retention around seamounts explain seamount species diversity? A meta-analysis of global physical and biological data.

09.20 Clark M.R. Deep seamount fisheries: seeking the elusive goal of sustainability.

09.40 Christiansen B., Martin B. & Hirch S. Composition, population structure and trophic relationships of benthopelagic fishes at Seine Seamount, NE Atlantic.

10.00 Howell K.L., Davies J.S., Hall-Spenser J., Hughes D., Jacobs C., Narayanaswamy B.E. & Roberts J.M. Mapping deep water habitats on Rockall Bank in view of human use and management of the area.

10.20 Dower J., Tunnicliffe V., Juniper K., Stevens C. & Tyler J. Observations of flatfish 'spas' from hydrothermally active seamounts in the Mariana Arc.

10.40 Coffee and Posters

11.20 Tittensor D., Rogers A.D., Clark M. & Myers R. Predicting global habitat suitability for scleractinian corals on seamounts.

11.40 Cho W. & Shank T. Genetic connectivity of invertebrate populations on North Atlantic Seamounts .

12.00 Rowden A.A. & Clark M.R. Pattern of macroinvertebrate biodiversity on seamounts in the New Zealand region: not quite what you might expect.

12.20 Narayanaswamy B.E., Hughes D.J., Howell K.L., Davies J.S., Roberts J.M. & Jacobs C.L. Exploration of seamounts and banks in the NE Atlantic.

12.40 Lunch

***Physiology* Chair: Chris Hauton**

14.00 Frank T. Do ontogenetic migrators adapt to different light environments during their life histories?

14.20 Jamieson A.J., Godø O.R., Bagley P.M., Partridge J.C. & Priede I.G. Mechanical stimulation of bioluminescence by trawl gear.

14.40 Cohen J.H. & Frank T.M. Eye structure and visual physiology of the copepod *Gaussia princeps.*

15.00 Bush S.L. & Robison B.H. Examination of ink release by mesopelagic squids.

15.20 Drazen J.C. & Seibel B.A. Depth-related trends in metabolism of benthic and benthopelagic deep-sea fish.

15.40 Tea and Posters

16.20 Pane E.F. & Barry J.P. Acid-base balance in the deep-sea decapod crab *Chionoecetes tanneri*: the mediating role of oxygen availability.

16.40 Nomaki H., Ohkouchi, N, Chikaraishi Y., Suga H., Matsumoto K., Heinz P. & Kitazato H. Degradation and synthesis of $_{13}$C labelled organic matter by benthic foraminifera and bacteria in bathyal Sagami Bay, Japan.

17.00 Veit-Köhler G. & Seifried S. Sex ratio in the deep sea – a paradise for male copepods?

17.20 Miwa T., Koyama S., Konishi S., Hatashi J., Horikoshi, K & Aizawa M. Developments of tissue culture from deep-sea organisms and the life support system 'DEEPAQUARIUM'.

17.40 End

19.00 National Oceanography Centre, Southampton Reception and Media Event

Wednesday 12th July Parallel session #1

***Biodiversity* Chair: Tammy Horton**

09.00 Wilson G.D.F. Biodiversity of the Arafura Sea: a transitional deep-sea fauna on a tropical outer shelf.

09.20 Paterson G.J.L., Glover A., Smith C.R., Dyal P., Menot L. & Galéron J. Patterns of polychaete biodiversity in the abyssal Pacific – comparison of morphology and molecular results.

09.40 Schüller M., Hilbig B. & Wägele J.-W. The polychaetes of the Antarctic deep sea: ANDEEP I/II 2002 to the Scotia and Weddell Seas.

10.00 De Mesel I., Vanhove S., Vermeeren H., Ingels J. & Fonseca G. Biodiversity of Nematoda in the Southern Ocean.

10.20 Coffee and Posters

11.00 Cunha M.R. & Sorbe J.C. Crustacean assemblages from bathyal environments in the Gulf of Cadiz.

11.20 Lampadariou N. & Tselepides A. Bathymetric patterns of free-living nematodes in the Aegean Sea, eastern Mediterranean.

11.40 Larusdottir, O., Watling L. & Svarvasson J. Distribution and diversity of cumaceans (Crustacea, Cumacea) in the N. Atlantic – effects of the GIF Ridge.

12.00 Miljutina M., Miljutin D., Mahatma R. & Martinez Arbizu P. Structure of nematode communities from a deep-sea polymetallic nodule site.

12.20 Hoste E., Soltwedel S., Vanhove S. & Vanreusel A. The temporal and spatial variability in the meiobenthos at the Arctic marginal ice zone.

12.40 Packed lunch- provided

13.30 Leave for Portsmouth Naval Dockyard

17.30 Reception on HMS *Warrior*

19.00 Dinner on HMS *Warrior*

22.30 Depart for Southampton

Wednesday 12th July Parallel session #2

Trophic ecology **Chair: Andy Gooday**

09.00 Schewe I., Soltwedel, T. & Klages M. Deep-sea benthic community responses to pulsed food supply in the Arctic Ocean.

09.20 Larkin K.E., Gooday A.J., Pond D.W. & Bett B.J. Fatty acid analysis reveals the importance of Foraminifera in benthic organic matter recycling.

09.40 Guðmundsson G., Osborn K.J. & Svarvasson J. Feeding of large asellote isopods (Crustacea, Isopoda) in the deep sea – are they active predators?

10.00 Pile A.J., Hudson I.R., Fletcher C. & Robertson K. Effects of physical disturbance associated with deep-sea drilling on scavenger activity in temperate and tropical Australia.

10.20 Bailey D.M., Ruhl H.A., Drazen J.C., Morrell L.J., Ruxton G.D. & Smith K.L. Jr. Change in the abyssal fish fauna of the Pacific Ocean driven by variation in food availability.

10.40 Coffee and Posters

Autecology

11.20 Guijarro B. & Massuti E. Influence of environmental factors in the population dynamics of the deep-water shrimp *Parapanaeus longirostris* (Crustacea, Decapoda) in the Balearic Islands (western Mediterranean).

11.40 Chan B.K.K. & Lee K.S. Population dynamics of the deep-sea barnacle *Rostraverruca koehleri* (Cirripedia, Verrucamorpha) epibionts on the spines of the sea urchin *Stylocidaris* in Taiwan.

12.00 Schnabel K., Probert K. & Bruce N. Deep-sea downunder, species richness, habitat and distributional patterns of New Zealand squat lobsters (Chirostylidae, Anomura, Crustacea).

12.20 Vardaro M.F. & Smith K.L. Jr. Deep-sea bioturbation and the role of the sea urchin *Echinocrepis rostrata*.

12.40 Packed lunch- provided

13.30 Leave for Portsmouth Naval Dockyard

17.30 Reception on HMS *Warrior*

19.00 Dinner on HMS *Warrior*

22.30 Depart for Southampton

Thursday 13th July Parallel session #1

Chemo-environments **Chair: Eva Ramirez-Llodra**

09.00 Shank T.M., Beaulieu S.E., Luther G.W. III, Moore T., Seyfried W.E. Jr., Ding K., Ward N., Vetriana C., Sievert S.M. & Lutz R.A. Integrated *in situ* approaches to determine the role of fluid chemistry and microbial biofilms on the colonisation and distribution of hydrothermal vent fauna.

09.20 Watanabe H., Kado R., Tsuchida S., Shitashima K., Furushima Y., Urakawa H. & Kojima S. Distribution of larvae of vent animals around the vent fields on Myojin Knoll, in the Izu-Ogasawara Arc.

09.40 Johnson S.B., Warén A., Lutz R.A. & Vrijenhoek R.C. Population structure and dispersal in deep-sea limpets from the eastern Pacific.

10.00 Van Gaest A.L. & Young C.M. Long-distance larval dispersal of the cold-seep gastropod *Bathynerita naticoidea.*

10.20 Coffee and Posters

11.00 Martins I, Colaço A., Desbruyères, D., Sarradin P.-M. & Santos R.S. Estimation of microbial and *Bathymodiolus* sp. production at vent sites of the Mid-Atlantic Ridge using a C-flux model.

11.20 Hardvillier Y., Leignel V., Denus F., Chenais B., Laulier M. & Cosson R. Metallothioneins in the hydrothermal vent mussels *Bathymodiolus azoricus* and *B. thermophilus.*

11.40 Kadar E. & Costa V. Is essential metal requirement of the vent mussel *Bathymodiolus azoricus* enhanced as compared to non-hydrothermal vent mussels?

12.00 Bettencourt R., Santos R. & Roch P. First innate immune parameters unveiled in the deep sea mussel *Bathymodiolus azoricus.*

12.20 Van Dover C.L., Ward M.E., Scott J.L., Underdown J., Gustafson C., Anderson B., Whalen M. & Carnegie R. An emergent fungal epizootic in hydrothermal vent mussels.

12.40 **Business Meeting** followed by lunch

Chair: Maria Baker

14.00 Braby C.E., Williams S.J., Jones W.J. & Vrijenhoek R.C. Bathymetric and temporal changes in whalefall communities in Monterey Bay.

14.20 Van Gaever S. Vanreusel A., Moodley L., de Beer D. & Galeron J. Meiofauna at deep-sea cold seeps: diversity, adaptation and trophic position.

14.40 Rodrigues C.F., Webster G., Weightman A.J. & Cunha M.R. Trophic relationships of chemosynthetic species and the role of prokaryotic endosymbionts in the nutrition of Solemtidae and Lucinidae bivalves from mud volcanoes in the Gulf of Cadiz.

15.00 Borowski C., Wenzhöfer F., Felden J., Zielinski F., Dubilier N. & Boetius A. Evaluation of spatial variability of physico-chemical gradients at hydrothermal vents and cold seeps and their effects on community structures.

15.20 Tea and Posters

16.00 Miyake H., Kitada M., Tsuchida S., Suzuki, Y. & Takai K. Long-term rearing of deep-sea animals in chemosynthetic ecosystem using artificial hydrothermal vent system.

16.20 Martinez Arbizu P., Ivanenko V.N. & Gad G. Hydrothermal vent fauna in the Mid-Atlantic Ridge: is the Romanche Fracture Zone a biogeographic barrier? Lessons from meiofauna.

16.40 Dando P.R., Pendlebury, S. & Nortley H.K. Behaviour and nutrition of the MAR vent limpet *Lepetodrilus atlanticus*.

17.00 Anderson L.M., Lechaire J.P., Frébourg G., Boudier T., Halary S., Zbinden M., Laval J.-Y., Marco S. & Gaill F. Energy filtering transmission electron tomography (EFTET) of bacteria-mineral associations within the deep-sea hydrothermal vent shrimp *Rimicaris exoculata.*

17.20 Smith C.R., Altamira I. & Nation J.B. Whale-fall communities, whaling and species extinctions at the deep-sea floor.

18.00 Civic Reception by Southampton City Council at Civic Centre Art Gallery: Presentation of BP Kongsberg underwater image competition awards

20.00 Evening free

Thursday 13th July Parallel session #2

Biodiversity **Chair: Sven Thatje**

09.00 Galkin S.V. Bottom fauna in the region of RRS *Titanic* wreck: trawl data and submersible observations.

09.20 Brind'Amour A., Menot L., Galéron J. & Sibuet M. Multiscale spatial distribution of a sedimentary macrobenthic community on the Angolan margin.

09.40 Hasemann C. & Soltwedel T. Small-scale heterogeneity in the Arctic deep sea: impact of small cold-water sponges on the diversity of benthic nematode communities.

10.00 George K.H. Argestidae (Copepoda, Harpacticoida) of the deep Angola Basin (SE Atlantic). Distribution patterns, community structure and species diversity.

10.20 Raupach M.J. & Wägele J.W. Genetic diversity within benthic deep-sea Asellota (Crustacea, Isopoda) of the Southern Ocean: opening Pandora's box?

10.40 Coffee and Posters

11.20 Kröger K. & Rowden A.A. Deepwater polychaete assemblages in the North-western Ross Sea: are they affected by iceberg disturbance?

11.40 Brix S., Kaiser S. & Brandt A. To worm a secret out of the deep sea: the phylogeny of Desmosomatidae Sars, 1897 (Isopoda, Crustacea).

12.00 Osborn K.J. A phylogenetic hypothesis for the Munnopsidae (Isopoda, Asellota) based on three genes and introduction of new pelagic members.

12.20 Kavanagh F.A. Heterochrony in the deep sea: species of Ischnomesidae show progenesis.

12.40 **Business Meeting** followed by lunch

Fish biology **Chair: Ian Hudson**

14.00 Priede I.G. Absence of sharks from the abyss: factors determining depth limits of fish.

14.20 Menezes G., Rosa A., Melo P. & Pinho M. Demersal fish assemblages off the Seine and Sedlo seamounts from longline surveys (NE Atlantic).

14.40 Bergstad O.A., Menezes G. & Hoines Aa. Distribution patterns and structuring factors of deepwater demersal fishes on a mid-ocean ridge.

15.00 Sulak K.J., Luke K.E., Norem A.D. & Randell M. Sequential frame analysis of fishes associated with *Lophelia* reefs in the Gulf of Mexico.

15.20 Felley J.D., Vecchinone M. & Wilson R. Habitat preferences for deep-sea demersal nekton in the Charlie-Gibbs Fracture Zone of the Mid-Atlantic Ridge.

15.40 Tea and Posters

16.00 Kemp K.M., Fraser K.P.P., Collins M.A. & Priede I.G. Temporal variation in the nutritional condition of deep-sea macrurids in the NE Atlantic: a seasonal study between 1300 and 4300m.

16.20 Wigham B.D., Priede I.G. & Bett B.J. Diversity, distribution and abundance of demersal scavenging fish on the Angola Margin.

16.40 King N.J., Wigham B.D., Jamieson A., Bagley P. & Priede I.G. Demersal ichthyofaunal composition in two contrasting productivity regions of the Crozet Plateau.

17.00 Bergmann M., Dannheim J. & Klages M. Trophic relationships between demersal fish and benthic fauna at 'Hausgarten' (79ºN west of Svalbard).

17.20 Sanchez F., Serrano A., Cartes J., Preciado I., Parra S., Frutos, I., Sorbe J.C., Velasco F. & Olaso I. Structure and dynamics of Le Danois Bank ecosystem.

18.00 Civic Reception by Southampton City Council at Civic Centre Art Gallery: Presentation of BP Kongsberg underwater image competition awards

20.00 Evening free

Friday 14th July Parallel session #1

Corals **Chair: Adrian Glover**

09.00 Watling L., Simpson A & Mosher C. Gorgonian octocorals and their invertebrate commensals of the New England and Corner Rise seamounts

09.20 Brooke S.D., Messing C.G., Reed J.K. & Gilmore G. Exploration of deep-sea coral ecosystems along the east coast of Florida.

09.40 Molodtsova T. Black corals of the NE Atlantic: an overview.

10.00 Baco A.R. Population genetic structure of the deep-sea precious coral *Corallium secundum* from the Hawaiian Archipelago based on microsatellites.

10.20 Le Guilloux E., Olu-Le Roy K., Lorance P., Lecornu F., Galéron J., Fifis A., Sibuet M., Vacelet M., Zibrowius H., Grehan A. & Henriet J.P. Structure of megafaunal community associated with deep-sea corals on carbonate mounds and distribution at the regional scale.

10.40 Coffee

Megafauna

11.20 Ruhl H.A. & Smith K.L. Jr. Abyssal megafaunal community responses to interannual climate fluctuation in the NE Pacific.

11.40 Gebruk A. V. & Budaeva N. Patterns of benthic fauna distribution along the Mid-Atlantic Ridge in the North Atlantic.

12.00 Galéron J., Scolan P., Fifis A. & Sibuet M. Spatial variability of megafaunal assemblages in the deep-sea polymetallic nodule fields of the Northeast Pacific.

12.20 Lavrado H.P., Campos L.S., Curbelo-Fernandez M.P. & Falcão A.P. Benthic megafauna distribution at the southeastern Brazilian continental margin: Campos Basin.

12.40 Lunch

Chair: David Billett

14.00 Ramirez-Llodra E., Ballesteros M., Sardà F. & Company J.-B. Biodiversity and spatio-temporal variations in the biomass and abundance of non-decapod invertebrates in the bathyal continental margin of the North-western Mediterranean Sea.

14.20 Young C.M., Pile A., Maldonada M., Wood A.M., Holmes M. & Reiswig H. Biotic and abiotic control of the vertical distribution in an abundant glass sponge field on the flank of Mauna Loa Volcano, Hawai'i.

14.40 Serrano A., Sanchez F., Cartes J., Frutos I., Sorbe J.C., Parra S., Preciado I., Velasco F. & Olaso I. Habitat complexity, prey availability and other environmental factors determining spatial distribution of epibenthic communities in the Le Danois Bank (Cantabrian Sea, N Spain).

15.00 Beaulieu S. E., Smith K.L. Jr., Ruhl, H. & Baldwin R. Megafauna at the abyssal seafloor underlying the North Pacific subtropical gyre: composition and abundance from photographic and video surveys.

15.20 Tea and Posters

Food for thought on the way home **Chair: David Billett**

15.40 Rees M., Brunskill G.J., Burns K.A. & Hayward A.J. Observations of seeps and interregional benthic macrofauna on the Northern Australian continental slope.

16.20 Voight J.R. Biotic interactions define the temporal stability of deep-sea wood falls in the N. Pacific.

16.40 Glover A.G., Goetze E., Dahlgren T.G. & Smith C.R. The ‘snowboarding’ scaleworm: morphology, reproductive biology and genetic structure of a stepping stone species.

17.00 Barry J.P., Buck J.R., Paull C.K., Xu J.P., Whaling P.J., Ussler W. III, Lovera C. & Kuhnz L. The influence of turbidity flows on carbon transport and benthic biological patterns in the Monterey Canyon.

17.20 Closure

Friday 14th July Parallel session #2

***Pelagos* Chair: Monty Priede**

09.00 Haddock S.H.D. & Thuesen E.V. Deep-sea planktonic biomass and biodiversity using complementary methodologies.

09.20 Robison B.H., Sherlock R.E., Reisenbichler K.R. & Osborn K.J. The bathypelagic community of the Moneterey Canyon.

09.40 Sutton T., Porteiro F., Uiblein F., Byrkjedal I., Dolgov A., Heino M., Horne J., King N., Falkenhaug T., Godo O. & Bergstad O. Bathypelagic fish associated with the Mid-Atlantic Ridge.

10.00 Kenaley C.P. Breaking from the moveable feast: the evolution of prey choice and foraging strategies in the loosejaw dragonfishes (Stomiifromes: Stomiidae, Malacosteinae).

10.20 Coffee

11.00 Pagès F., Martín J., Palanques A., Puig P. & Gili J.-M. High occurrence of the elasipod holothurian *Penilipdia ludwigi* (von Marenzeller 1893) in bathyal sediment traps moored in a western Mediterranean submarine canyon.

11.20 Falkenhaug T., Hansen H.Ø., Willassen E. & Christiansen M. Pelagic shrimps (Decapoda, Caridea) on the Mid-Atlantic Ridge.

11.40 Pedchenko A.P. & Dolgov A.V. Habitat conditions of mesopelagic fish in the Irminger Sea.

12.00 Lunch

***Pole to Pole* Chair: Alan Hughes**

13.40 Thatje S. The deep-sea connection: past climate change and the colonisation of Antarctica.

14.00 Pawlowski J., Cornelius N., Lecroq B., Longet D., Fahrni J., Cedhagen T. & Gooday A.J. Bipolar gene flow in deep-sea Foraminifera.

14.20 Held C. Recurrent polar submergence of serolid isopods in High Antarctic waters.

14.40 Brandt A., Brix S., Brökeland W., Choudhury M. & Kaiser S. Biodiversity and zoogeography of Southern Ocean deep-sea Isopoda (Crustacea, Malacostraca) – does this taxon support the source-sink hypothesis?

15.00 Janussen D, Tendal O.S., Plotkin A.S. & Rapp H.T. What is characteristic for the deep-sea sponge fauna in the Weddell Sea?

15.20 Tea and Posters

Poster Programme

MONDAY 10th July

Taxonomy & Phylogeny

1. Barrett B.M. Towards a revision and phylogeny of the genus *Paramphinome* M. Sars in G.O. Sars, 1872 (Polychaeta: Amphinomidae).
2. Barry P. Is there a case for the Subfamily Axinopsidinae (Bivalvia: Thyasiridae)?: revising the taxonomy of the minute thyasirids of the genera *Adontorhina*, *Mendicula* and *Axinulus*.
3. Brandao S.N. Deep-sea Bythocytheridae (Crustacea, Ostracoda, Cytherocopina) from Antarctica.
4. Brandao S.N. & Schön I. First molecular study on deep-sea Ostracoda (Crustacea).
5. Dohrmann M., Janussen D., Reitner J. & Wörheide G. Phylogeny of Hexactinellida.
6. Dolan E., Tyler P.A., Rogers A.D. & Billett D.S.M. Taxonomic revision of deep-sea Pennatulacea.
7. Doner S. & Blake J.A. Cirratulidae (Polychaeta) from the continental slope Weddell Sea, Antarctica, with description of two new species.
8. France S.C. Not all deep-sea whips are created equal: genetic analysis of bamboo corals (Octocorallia, Isididae).
9. George K.H. New Ancorabolidae (Copepoda: Harpacticoida) of the Atlantic Ocean. The taxon *Ceratonotus* Sars, 1909.
10. Golovko L. Bivalves molluscs of the genus *Policordia* of the Atlantic Ocean.
11. Kaiser S., Brix, S. & Brandt A. Desmosomatidae versus Nannoniscidae (Isopoda, Crustacea). Systematics and problematics.
12. Kamenskaya O.E. Komokiaceans (Foraminifera, Komokioidea) from the hadal trenches of the West Pacific.
13. Lecroq B., Gooday A.J., Cedhagen T. & Pawlowski J. Origin of the Komokiacea – molecular insight.
14. Leignel V., Van Wormhoudtb A., Bui Q.T., Ravallec R., Hardivillier Y. & Laulier M. Evidence of phylogenetic molecular proximity between hydrothermal (Alvinocarididae, Mirocaridiae) and deep-sea (Nematocarcinidae, Oplophoridae) shrimp families.
15. Liao Y.C. & Shao K.T. Molecular phylogenetics of Stomiiformes (Pisces) inferred from mitochondria Cy b gene sequences.
16. Mahatma R., Martinez Arbizu P. & Ivanenko V.N. *Brychiopontius galeronae* sp.n. (Copepoda, Siphonostomatoida, Brychiopontidae) from the North Pacific nodule province
17. Malyutina MV & Brandt A. Munnopsidae Lilljeborg, 1864 (Crustacea, Isopoda) from the South Atlantic and Southern Ocean: current state.
18. Menzel L. & George K.H. Systematics of the *Mesocletodes abyssicola* group (Argestidae, Harpacticoida, Copepoda).
19. Miljutin D.M., Miljutina M.A. & Martinez Arbizu P. New data on distribution and taxonomy of Benthimermithidae (Nematoda), parasites of deep-sea invertebrates.
20. Oliver P.G. & Holmes A.M. The Thyasiridae (Bivalvia) in deep-sea settings.

21. Packer M., Blenkin S., Floyd R., Abebe E., Angel P., Baldwin J., Cook A., Creer S., Lunt D.H., Rogers A.D., Thomas K. & Lambshead P.J.D. Development and uses of a deep sea nematode morphological and DNA barcode database.
22. Rapp H., Tore H., Janussen D. & Tendal O.S. Calcareous sponges from abyssal and bathyal depths in the Weddell Sea, Antarctica.
23. Raupach M.J. & Wägele J.-W. The phylogeny of the deep-sea Asellota (Crustacea: Isopoda) inferred from 18S rDNA data.
24. Rehm P., Brandt A., Mühlenhardt-Siegel U. & Thatje S. New record of the Southern Ocean species *Cumella emergens* (Cumacea: Nanastacidae) that emerged from the deep.
25. Reimer J.D., Sinniger F., Fujiwara Y., Hirano S. & Maruyama T. Morphological and molecular characterization of *Abyssoanthus nankaiensis*, a new family, new genus and new species of deep-sea zoanthid (Anthozoa: Hexacorallia: Zoantharia) from a Northwest Pacific methane cold seep.
26. Rogacheva, A. Taxonomical composition and distribution of Arctic species of the family Elpidiidae (Echinodermata; Holothuroidea; Elasipodida).
27. Stransky B. & Svavarsson J. Distribution of a new arcturid species (Crustacea: Isopoda: Arcturidae) on the Greenland-Iceland-Faeroe Ridge.
28. Veit-Köhler G. & Thistle D. A new species of *Kliopsyllus* (Copepoda, Harpacticoida) extends the genus' deep-sea range.
29. Wiklund H., Glover A.G., Pleijel F., Johannessen P.J., Smith C.R. & Dahlgren T.G. The cosmopolitan carpet-worm: new species and records *Vigtorniella* (Annelida) at both deep-sea and shallow-water reducing environments.

Techniques etc

30. Bernardino A.F., Sumida P.Y.G., Smith C.R. & Yoshinaga M.Y. Assessing benthic megafauna abundance through image analysis: contrasting results from a time-lapse and an underwater video camera.
31. Cardigos F., Almeida D., Sebastião L., Colaço A., Nunes S., Pascoal A., du Buf J. & Santos R.S. Quest for high resolution mapping in deep-sea environments.
32. Hasemann C., Sablotny B. & Soltwedel T.N. New technologies for the study of ecosystem consequences of seabed disturbance: The development of an 'Integrated Sediment Disturber' (ISD).
33. Kemp K.M. & Priede I.G. Tides and currents in the deep sea: time signals and the potential for selective tidal transport.
34. Yeh H.-M., Shih T.-W., Chen L.-S. & Shao K.-T. Techniques for aquarium exhibition of live deep-sea fishes in Taiwan.
35. Yoshiki T., Shimizu A. & Toda T. Development of hydrostatic pressure apparatus for marine zooplankton study.

TUESDAY 11th July

Projects

1. Ahlfeld T. Application of deep-sea biological research to offshore oil and gas resource management decision making.
2. Bagley P., Smith K.L., Bett B., Priede I.G., Rowe G., Clarke J. & Walls A. Deep ocean Environmental Long term Observatory System (DELOS): Long term monitoring of the deep ocean demersal community in the vicinity of offshore hydrocarbon operations.
3. Baker M.C., Ramirez-Llodra E.Z., Tyler P.A. & German C.R. ChEss – Biogeography of deep-water chemosynthetic ecosystems - a Census of Marine Life pilot project.
4. Bergmann M. EXOCET/D consortium EXtreme ecosystem studies in the deep OCEan: technological developments – EXOCET/D.
5. Horton T., Baker M.C. & Bett B.J. Britain's deep-sea landscapes.
6. Hudson I.R., Jones D.O.B., Kaarainen J.I., Maclaren E.K. & Wigham B.D. SERPENT Project: Linking deep-sea science to the oil and gas industry.
7. Jaeckisch N., von Juterzenka, K. & Soltwedel, T. Studies on the mega-epibenthic community at the deep-sea long-term observatory HAUSGARTEN.
8. Jamieson A.J., Heger A. & Priede I.G. Opportunities for Deep Sea Biology in the KM3NeT Neutrino Telescope Project.
9. Jones D.O.B., Hudson I.R. & Bett B.J. Knowledge Transfer between deep-sea science and industry: Case Studies from the DIEPS Project.
10. Narayanaswamy B.E. Deep-Sea Education and Outreach ideas for Europe.
11. Sibuet M., Menot L., Carney R.S., Billett D.S.M., Levin L., Passeri Lavrado H. & Rowe G.T. CoML/COMARGE-- Continental Margin Ecosystem on a worldwide scale.
12. Soltwedel T. and the HAUSGARTEN Scientific Party HAUSGARTEN – multidisciplinary investigations at a deep-sea long-term observatory in the Arctic Ocean.
13. Thatje S., Shillito B., Hauton C., Billett D.S.M. & Tyler P.A. Discovering the unknown: experimental laboratory studies in deep-sea organisms.
14. Wigham B.D. and the ECOMAR Consortium ECOMAR - A multi-disciplinary study of non-vent ecosystems on the Mid-Atlantic Ridge.

Corals/Seamounts/Conservation &Management

15. Consalvey M., Clark M.R., Rowden A.A. & Stocks, K.I. A global census of marine life on seamounts: are they really oases in the ocean?
16. Davies J.S., Hall-Spencer J., Howell K.L., Roberts J.M., Hughes, D. & Narayanaswamy B.E. The distribution of cold-water corals on UK banks and seamounts.
17. Fletcher C.A. A descriptive examination of the effects of drilling activity on the epibenthic megafauna of northwestern Australia.
18. France S.C. & Brugler M.R. Distribution and abundance of black corals (*Antipatharia*) in relation to depth and topography on the New England Seamounts (Northwest Atlantic).
19. George R.Y. Fish and Crustacea associated with *Lophelia* Reefs in the Agassiz Coral Hills (Blake Plateau) in the 'OSPAR' region of Northeast Atlantic.

20. Gillet P. & Surugiu V. Polychaetous annelids from North Atlantic seamounts: a biogeographical approach.
21. Howell K.L., Gordon J.D.M., Jones E., Duncan J.A.R. & Burrows M.T. Sustainable management of deep-water fisheries and their impact on marine biodiversity.
22. Matsumoto A.K. & Tsukamoto K. The observation of deep-water octocorals on the equatorial seamounts, Mariana, W Pacific.
23. Medeiros M.S. Brazilian deep sea octocorals: an evaluation of the state of art.
24. Molodtsova T. & Budaeva N. Effect of associated fauna to the corallum growth of black corals.
25. Mullineaux L.S., Mills S.W. & Ferrini V. Octocoral size-distributions and their implications for recruitment dynamics on the New England Seamounts.
26. Narayanaswamy B.E, Hughes D.J, Lamont P., Harvey R. & Robb L. Macrofauna inhabiting the seamounts and banks of the Northeast Atlantic.
27. Nguyen T.H.Y., Ikejima K., Pedersen O., Sunada K. & Oishi S. Using worldwide ReefCheck monitoring data to develop Coral Reef Index of Biological Integrity.
28. Pires D.O., Castro C.B., Arantes R.C. & Medeiros M.S. Evaluation of the use of ROV images and collected samples on the assessment of Cnidaria associated with deep-sea reefs in the Southwestern Atlantic.
29. Robertson K., Thomson M. & Pile A.J. Heat shock proteins as indicators of stress in marine organisms: A deep-sea study off the northwest shelf of Australia.
30. Salmeron F. & Ramos A. Demersal icthyofauna of Sierra Leone Rise seamounts (Gulf of Guinea, Africa).
31. Tilot de Grissac V. Biodiversity and distribution of the suprabenthic megafaunal assemblages in an abyssal polymetallic nodule province of the eastern equatorial Pacific ocean; recommendations for a high seas conservation issue.
32. Unger M.A., Vadas G.G., Harvey E & Vecchione M. Accumulation of persistent organic pollutants and tributyltin in nine species of Atlantic deep-sea cephalopods.
33. Waller R.G., Scheltema R.,Tyler P.A. & Smith C.R. The reproduction and larval ecology of Antarctic deep-water corals.
34. Waller R.G., Watling L., Auster P.A. & Shank T.S. Anthropogenic impacts on the Corner Rise Seamounts, NW Atlantic.

Bacteria

35. Buck K.R., Barry J.P., McClain C., Romer E.M., Yager P.L. & Carman K.R. Deep-sea benthic respiration: bacterial contribution to sediment community oxygen consumption assessed with allometry.
36. Egan S.J., McCarthy D.M., Fleming G.T. & Patching J.W. Reponses of a deep-ocean bacterial community to organic nutrients.
37. Elsaied H.E, & Maruyama A. Recovery of novel mobile integron/gene cassette metagenomes from deep-sea environment.
38. Malinowska R.E, Billett D.S.M, Rogers A.D. & Pearce D.A. FISHing for Bacteria: biodiversity in deep-sea sediments.

39. Quéric NV. & Soltwedel T. Spatial heterogeneity of prokaryotic communities in Arctic deep-sea sediments: a question of scale?
40. Schauer R., Bienhold C. & Harder J. Bacterial diversity in oligotrophic abyssal surface sediments of the South-Atlantic Ocean.
41. Yoshida T., Kojima S. & Maruyama T. Phylogenetic analysis of bacterial symbionts of vestimentiferan tubeworms in the western Pacific.

WEDNESDAY 12th July

Biodiversity

1. Alves D.M., Cunha M.R., Ravara A. & Billett D.S.M. The Portuguese submarine canyons - 'hotspots' of benthic biodiversity?
2. Arantes R.C.M & Castro CB. Diversity and spatial distribution of deep-sea Octocorallia (Cnidaria) from Campos Basin, Brazil.
3. Barboza C.A.M, Campos L.S. & Lavrado H.P. Population structure of *Ophiura ljungmani* (Lyman, 1878) (Echinodermata: Ophiuroidea) from Campos Basin off Brazil, SW Atlantic.
4. Budaeva N.E., Mokievsky V.O., Soltwedel T. & Gebruk A.V. Horizontal distribution patterns in Arctic deep-sea macrobenthic communities.
5. Büntzow M. & George K.H. Meiofauna and harpacticoid associations on Seine and Sedlo Seamounts.
6. Cartes J.E., Madurell T., Fanelli E., López-Jurado J.L. & Massutí E. Composition and dynamics of suprabenthos communities around the Balearic Islands (Western Mediterranean).
7. Choudhury M., Brökeland W., Malyutina M. & Brandt A. Preliminary results of the ANDEEP III cruise: distribution of peracarid crustaceans in the deep Weddell Sea, Antarctica.
8. Danovaro R.C., Gambi C., Covazzi A., Luna G.M., Bianchelli S., Corinaldesi C., Dell'Anno A., Magagnini M., Pusceddu A., Scopa M.S., Zeppilli D. & Albertelli G. Multi-layer biodiversity in the deep Mediterranean Sea: a comparison of spatial patterns of prokaryote, meiofauna and macrofauna diversity.
9. Escobar E., Plaza I.P., Martinez M., Rabiela D. & Arredondo I. Variability in space and time in the abyssal macrofaunal community of the Gulf of Mexico.
10. Galéron J., Menot L., Sibuet M. & the NODINAUT scientific team. Baseline study of benthic communities and of their habitats in deep-sea polymetallic nodule fields in the Northeast Pacific: the NODINAUT cruise.
11. Gooday A.J., Kamenskaya O.E. & Cedhagen T. The biodiversity and biogeography of komokiacean foraminifera in ANDEEP III samples from the abyssal Southern Ocean.
12. Goren M. & Galil B.S. The Eastern Mediterranean is a deep-Sea desert.
13. Ingels J. & Vanreusel A. Biodiversity of meiofauna on margins of European seas.
14. Ingole B. Distribution of nematode and harpacticoid fauna in the Central Indian Ocean.
15. Kaiser S., Brökeland W. & Brandt A. Deep evolution and cold ecology at multiple scales: Southern Ocean isopods show how complex the deep sea can be.

16. Kim D.S., Min W.G. & Kim W.S. Community structure and distributional pattern of meiofauna in the deep-sea bottom of the Clarion-Clipperton Fracture Zone of the Northeastern Pacific.
17. King N., Jamieson A., Bagley P.M. & Priede I.G. Deep-sea scavenging demersal fauna of the Nazaré Canyon system, Iberian coast.
18. Larusdottir O., Watling L. & Svavarsson J. Occurrances of deep-water cumaceans (Crustacea, Cumacea) in the North Atlantic – relationship to water masses?
19. Lavrado H.P., Campos L.S., Curbelo-Fernandez M.P. & Falcão A.P.C. Macrofauna community structure at Campos Basin continental slope, Southeast Brazil.
20. Macpherson E. Distribution of species of the genera *Munidopsis* and *Galacantha* (Crustacea, Decapoda, Galatheidae) in the SW Indian and SW Pacific Oceans.
21. Mahatma R. & Martinez Arbizu P. Meiofauna communities of the Pacific nodule province.
22. Martín J., Cartes J.E., Palanques A., Sorbe J.C. & Vitorino J. Preliminary Results on suprabenthic peracarids collected in near-bottom sediment traps deployed in the Nazaré submarine canyon.
23. Menot L., Galéron J. & Sibuet M. Multiscale spatial distribution of a sedimentary macrobenthic community on the Angolan margin.
24. Menot L., Galéron J., Fifis A. & Sibuet M. Influence of nodules on macro-infaunal communities in the abyssal Pacific.
25. Mercier A. & Hamel J.F. Epibiotic sea anemones on marine gastropods: diversity, dynamics and role of bathyal associations.
26. Nozawa F., Ohkawara N., Kitazato H. & Gooday A.J. 'Live' benthic foraminifera from the abyssal equatorial Pacific nodule province.
27. Olu-Le Roy K., Galéron J., Cosel R., Vangriesheim A. & the BIOZAIRE 3 scientific team. Unexpected megafauna community structure in the surroundings of the deep Zaire Canyon (East Equatorial Atlantic).
28. Parra S., Valencia J. & Frutos I. Infaunal macrobenthos communities and sedimentary characteristics of Le Danois Bank (NE Atlantic, N Spain): preliminary studies.
29. Pattenden A., Tyler P.A., Bett B.J. & Masson D.G. Community structure of canyon megafauna in relation to energetics and substratum.
30. Ramos A., Hernandez C., Gonzalez J.F., Faraj A., Balguerias E. & Ramil F.. Deep demersal communities of Moroccan waters: first faunistic results of MAROC-0411 Survey.
31. Ramos A., Ramil F., Mesfoui H., Setih J., Burgos C., Faraj A., Balguerias E. & Soto S. Megabenthos of Morocco deep waters: preliminary results of MAROC-0411 and MAROC-0511 Surveys.
32. Shields M.A. & Hughes D.J. The feeding guilds of polychaetes located along a latitudinal transect within the Northern Seas region.
33. Soto E.H., Paterson G.L.J., Billett D.S.M., Hawkins L.E., Sibuet M. & Galéron J. Temporal variability in polychaetes assemblages of abyssal plain from NE Atlantic Ocean.
34. Soto S., Soto E., Balguerias E., Garcia-Isach E., Ramil F. & Ramos A. Deep-sea megabenthic invertebrate fauna off Namibia: preliminary results.

THURSDAY 13th July

Fish

1. Aranha A., Menezes G., Leocádio A., Pinho M.R., Melo O. & Isidro E. Some biological aspects of three lantern sharks *Etmopterus spinax* (Linnaeus, 1758), *Etmopterus pusillus* (Lowe, 1839) and *Etmopterus princeps* Collet, 1904 in Azores Islands.
2. Aranha A., Menezes G., Leocádio A., Pinho M.R., Melo O. & Isidro E. Distribution and some biological aspects of *Deania profundorum* (Smith & Radcliffe, 1912), *Centrophorus squamosus* (Bocage & Capello, 1864) and *Centroscymnus crepidater* (Bocage & Capello, 1864) from Azores Islands.
3. Baldwin Z.H. & Kenaley C.P. Diel vertical migration of lightfishes (Teleostei: Stomiiformes) in the western North Atlantic Ocean.
4. Biscoito M. & Freitas M. Deep-sea bony fishes caught off Madeira (NE Atlantic Ocean) between 750 and 2500m.
5. Braga A.C., Costa P.A.S., Lima A.T., Nunan G.W.A., Martins A.S. & Olavo. G. Distribution patterns of epi- and mesopelagic teleost fish from eastern Brazilian coast.
6. Costa P.A.S., Braga A.C., Melo M.R.S., Nunan G.W.A., Martins A.S. & Olavo G. Distribution patterns and community structure of demersal and benthopelagic fishes on the slope of eastern Brazilian coast.
7. Delgado J.H., Carvalho D.M., Isidro E., Menezes G., Sousa R. & Ferreira S. Demersal fish communities of the Madeira Archipelago slope (eastern Central Atlantic).
8. Dolgov A.V. Comparative analysis of the mesopelagic fish community in the northern Mid-Atlantic.
9. Fernandez L., Ramos A., Meiners C. & Diop M. Occurrence and distribution of black hakes *Merluccius senegalensis* Cadenat 1950 and *Merluccius polli* Cadenat 1950 off Mauritania.
10. Fernandez L., Salmeron F., Ramos A. & Kallahi M. Some biological parameters of black hakes *Merluccius senegalensis* and *Merluccius polli* in Mauritanian waters.
11. Franco M.A.L., Costa P.A.S. & Braga A.C. New records of Aphyonidae fishes (Ophidioidei) from southwestern Atlantic.
12. Freitas M. & Biscoito M. Deep-sea Chondrichthyes caught between 1000 and 2500m off Madeira (NE Atlantic Ocean).
13. Henriques C., Bagley P.M. & Priede I.G. Bathyal and abyssal fish tracking.
14. Ho H.-C. & Shao K.-T. Review of Lophiidae (Order Lophiiformes) of Taiwan, with description of two new species.
15. Meiners C., Farai A., Belcaid S., Salmeron F. & Ramos A. Geographic and bathymetric distribution of Alepocephalidae fish species in the NW African deep waters.
16. Meiners C., Salmeron F., Manchih K., Belcaid S., Faraj A. & Ramos A. Bathymetric distribution limits and biological parameters of some gadiform fish species in deep waters off NW Africa.
17. Partridge J.C., Powles A., Haycock J. & Douglas R.H. The effect of elevated hydrostatic pressure on the spectral absorption of deep-sea fish visual pigments.

18. Preciado I., Cartes J., Velasco F., Olaso I., Serrano A., Frutos I. & Sánchez F. The role of suprabenthic and epibenthic communities in the diet of a deep-sea fish assemblage (Le Danois Bank, Cantabrian Sea, N Spain).
19. Salmeron F., Hernandez C., Belcaid S., Faraj A. & Ramos A. Deep-sea demersal Chondrichthyes off NW Africa.
20. Shephard S. & Rogan E. Seasonal feeding success and otolith zones in juvenile NE Atlantic orange roughy.
21. Stein D.L., Drazen J.C., Schlining K.L., Barry J.P. & Kuhnz L. Snailfishes of the central California coast video, photographic, and morphological observations.
22. Thygesen U.H., Farnsworth K.D., Ditlevsen S., King N. & Bailey D.M. How to estimate scavenger abundance with confidence.
23. Yeh H.M. & Shao K.T. Faunal zonations and diversities of the deep-sea demersal fishes on the continental slope of Taiwan.
24. Yeh H.-M., Suetsugu K., Shao K.-T. & Ohta S. Faunal zonation of the deep-sea demersal fish in the Sulu Sea.

Chemosynthetic Environments

25. Beaulieu S.E., Shank T.M., Soule S.A., Fornari D.., Rzhanov Y. & Mayer L. Automated generation of geo-referenced mosaics from video collected by deep-submergence vehicles: an example from Rosebud vent (Galapagos Rift).
26. Beaulieu S.E., Mullineaux L.M., Poehls D.K. & Mills S.W. Short-term variability in larval supply to hydrothermal vents: a comparison of sediment traps and plankton pumps.
27. Blazewicz-Paszkowycz M. & Larsen K. Tanaidacea (Crustacea; Peracarida) from hydrothermal vents: The Juan De Fuca Ridge, Northeast Pacific and the Lucky Strike Field, Mid-Atlantic Ridge.
28. Casse N., Bui Q.T, Hardivillier Y., Renault S., Halaimia-Toumi N., Nicolas V., Demattei M.-V., Laulier M., Bigot Y. & Chénais B. Detection of marine transposons in the genome of hydrothermal organisms: evidence for horizontal transfer in marine invertebrate genomes.
29. Cibois M., Leignel V., Moreau B., Laulier M., Hardivillier Y. & Chénais B. Molecular particularism and structural adaptations of HSP70 (heat shock protein 70 kDa): genes from hydrothermal crabs (Bythograeidae, Eubrachyura).
30. Copley J.T. & Mestre N.C. Reproductive patterns of crustaceans in chemosynthetic environments beneath contrasting regimes of surface productivity: a test of Crisp's Rule.
31. Costa V. & Kadar E. Site-specific metal signature in the shells of the deep-sea hydrothermal vent mussel *Bathymodiolus azoricus.*
32. Demina L.L & Galkin S.V. New data on the microelements' composition of the vent bottom fauna.
33. Galkin S.V, Budaeva N.E., Kamenskaya O.E. & Zasko D.N. Lost village in the suburb of the Lost City: new evidence about bottom fauna at off-axis hydrothermal vents.
34. Génio L., Kiel S., Little C.T.S., Grahame J. & Cunha M.R. Phylogenetic relationships of two distinct groups of molluscs from deep-sea chemosynthetic ecosystems.

35. Goroslavskaya E.I. The deep-sea fauna associated with mussel beds and alvinellid polychaete colonies at 9°N EPR, the composition and structure.
36. Harmer T.L., Nussbaumer A.D., Bright M. & Cavanaugh C.M. Hunting the wild symbiont: free-living tubeworm symbionts at deep-sea hydrothermal vents.
37. Flint H.C., Copley J.T., Ferrero T.J. & Van Dover C.L. Patterns of nematode diversity at hydrothermal vents on the East Pacific Rise.
38. Hilário A., Tyler P.A. & Cunha M.R. Reproductive biology of pogonophorans from cold seeps in the European margin: Species from mud volcanoes in the Gulf of Cadiz.
39. Hughes D.J. & Crawford M. Living off yesterday's news? A new record of vestimentiferans (*Lamellibrachia* sp.) from a deep shipwreck in the eastern Mediterranean.
40. Libertinova J., Dando P.R., Clarke L.J., Kennedy H. & Richardson C.A. Hydrothermal vent mussels as recorders of the environmental change.
41. MacDonald I.R. & CHEMO-III Project Team. Investigations of chemosynthetic communities on the lower continental slope of the Gulf of Mexico.
42. MacDonald I.R. & RV METEOR 67/2 Scientific Party. Asphalt volcanism and chemosynthetic communities in the southern Gulf of Mexico: preliminary results from RV METEOR cruise 67/2.
43. Martins I., Colaço A., Serrão Santos R., Cosson R. & Sarradin P.-M. Physiological condition of mussel *Bathymodiolus azoricus* from Eiffel Tower hydrothermal vent field: filament bacteria approach.
44. Matabos M., Barnay A.S., Jollivet D. & Thiébaut E. Preliminary results on community structure of gastropods from mussel beds at deep-sea hydrothermal vents along the South East Pacific Rise (SEPR).
45. Osterberg J.S., Romano J. & McClellan-Green P. Glutathione and superoxide dismutase activity in *Alviniconcha hessleri* and *Bathymodiolus brevior* from Lau and North Fiji Basin hydrothermal vents.
46. Romano J., Osterberg J.S. & McClellan-Green P. Lipid peroxidation and catalase activity in gill and foot tissue of Lau and North Fiji Basin hydrothermal vent molluscs.
47. Schmidt C., Le Bris N., Le Gall C., Rodier P. & Gaill F. Modelling biogeochemical processes associated with symbiotic shrimps in deep-sea hydrothermal environments.
48. Tyler P.A., Young C.M., Dolan E., Arellano S., Brooke S.D. & Baker M. Gametogenic periodicity in the chemosynthetic mussel genus "*Bathymodiolus" childressi.*
49. Tyler P.A., Marsh L. & Smith C.R. *Idas washingtonia*: why be a protandric hermaphrodite on whale falls?
50. Watanabe H., Urakawa H., Suzuki Y., Kado R., Nemoto S., Koduka Y., Uematsu K., Tsuchida S. & Kojima S. Specialized cirral activity: inferred bacterial symbiosis in the vent barnacle *Neoverruca* sp. on the Myojin Knoll, Izu-Ogasawara Arc, Japan.

FRIDAY 14th July

Ecology & Experimentation

1. Andrews G.O., Simpson S. & Pile A.J. The effect of physical disturbance associated with deep-sea drilling on the nutritional ecology of deep-sea scavengers.
2. Barry J.P., Buck K.R., Okuda C. & Risi M. Effects of hypercapnia on the metabolic rate of a deep-sea sediment community.
3. Billett D.S.M., Bett B.J., Hughes J.A., Salter I., Smith T. & Wolff G.A. Primary productivity, export flux and abyssal megabenthos community structure.
4. Cabezas P., Macpherson E. & Machordom A. The Tonga and Kermadec Trenches as biogeographical barriers in the South Pacific Ocean: evidence from mtDNA evolution in galatheids from the French Polynesia and the South West Pacific.
5. Cartes J.E., Huguet C., Sprovieri M., Serrano A., Parra S. & Sanchez F. The response of deep-water decapod communities to depth and seasonal changes in food availability in Le Danois Bank (NE Atlantic).
6. Colaço A., Porteiro F., Gebruk A. & Serrão Santos R. Determination of trophic relationships on deep-sea species from the Mid-Atlantic Ridge: a stable isotope approach.
7. Collins M.A., Bailey D.M., Ruxton G.D. & Priede I.G. Trends in body size across an environmental gradient: a differential response in scavenging and non-scavenging demersal deep-sea fish.
8. Chan B.K.K, Lin I.-C., Shih T.-W. & Chan T.-Y. Bioluminescence emission of the deep-water pandalid shrimp *Heterocarpus sibogae* (Decapoda: Caridea: Pandalidae) under laboratory conditions.
9. Dando P.R.A., Southward A.J. & Southward E.C. The distribution of the small frenulate pogonophores of the NE Atlantic in relation to sediment geochemistry.
10. Fanelli E & Cartes J.E. Spatial and temporal changes in the diet and feeding of the pandalid shrimp *Plesionika martia* off the Balearic Islands (Western Mediterranean) by stomach contents and stable-isotope analyses.
11. Frank TM. UV photosensitivity in a deep-sea benthic crab.
12. Huguet C., Thurston M.H. & Billett D.S..M. Factors controlling the bathymetric distribution of crustaceans on the continental slope and abyssal plain in the Porcupine Seabight.
13. Jeffreys R.A. & Wolff G.A. Influence of an oxygen minimum zone on food quality and trophic strategies of benthic fauna: as revealed by lipid biomarkers.
14. Jones D.O.B., Bett B.J. & Tyler P.A. Ecological controls on diversity and density of polar megabenthos.
15. Kaariainen J.I. & Bett BJ. Evidence for benthic body size miniaturisation in the deep sea.
16. Kaariainen J.I., Kelly-Gerreyn B.A., Anderson T.R. & Bett B.J. Size-based modelling of benthic communities in the Faroe-Shetland Channel.
17. Kaariainen J.I. & Bett B.J. Investigating the body size structure of benthic communities
18. Kitazato H., Oguri K., Glud R. & Nomaki H. Roles of benthic foraminifera in carbon cycling at marginal oceans with active tectonic forcing: *In situ* experiment and observations.

19. Kuhnz L.A., Barry J.P. & Whaling P.J. Community structure and seasonal to interannual variation in benthic faunal communities, Monterey Bay, California.
20. Leocádio A.M., Pinho M.R., Aranha A., Melo O., Menezes G.M. & Isidro E. Biometrical study of the deep-water crab *Chaceon affinis* (Milne-Edwards and Bouvier, 1894) off the Azores.
21. Madurell T., Cartes J.E., Fanelli E. & Billett D.S.M. First results and perspectives of trophodynamics for bathyal suprabenthos from the Catalano-Balearic Basin: stable isotopy, secondary production, and biomarkers.
22. Mills S.W., Mullineaux L.S. & Tyler P.A. Habitat associations in gastropod species at East Pacific Rise hydrothermal vents (9°50'N).
23. Mytilineou C., Haralabous J., Kavadas S., D'Onghia G., Kapiris K. & Maiorano P. Influence of environmental factors in the abundance and length distribution of the deep-water red shimps, *Aristaeomorpha foliacea* (Risso, 1827) and *Aristeus antennatus* (Risso, 1816) in the eastern Ionian Sea.
24. Petrov A., Shalyapin V. & Ignatyev S. Influence of climatic and oceanographic processes on formation of coastal underwater landscapes and condition of bottom communities (Crimea, Black Sea).
25. Premke K. & Klages M. Arctic deep-sea scavengers at large food falls: temporal attraction, consumption rate and population structure.
26. Raupach M.J., Misof B. & Thatje S. Population genetics and dynamics of the Antarctic deep-sea shrimp *Nematocarcinus lanceopes* Bate, 1888 (Decapoda: Caridea).
27. Rex M.A., Etter R.J., McClain C.R., Stuart C.T. & Boyle EE. A global analysis of standing stock and body size in the deep-sea benthos.
28. Rothe N., Hudson I.R., Bett B.J., Billett D.S.M., Tyler P. A. Recolonization in the Deep Sea: Experimental Approaches using Remotely Operated Vehicles (ROVs).
29. Murty S.J., Bett B.J. & Billett D.S.M. Benthic megafauna responses to strong oxygen gradients on the Pakistan Margin in the Arabian Sea.
30. Seibel B.A. On the depth and scale of metabolic rate variation.
31. Smith J., Tyler P.A. & Lampitt R.L. The influence of oceanographic parameters and water depth on the distribution of Cuvier's Beaked Whale, *Ziphius cavirostris*, in the Bay of Biscay and the CapBreton canyon.
32. Smith T., Billett D.S.M., Wolff G, Hudson I.R. & Tyler P.A. Sexual chemistry in the deep sea - the link between phytoplankton and abyssal sea cucumbers.
33. Sneli J.A., Tendal O.S., Hartley J.P. The life style of a deep-sea sponge, *Chondrocladia gigantea*.
34. Vetter E.W. & Smith C.R. Canyon and slope assemblages on the oceanic island of Oahu: detrital enrichment in the deep blue sea.
35. Wagner H.J., Kemp K. & Priede I.G. Rhythms on the bottom of the deep sea: cyclic current flow changes, and melatonin patterns in two species of demersal fish.
36. Wei C. & Rowe G.T. The bathymetric zonation of deep-sea macrobenthos in the northern Gulf of Mexico.

37. Wigham B.D., Hudson I.R., Jamieson A.J., Jones D.O.B. & Bailey D.M. Oxygen consumption of the abyssal urchin *Echinocrepis rostrata*: BICS field trials at Station M, NE Pacific.

Abstracts of Oral Presentations

Energy Filtering Transmission Electron Tomography (EFTET) of bacteria-mineral associations within the deep sea hydrothermal vent shrimp Rimicaris exoculata

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The shrimp *Rimicaris exoculata* flourishes around the extreme environments of hydrothermal vents on the Mid-Atlantic Ridge (MAR). Epibiotic bacteria and minerals found within the branchial chamber of the shrimp are of great interest in the search for a chemical model for the Rainbow MAR hydrothermal vent site. Here we examine the close three-dimensional (3D) relationship between bacteria (on inner surface of the branchial chamber (BC) wall) and the minerals that surround them. The morphology and chemistry of the minerals were analysed by Energy filtering Transmission Electron Microscopy (EFTEM, on a LEO-912 microscope) and X-ray Nano-analysis (EDXN, on a JEOL-2010 FEG microscope) respectively, and the 3D organization was determined by Transmission Electron Tomography (TET) and EFTET. Consecutive thin and semi-thin sections of 50-80nm (for EFTEM and EDXN) and 200nm–250nm (for TEM and EFTET) were cut through the BC cuticle and mounted on standard microscope grids. Sections were observed initially for morphology, to find broad relationships between bacteria and minerals. EFTET series acquisition was performed under cryo-conditions (-175°C) using a LEO-912 microscope. At each position of interest four energy tilt series were taken at two degree increments between -55° and +55° at various energy-losses: 1) zero-loss (ref); 2) 720 eV, 3) 690 eV and 4) 670eV, to reconstruct the 3D location of iron. Tilted series were obtained using the ESIvision program (Soft-Imaging Software, Münster, Germany) with additional in-house scripts for automated acquisition. The 3D EFTET reconstruction volume was produced from the four tilted series using recently developed EFTET-J software (http://www.snv.jussieu.fr/~wboudier/softs.html). In many cases the observed minerals exhibit a sharp boundary against the bacteria, often with a substantial void between bacterial membrane/cell wall and mineral boundary. Mineral layering and zoning are also present.

Gromiids: an important group of large protists on bathyal continental margins in the Arabian and Weddell Seas

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Gromiids are large benthic protozoa with filose pseudopodia, an organic test, and a ubiquitous distribution. They are closely related to, but distinct from, the Foraminifera. One species, *Gromia oviformis* (probably a complex of cryptic species), is well known from shallow water, but the group was unknown in the deep sea until the first species (*Gromia sphaerica*) was discovered at bathyal depths on the Oman margin of the Arabian Sea. Since then, a variety of undescribed gromiid-like protists have been found at other localities on the Oman margin, and on the Pakistan margin. They range in size from a millimetre to a few centimetres and include 6-7 species, based on morphological and molecular genetic criteria. In the Arabian Sea, gromiids were found mainly at bathyal depths (1000-1800 m on the Oman margin and 1600-1900 m on the Pakistan margin), below the Oxygen Minimium Zone where oxygen levels were > 0.5 ml/l and the organic carbon content of the sediment still relatively high. Analyses of fatty acid biomarkers and natural stable isotopes in gromiids from the Pakistan margin suggest that these large protists ingest sediment and associated detritus, a result consistent with the presence within their tests of large quantities of sedimentary waste material. However, differences in the isotopic signatures and species-specific fatty acid profiles indicate that the diets of different species are somewhat different. During Polarstern Cruise ANT XXII/3 (ANDEEP III Campaign, Jan-April, 2005), numerous gromiids were discovered on the continental slope in the Weddell Sea (1000-4400 m water depth). Twenty distinct types, including sausage and grape-shaped

morphotypes, were recognised. This new evidence from the Southern Ocean suggests that gromiids are widely distributed at bathyal depths continental margins around the world.

Population Genetic Structure of the Deep-Sea Precious Coral *Corallium secundum* from the Hawaiian Archipelago based on Microsatellites

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Deep-sea precious corals (G*erardia* sp., *Corallium lauuense*, and *Corallium secundum*) on the Islands and seamounts of the Hawaiian Archipelago have supported an extremely profitable fishery, yet little is known about the life history and dispersal of the exploited species. Recent studies indicate significant genetic structure between shallow-water coral populations, including several species capable of long distance dispersal. If significant genetic structure exists in seamount and Island populations of precious corals, this could suggest that the elimination (through overharvesting) of a bed of precious corals would result in loss of overall genetic diversity in the species. Here I discuss results based on microsatellite studies of the precious coral, *Corallium secundum*, from 11 sites in the Hawaiian Archipelago collected between 1998 and 2004, and compare the population genetic structure and dispersal capabilities of *Corallium secundum* to the results for *Corallium lauuense*. Microsatellite studies of *Corallium lauuense* indicated significant heterozygote deficiency in most populations, suggesting recruitment in most populations is from local sources with only occasional long-distance dispersal events. Also, two populations appear to be significantly isolated from other populations of *Corallium lauuense* and may be separate stocks. In contrast, *Corallium secundum* populations have little heterozygote deficiency and separate into 3 distinct regions. In addition to having fisheries management implications for these corals, the results of these studies also have implications for the management and protection of seamount fauna.

Change in the Abyssal Fish Fauna of the Pacific Ocean Driven by Variation in Food Availability

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Few long-term studies of deep-sea fish communities exist, and so our understanding of the population dynamics of these animals is extremely poor. Studies were conducted from 1989 to 2005 at 4100 m in the North East Pacific. Abundances and body sizes of fish, benthic mega- and macrofauna, and the particle fluxes from the surface were determined using a camera sled, baited landers, traps, long-lines, and sediment traps. Fisheries data for the overlying California Current System were used to estimate changes in the abundance and distribution of carrion supply to the seafloor. Modelling and stomach content analyses were used to interpret the changes in fish community structure. Over 90% of the fish observed by the traps and landers were grenadiers (Coryphaenoides spp.) and their total abundances and average body masses more than doubled over the study period. Coryphaenoides spp. abundance was significantly correlated with total abundance of mobile epibenthic megafauna (echinoderms), with changes in fish abundance lagged behind changes in the echinoderms. Direct correlations between surface climate and fish abundances, and particulate organic (POC) flux and abyssal fish abundances were weak, which may be related to the varied response of the potential prey taxa to climate and POC flux. This study provides a rare opportunity to study the long-term dynamics of an unexploited marine fish population, and suggests a dominant role for bottom-up control in this system.

The influence of turbidity flows on carbon transport and benthic biological patterns in Monterey Canyon

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Monterey Canyon incises the continental margin from the shore to the abyssal plain. Instrument deployments in the axis of Monterey Canyon by MBARI and the USGS from 2001 to 2005 have recorded evidence of ~10 turbidity events in the upper canyon (<1500 m), ranging from mild increases in near-bottom turbidity with no detectable change in bottom currents, to major, energetic, down-canyon flows with high current speeds and turbidity, large volumes of sediment transport, and displacement of moored systems. Large events had current speeds of >100 – 200 cm.s-1, and often buried deployed instruments, with a deposition of up to 1+ m of sediment. Samples from sediment traps moored 10 m above bottom in 1274 m depth along the canyon axis indicate that carbon and material transport during these events account for 73% and 87%, respectively of the total annual down-canyon flux. Coarse material captured in traps during turbidity events differed from non-event periods in both carbon content (0.7 vs. ~2.0%, respectively) and isotopic composition (δ_{13}C PDB = -24 vs. -22‰, respectively). In contrast to the upper canyon, no significant turbidity events have been observed recently in the lower canyon, and related studies indicate that large events have not impacted the lower canyon for perhaps 100+ y. The high frequency and intensity of disturbance by turbidity flows in the upper canyon and their apparently rare penetration into the lower canyon generates a strong gradient in physical disturbance for canyon benthos. Video transects and sediment samples along the canyon axis indicate an increase in the abundance of sessile, long-lived fauna with depth in the canyon. This disturbance gradient largely coincides with the position of the oxygen minimum zone, which also plays a large role in the distribution and productivity of canyon benthos.

Megafauna at the abyssal seafloor underlying the North Pacific Subtropical Gyre: composition and abundance from photographic and video surveys

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The Hawaii-2 cable seafloor observatory (H_2O) at 5000-m depth in the NE Pacific enabled a unique opportunity to assess benthic biodiversity in this oligotrophic area (27 53' N, 142 00' W). Here, we report the only estimates of megafaunal density on record within an area 30 degrees of latitude and longitude in dimension underneath the North Pacific Subtropical Gyre. The composition of epibenthic and bentho-pelagic megafauna was assessed from video collected by ROV from 1998-2004 (total 360hrs observations, approximately 120km surveyed). In 2003 we also conducted 3 camera sled transects, which image a smaller area of the seafloor with higher resolution. We observed 65 putative species, with 10 positively identified from collected specimens. We conducted a total of 22km of quantitative video transects and estimated 65 and 93 ind./ha, for the May and Sep. 2003 cruises, respectively. Holothurians represented 1/6 of the megafauna in May 2003 (11/ha) and 1/2 (45/ha) in Sep. 2003. The difference between our two time points may be explained by the abundance of the holothurian *Peniagone diaphana* in Sep. 2003. Overall, these densities compare well to those observed in the Peru Basin manganese nodule study area and are slightly lower than the densities reported for the Clarion-Clipperton Fracture Zone. Sediment organic content and phytopigments at H_2O were quite low (mean 0.27%dw $_{org}$C, 2ng/gdw chl *a*), as expected for this oligotrophic region. Also in agreement with other abyssal oligotrophic areas, abundance of sediment macrofauna at H_2O (from multiple corer samples collected in Sep. 2003) was quite low and dominated by agglutinated foraminifera. Our baseline study of megafaunal diversity and abundance in this remote habitat may be important in the future for assessing human impacts and/or the impact of climate change on deep-sea benthic communities.

Trophic relationships between demersal fish and benthic fauna at 'Hausgarten` (79°N west off Svalbard)

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In 1999, the AWI deep-sea research group established the first and only long-term deep-sea observatory beyond the polar circle, *Hausgarten* (see Soltwedel *et al*.). Footage from underwater camera transects has shown that demersal fish largely belonging to the eelpout family (Zoarcidae) constitute an important fraction of the benthic fauna. Despite their numerical abundance, little is known

about their biology and functional ecological role. Here, we used baited traps and trawls to sample the demersal ichthyofauna at six stations that constitute the shallower end of the *Hausgarten* depth transect (1200-3200m). Stomach contents analysis showed that trawled eelpout chiefly fed on small crustaceans (cumaceans, amphipods, isopods) and polychaetes whereas trap-caught fish fed largely on scavenging amphipods. Results from radio stable isotope analysis indicate that starfish (*Hymenaster pellucidus*, *Poraniomorpha* cf. *tumida*, *Bathybiaster vexillifer*) followed by scavenging amphipods (*Eurythenes gryllus*) occupied the highest trophic level at most stations δ15N 11.9-24.6‰). Fish had an intermediate trophic position (*Lycodes* spp. δ 15N 12.8-13.7‰), reflecting their preference for macrofaunal invertebrates. The lowest trophic level at different stations was occupied by various taxonomic groups due to differences in the composition of species sampled. Assuming a stepwise δ 15N enrichment of 3.8‰ per trophic level, the benthic food web sampled at stations along the depth gradient ranged from four to six trophic levels. This large figure may be indicative of a complex food web structure caused by intense recycling of nutrients which is characteristic for food-limited deep-sea environments. Food limitation may be even stronger at high latitudes due to reduced primary productivity caused by seasonal ice coverage.

Distribution patterns and structuring factors of deepwater demersal fishes on a mid-ocean ridge

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Mid-ocean ridges offer diverse habitats to benthic and benthopelagic fish, but the species-specific patterns of abundance and distribution as well as community patterns have not been extensively studied. Analyses were conducted of the demersal fish on the mid-Atlantic Ridge using bottom trawl data from the 2004 RV G.O.Sars expedition to the ridge segment north of the Azores (42^{o}N) to south of Iceland (54^{o}N). Overall fish biomass and abundance declined with depth from the summit of the ridge to the middle rises on either side. Seventy species occurred in the 17 trawls used in the analyses. Multivariate analyses revealed that the species composition primarily changed with depth, and that variation by latitude was secondary. The latitudinal variation was greater in shallow than in deep areas. Cross-ridge differences were apparently minor. The number of species was inversely related to latitude, but declined with depth below the slope depths. The evenness component of diversity was higher in deep slope and rise areas than on the slopes. Assemblages of species could be defined for different depth zones and sub-areas, but there was no clear zonation by depth. Individual depth and latitudinal ranges of the different species produced the patterns. Temperature, salinity, and oxygen concentration were similar at all trawling locations, and other factors varying more strongly with depth and latitude appear to influence the distribution patterns of individual species and assemblage structure. A general decline in food availability with depth may explain the decrease in abundance and biomass with depth. A difference in pelagic productivity and species composition of zooplankton and nekton between the areas north and south of the Sub-polar Front may underlie the latitudinal change in abundance and species composition.

First innate immune parameters unveiled in the deep-sea mussel, *Bathymodiolus azoricus*

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The constant microbial threat to which Molluscs are subjected in their natural habitats represents a suitable model for the study of biotope imbalances and their implications on human health as well as for providing insights into the physiological principles that govern the defense mechanisms in marine bivalves. The activation of host-defense mechanisms involves cell-mediated and humoral components which quite efficiently bring the presence of harmful pathogens or environmental microorganisms, to sub-infectious levels. The hydrothermal vent mussel *Bathymodiolus azoricus* is a suitable model for providing experimental evidence to understand humoral and cellular defense reactions in spite of the extreme physical and chemical conditions, in which they thrive. In addition to unusual levels of toxic heavy metals and high concentrations of sulfide, mussels dwelling around the vent sites must also successfully cope with environmental microbes. In this first series of innate defense response studies in *Bathymodiolus azoricus*, we have put in evidence immune parameters that are commonly found in

other marine bivalves. The present study contemplates hemocytes reactions, gene expression experiments and nucleotide sequence analyses all supporting the premise of an evolutionary conserved innate immune system in *Bathymodiolus*. Such system is seemingly homologous to that of Insects and other bivalves and involves the participation of NF-kappa B transcription factors and antibacterial genes.

Long-term Benthic Infaunal Monitoring at the San Francisco Deep-Ocean Dredged Material Disposal Site (SF-DODS)

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A total of 135 benthic infaunal samples collected over a 10-year period (1995–2004) at the SF-DODS were analyzed to understand the impact of dredged material disposal in a deep-sea continental slope environment. Each box core sample consisted of 0.1 m^2 of sediment cut to a depth of 10 cm and sieved at 300-µm. Despite the relatively small geographic area and depth range (2400–3150 m), 800 species of benthic invertebrates were identified. Most species are rare, with approximately 65% new to science. The dominant taxa in the study area are the same as those encountered during baseline surveys (1990–1991). No region-wide impact or degradation of benthic infauna due to dredged material disposal has been identified. Within the SF-DODS site boundary, species richness and diversity were often reduced. *Ophelina* sp. 1, a small polychaete, sometimes appeared in dense populations in newly deposited coarse sediments. In these samples, the diversity values were reduced but species richness remained high. Sites receiving dredged material are rapidly recolonized by taxa from adjacent areas and that were at these sites prior to disposal operations. Initial colonizers of fresh dredged material within SF-DODS include several of the spionid and paraonid polychaetes that are normally dominants in the area. It seems unlikely that larval dispersal and settlement alone account for this rapid recolonization; therefore it is postulated that adult organisms from adjacent areas move to the disturbed sites via boundary layer currents. Subtle year-to-year shifts in faunal assemblages are evident at locations on the boundary of SF-DODS; these shifts appear to be associated with changes in sediment grain size associated with dredged material disposal. At these locations species richness and diversity remain high with shifts in faunal assemblages. (Supported by the USEPA Region IX and USACE, San Francisco District).

Evaluation of spatial variability of physico-chemical gradients at hydrothermal vents and cold seeps and their effects on community structures

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Hydrothermal vents, cold seeps and other anoxic environments are shaped by a complex interplay of biological, geochemical, and geological processes. Biogeochemical and physicochemical gradients are very steep and variable in these ecosystems. By mixing with seawater in the subseafloor, hydrothermal fluids cool down to temperatures tolerable for microbial and invertebrate life and lush hydrothermal communities thrive around diffuse fluid emanations. However, still little is known on the spatial and temporal distribution of fluid and gas flow around diffuse hydrothermal vents or in sediments around seep structures. The effects of small-scale spatial and temporal fluid-flow variability on biological production and biogeochemical processes are largely unknown. These effects may even gain particular importance where habitat structuring organisms influence fluid flow and geochemical gradients, such as e.g. hydrothermal vent mussels do in mussel beds. The expulsion and venting of hydrocarbon-rich fluids at cold seeps fuel a variety of geomicrobial processes such as carbonate precipitation and the growth of chemosynthetic communities. Biogeochemical reactions take place along sharp gradients below the sediment surface (often on cm-scale). The major flow and energy pathways are highly complex and require interdisciplinary and multiphase approaches to quantify fluid and gas emission. This can only be achieved by a combination of ROV-operated in situ studies to measure and sample at targeted habitats. So far, very few geochemical and microbiological investigations have been carried out based on in-situ studies of methane seeping sediments and microbial habitats. We have investigated the physico-chemical gradients and associated community structure at a variety of deep water ecosystems. Here we report novel results from hydrothermal vents on the Mid Antlantic Ridge and from hydrocarbon seeps in the Gulf of Mexico. In-situ microsensor

measurements of O_2, pH, H_2S and T were used to investigate the links between the geochemical energy supply and the communities at vents and seeps. 2D imaging of the O_2 and pH distribution in seep sediments were used to study the spatial variability.

Bathymetric and temporal changes in whalefall communities in Monterey Bay

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Whalefall communities, like hydrothermal vents and cold seeps, are recognized as nutritional oases on the deep seafloor, where the biomass of both specialists (eukaryotes with chemoautotrophic symbionts) and generalists (consumers of specialists) is relatively high. The succession patterns in these ephemeral communities have been studied but the role of depth in community structure is not known. To address potential bathymetric effects on community structure, we have examined whalefalls at 3 depths in Monterey Bay. A natural whalefall was discovered at 2895 m in Monterey Bay in 2002 (Goffredi et al. 2004) and we deployed two new whale carcasses at depths of 1018 m (2004) and 381 m (2005). We monitored the macrofaunal communities using remotely operated submarines. Although all three sites are located within the same submarine canyon system, these sites are distinctive in their physical properties (depth, oxygen and temperature) and in the associated taxa. To date, we have discovered 5 species of the bone-eating worm, *Osedax*, each of which occurs on only one of the 3 whalefalls suggesting they are limited in their depth distribution. Macrofauna exhibited succession patterns similar to those previously described from other whalefalls: 1) mobile scavenger stage, 2) enrichment/opportunist stage, and 3) sulphophilic stage, although stage 2 and 3 are largely overlapping. The deep whalefall supports a rich community of generalists and has harbored three *Osedax* species over four years. In contrast to the deep whalefall, the two shallow whalefalls each have a single *Osedax* species and few associated taxa. The ubiquity of *Osedax* at all depths studied to date and the rapidity with which it establishes populations, is further evidence of the role of whalefalls in structuring deep-sea communities and speciation of deep-sea taxa.

Cosmopolitan Deep-Sea Ostracoda (Crustacea)?

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Several geological and biological projects in many different oceanographic regions collected thousands of samples of dried and “wet” sediment, which provided specimens for many publications on deep-sea Ostracoda. Based on these studies one can note that there are two contrasting ideas concerning the geographical distribution of the deep-sea ostracod taxa. On one hand side, the great majority of ostracodologists support the paradigm that the deep-sea species are cosmopolitans (or pan-abyssal). On the other hand side, few authors accept the idea that the deep-sea species are restricted to one or few neighbouring abyssal basins only. In order to test both contrasting ideas, I analyzed 65 samples collected in the Atlantic Sector of Antarctica, from 186 to 6500 meters depth, during four cruises of the R.V. Polarstern (EASIZ II, ANDEEP I, II and III). More than 2500 live specimens in more than 120 species were analyzed, with almost 90% of the species occurring in one to five samples. Showing that even in the restricted geographical area, where this study took part, the ostracod species present a very restricted geographical distribution. Furthermore, analyzing the illustrations of different publications, which recorded these supposedly pan-abyssal species, as for example Henryhowella dasyderma (Brady, 1880), one can note that these supposed single species are actually groups of different species. One probable explanation for these numerous misidentifications might be the insufficient standard of the illustrations and descriptions typical from the publications of the 19th Century, which made an accurate identification practically impossible. Otherwise, nowadays several publications including SEM-photos and line drawings of the type specimens provide, in many cases, sufficient information for a new phase of more accurate identification of the deep-sea specimens, and consequently better estimates of the biodiversity of ostracods in the deep-sea.

Biodiversity and zoogeography of Southern Ocean deep-sea Isopoda (Crustacea, Malacostraca) – does this taxon support the source-sink hypothesis?

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The Antarctic shelf is well isolated and characterised by more than 370 species of Isopoda with a degree of endemism of 88%. The knowledge of Southern Ocean deep-sea Isopoda is relatively scarce. Due to the ANDEEP (ANtarctic benthic DEEP-sea biodiversity: colonisation history and recent community patterns) expeditions we now know that the degree of endemism of deep-sea Isopoda is almost as high as on the shelf. More than 317 species were reported from the expeditions ANDEEP I & II, of these 277 were new to the area or even to science, 50 were already known and 27 of these from the Southern Ocean (SO), and most of the other known species from the Atlantic deep sea. During ANDEEP III, the question of the potential origin of Antarctic benthic taxa and colonisation of the deep sea from the Antarctic (submergence versus emergence of species) was a major objective especially off the Kapp Norwegia shelf in the deep eastern Weddell Sea. However, the incredible isopod abundance and biodiversity reported also opens new questions for ANDEEP III like: is the degree of endemism of the SO deep-sea Isopoda really so high, or is this an artefact due to the little knowledge of the isopod faunas of the adjacent deep-sea basins? Which are the dominant isopod taxa in the SO deep-sea, will we find a similar composition of asellote families like during ANDEEP I&II? Do local and regional diversity differ? Is the source-sink hypothesis proposed by Rex et al. 2005 be supported by this taxon? Preliminary answers to some of these and other questions will be presented.

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Does oceanographic retention around seamounts explain seamount species diversity? A meta-analysis of global physical and biological data

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Processes structuring seamount benthic communities are poorly understood. However, despite limited seamount species inventories, biogeographical examination of accumulated data suggest that communities may vary in composition and structure at local and regional scales, that they may contain high endemicity, and are potential centers of speciation in the deep-sea. Theoretically, drivers of these patterns are in part, related to reduced seamount connectivity to the regional species pool. Therefore, seamount isolation over evolutionary time scales may have led to divergent seamount communities observed today. Recently, modeled and empirical oceanographic studies have shown that many seamounts generate trapped recirculating flows (e.g. Taylor cap formation or rectified tidal flow) that may restrict advection of particles away from the seamount. Such isolating processes have been implicated in restricting colonization between seamounts (i.e. reducing connectivity) and therefore may be an important process in structuring seamount communities. Using global physical datasets, we synthesize an index of the retentive potential of individual seamounts. We then compare this index to seamount community taxonomic distinctiveness (sensu Warwick and Clarke) based on global biological data. This metric incorporates species phylogeny into an overall measurement of diversity. Hence, variability in taxonomic distinctiveness may reflect the effects of long-term community isolation from the regional species pool. Results of this analysis are discussed with respect to alternative processes structuring seamount communities at various spatio-temporal scales.

Multiscale spatial distribution of a sedimentary macrobenthic community on the Angolan margin

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Organisms are often not randomly distributed in space. They are rather more abundant in some areas than in others, displaying spatial discontinuities in patches, gradients or other spatial structures. These structures are primarily a response to environmental changes and/or biotic interactions, which may be occurring at different spatial scales. Understanding variation in the spatial distribution and abundances of organisms is an important component of ecological theories and more pragmatically it is an essential part in the development of sampling strategies. This study aimed at assessing the multiscale variability of a macrobenthic community inhabiting fine sediments on the Angolan margin. Data were obtained from sampling cruises carried out during the Biozaïre program, a partnership between Ifremer and the French oil-company Total. Samples were collected in 2000, 2001, and 2003 at depths ranging between 1300 and 1400 m. Multiscale variability of the macrobenthic fauna was analyzed using a new statistical approach, Principal Coordinates of Neighbor Matrices (PCNM), which allows the detection and quantification of spatial variability over a wide range of spatial scales detectable by the sampling grain. The macrobenthic community displayed spatial structures according to the size classes of the taxa studied. Small mollusks and crustaceans (mesh sizes: 250 µm and 300 µm) displayed spatial structures at the fine (0.25 m^2), meso (200 m^2), and very broad spatial scales (6700 km^2), explaining 53.1 % of the total variability of the small taxa. Large mollusks and crustaceans (mesh sizes: 500 µm and 1 mm) showed less spatial variability, displaying structures at the meso and very broad spatial scales and explaining 38.1 % of the large taxa variability. Further analyses are being done to identify association of size-related taxa. The results will be address in the context of the spatial variability of size-related biological interactions in the deep-sea benthos.

To worm a secret out of the deep: The phylogeny of Desmosomatidae Sars, 1897 (Isopoda, Crustacea)

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The existing system of the deep-sea family Desmosomatidae Sars, 1897, including Nannoniscidae Hansen, 1916 is discussed and brought up to date in a phylogenetic analysis based on morphological and molecular data. They are a difficult group for systematic research because of the high variability of forms of characters. The number of undescribed species that have interesting and phylogenetic informative characters is extremely high. In the morphological analysis, a total of 107 species and 129 characters were included. All characters were discussed in detail sensu Hennig (1966, Wägele 2004). Describing new species helped to clarify relationships indicated by intermediate forms. Some of the new species and two new genera are presented in this talk. Five (new) subfamilies are defined, which are supported by the result of the phylogenetic analysis (consensus trees).

Exploration of deep-sea coral ecosystems along the east coast of Florida

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Deep-sea corals are major components of benthic assemblages associated with abundant topographic features on the continental margin of the southeastern United States, either as framework-builders of the features themselves, or as primary generators of complex habitat for dense and diverse assemblages of invertebrates and fishes. In November 2005, we made 14 dives on 11 features between Jacksonville and the Florida Keys using the submersible Johnson Sea-Link to characterize associated benthic communities. Secondary objectives addressed aspects of coral biology, diversity and biogeography of associated fauna, and microbial ecology. High-resolution video surveys and digital still images were taken at each site, together with samples of corals, associated invertebrates, and microbial communities. Visited sites included lithoherms and apparently unconsolidated coral mounds (bioherms) along the continental margin, and features associated with

the relict limestone Miami and Pourtalès Terraces. Percent cover of living coral, chiefly Lophelia pertusa, varied from 0 to almost 100% locally, with wide variations in assemblage structure, e.g., rubble fields, thickets of entirely dead standing coral, and scattered living colonies on dead thickets. Other major habitat-forming macrobenthos included hexactinellid sponges; primnoid, paramuriceid and isidid octocorals; the scleractinians *Madrepora oculata* and *Enallopsammia profunda*, and stylasterid hydrocorals. Though *L. pertusa*-dominated assemblages were chiefly observed in 600-800 m, extensive dense stands were also found along the crest of the Miami Terrace in as little as 320 m. Standing dead coral habitats supported a diverse mesobenthic assemblage, including an anemone and amphipod, both apparently restricted to coral calices; and, at several sites, dense turfs of arborescent, agglutinating astrorhizacean foraminiferans up to 15 mm tall. Coral habitats also supported populations of commercially valuable fishes, including wreckfish (*Polyprion americanus*), and a potential mating site was discovered for the roughtail catshark (*Galeus arae*). These sites currently appear to be unimpacted by human activity and have been proposed for protected status to the South Atlantic Fisheries Management Council.

Examination of ink release by mesopelagic squids

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Despite previous long-standing assumptions, squid ink release is not limited to shallow, sunlit waters. Ink release by several mesopelagic squid species was observed at depths to 1350 m. In order to understand deep-sea ink use, direct observations and video recorded from remotely operated vehicles were reviewed in order to examine species, depth, ink-type, and behavior associated with inking. Six patterns of ink release were observed: pseudomorphs, multiple pseudomorphs released in series, ink trails, clouds/smokescreens, diffuse puffs, and mantle fills. Each species released ink throughout all or most of its depth range. Although most species released a particular ink-type more often than any other form, none was limited to a single type. Ink-type was usually correlated with the individual's behavior. Pseudomorphs and pseudomorph series were generally associated with escape behaviors while ink trails, clouds, and puffs normally involved the animal remaining adjacent to or amid the ink. Deep-sea squids may ink for defensive purposes, as a decoy or to hide within, similar to the way shallow-dwelling cephalopods are thought to use ink.

Asteroidea (Echinodermata) from the Campos Basin Continental Margin, Southeast Brazil

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Studies on deep-sea Asteroidea (Echinodermata) species richness, density, abundance, and biomass from the south Atlantic are scarce. This work relates to sea star populations from the southeastern Brazilian continental margin sampled through two oceanographic campaigns as part of the Campos Basin Deep Sea Environmental Project/PETROBRAS. Thirty six sampling trawls (OTSB) were taken from 1100, 1300 and 1600m in February and August 2003 (summer and winter): 9 at the Northern, and 9 at the Southern areas of this basin in each season respectively. A total of 897 individuals of Asteroidea were sampled, and classified into five families: Astropectinidae, Benthopectinidae, Goniasteridae, Zoroasteridae, Brisingidae. Eight species have been identified: *Astropecten* sp1 (n=1), *Plutonaster bifrons* (n=378), *Cheiraster* (*Cheiraster*) *sepitus* (n=61), *Ceramaster* sp1 (n=42), *Nymphaster arenatus* (n=405), *Pseudarchaster gracilis gracilis* (n=30), *Zoroaster fulgens* (n=19), *Brisinga* sp1 (n=1). The species richness was similar between areas, depths and seasons. All species found are described as having large geographic distribution, but the area sampled here was relatively small (30,000 km^2), with a relatively low bathimetric range (max 500m). However, it was possible to observe that the density, abundance and biomass of most species tended to decrease with increasing depth. *N. arenatus*, *P. bifrons* and *C*. (*C*.) *sepitus* were the most abundant species. The density of *N. arenatus* varied from 132.08±43.61 to 997.11±322.88 ind.Km^{-2} and its biomass from 0.837±0.313 to 10.508±2.701g. m^{-2}, whilst *P. bifrons'* density varied from 67.92±31.09 to 749.90±174.53 ind.Km^{-2} and its biomass from 0.018±0.0100 to 0.701±0.383g.m^{-2}. In general, density and biomass of most species were higher at the Southern than the Northern area, except in the case of *P. bifrons*, which had its

density and biomass about 30% higher at the Northern than in the Southern area. A *P. bifrons* size distribution analysis showed that there were a higher number of small individuals (young) during winter than in the summer, possibly an indication of recruitment happening in winter. On the other hand, there were higher abundance and biomass of *N. arenatus* in the summer. Being a deposit feeder, the latter species probably takes advantage of higher nutritional input to the deep-sea during summer. However, the abundance of *C.*(*C.*)*sepitus*, a carnivore like *P. bifrons*, was similar in summer and winter. It is possible that like other benthopectinid *C.*(*C.*)*sepitus* is a continuous breeder that has either direct development or lecitotrophic larvae. More samples from different periods of the year would be necessary to test these hypotheses, and better understand the composition and dynamics of these sea star populations. It would be important to evaluate these sea stars feeding biology in relation to their reproductive strategies and other environmental parameters such as sediment features and the water column productivity at Campos Basin.

Conservation Status of Deepsea Chondrichthyans

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IUCN Shark Specialist Group

IUCN Red List of Threatened SpeciesTM is widely recognised as the most comprehensive source of information on the global conservation status of plant and animal species. The Shark Specialist Group is currently part way through a programme to complete assessments for all chondrichthyan species (>1,100 worldwide) by the end of 2007. This is being undertaken through a series of regional expert workshops to facilitate discussions and sharing of knowledge. To date six regional workshops have been held, as well as two generic workshops for deepsea species and batoids. As a result, approximately 550 chondrichthyan assessments have been submitted to the Red List, whilst another 320 are in preparation. Several of the deepsea chondrichthyans already assessed have been identified as threatened. Case studies to illustrate the Red Listing process will be presented, for example, three of the 16 species in the family Centrophoridae fall into the Critically Endangered category: Harrisson's dogfish *Centrophorus harrissoni* and the Southern dogfish *Centrophorus uyato* within the Australia and Oceania region, and most recently the gulper shark *Centrophorus granulosus* within the Northeast Atlantic, all due to dramatic declines as a result of commercial fishing activities. Some deepsea species posed a particular dilemma at the workshops – are they rare, or just rarely caught and documented? Our knowledge of the status of most deepsea chondrichthyans is seriously limited. Consequently the Data Deficient category was often assigned, despite concerns that deepsea chondrichthyans appear to be among the most vulnerable of species. Comprehensive assessment of all chondrichthyans using IUCN's Red List Categories will establish a baseline against which to monitor future changes in the global and regional status of chondrichthyans and improvements in our scientific knowledge of this group. This information will provide a powerful tool to promote improvements in the fisheries management of these biologically-vulnerable species. In the case of deepsea chondrichthyans, the need is perhaps stronger than most given the sparse information available on stock sizes and distribution, unresolved taxonomic issues (some fisheries are taking chondrichthyans that are not yet described), and the low management priority afforded them despite increasing development of deepsea fisheries.

Population dynamics of the deep-sea barnacle *Rostraverruca koehleri* (Cirripedia: Verrucomorpha), epibionts on the spines of the sea urchin *Stylocidaris* in Taiwan

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Verrucomorph barnacles have asymmetrical parietes (shells) and the single pair of opercular valves is hinged on one side of the opercular opening. In the deep waters at approx. 300 m depth off W. Taiwan, the Verrucomorph barnacle *Rostraverruca koehleri* are epibionts on the spines of the urchin *Stylocidaris annulosa*. Population ecology of deep-sea organisms are poorly known, due to their distribution are patchy and difficult in regular samplings. In Taiwan, the sea urchin *Stylocidaris* are common by-catches on the commercial deep-sea trawls. With the high abundance of the barnacle *Rostraverruca* on the urchin spines, *R. koehleri* is, therefore, a good model species to study the population ecology of deep-sea barnacles in Taiwan. In the present study, the population ecology of

the deep-sea barnacles *Rostraverruca koehleri* was conducted in a period of 5 years from Nov. 1997 – Jan 2003. The basal diameter of the barnacles *R. koehleri* from all spines of the urchin were measured and the cohort structure were analysed. The population structure of *Rostraverruca* consisted of a dominant cohort through the whole study period of 5 years, suggesting the barnacles have low mortality and their longevity could > 5 years. Recruitment was sparse and irregular. There was a single sparse recruitment occurred in winter from 1997-1999. There were no recruitment recorded from 2001 and 2001. In 2002, there was a sparse recruitment recorded in January. The growth rate of the barnacles was slow and the cohorts increased a mean size of 0.5 mm in 5 years. *Rostraverruca koehleri* has slow growth rate and long longevity appears to be related to the low temperature and limited food resources in the deep-sea environment. The recruitment is sparse and irregular which can be related to the variation in the reproductive output, larval supply and the dispersal in the deep-sea environment.

Genetic Connectivity of Invertebrate Populations on North Atlantic Seamounts

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The mechanisms of faunal dispersal across ocean basins are some of the key unknowns in our understanding of present-day biodiversity of deep-sea fauna. Seamounts are proposed to play several important roles in faunal evolution, acting as regional centers of speciation, stepping-stones for dispersal across ocean basins and boundary currents, and being areas of high production that support abundant faunal assemblages, including many commercially-important species of fish. With the decrease in pelagic fisheries, many fishermen are exploiting deep-sea species commonly found on seamounts, resulting in the loss of habitat (such as deep-water corals) for associated invertebrates and placing a premium on the maintenance of these species through dispersal and gene flow. We are using molecular systematic and comparative phylogeographic methods to investigate the patterns and pathways of dispersal and evolution of non-coral invertebrate fauna on the North Atlantic seamounts (including the New England Seamount chain, the Corner Rise seamounts, and Muir seamount). A comprehensive investigation of several species of ophiuroids with varying life histories found on these seamounts, looking for genealogical concordance over several molecular markers within multiple taxa, will determine the level of population connectivity that exists among these seamount populations. This approach will also assess the importance of a variety of factors, including geological history, current patterns, depth, and life history characteristics (such as associative relationships with coral hosts) that influences faunal dispersal and evolution.

Composition, population structure and trophic relationships of benthopelagic fishes at Seine Seamount, NE Atlantic

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Benthopelagic fishes were sampled during three cruises to Seine Seamount, NE Atlantic, using bottom trawl (ottertrawl and beamtrawl) and epibenthic sledge. A total of 17 fish species were caught on the summit plateau of the seamount at 160-180 m depth, belonging to 15 different families. Four species were common to all types of trawls, whereas the other species were found only in part of the catches. Most fishes caught were small species. The most abundant fish was the snipefish, Macroramphosus spp., which was important also in terms of biomass. The population structure (size classes and length/weight relationships) of the 5 most abundant species (*Macroramphosus* spp., *Capros aper*, *Anthias anthias* and *Callanthias ruber*, *Centracanthus cirrus*) shows that usually two or three age groups (year classes) were present, and that growth rates were high. A stomach content analysis of these fishes revealed a predominance of pelagic prey, mainly small copepods, which reflects the composition of the plankton community. However, differences preferred prey taxa showed up btween the fish species.

Deep-Sea Seamount Fisheries: Seeking the elusive goal of sustainability

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Deepwater fisheries on the upper continental slope have become an important component of commercial fisheries in a number of countries, and continue to be of potential interest to nations whose coastal and shelf fisheries are fully or over–exploited, These fisheries include well-known species like orange roughy, cardinalfish, oreos, and grenadiers, and often take place on seamounts. Typically the catch histories of these show rapid development to a relatively high level, and then a dramatic decline. Associated with such apparent boom and bust type situations, have come concerns about the sustainability of seamount fisheries, and the deepwater benthic habitat. In this paper I will present recent information on a number of deepwater fisheries around the world, and then focus in on experience with orange roughy around New Zealand and Australia. Fisheries for orange roughy were substantial and valuable fisheries through the 1980s and 1990s, with annual catches often over 30,000 t, and over 70,000 t at its peak in 1991. Much of this catch came off seamount features, but these fisheries proved vulnerable. Many seamount stocks have shown rapid decline, and catch levels have been cut dramatically. These limits are now thought to be at sustainable levels, but recovery response is slow and time is required to see if this is really the case. A lot of lessons have been learnt the hard way about the biology and ecology of the fish, fisheries characteristics, information needs, stock assessment techniques, and management strategies. In addition to fisheries issues, the physical impact of bottom trawling on the benthic habitat has become of increasing concern in recent years. A number of seamounts have been closed to trawling around both Australia and New Zealand, and total protection is an increasing element of seamount management in many countries. The overall experience in New Zealand with orange roughy is one of mixed results, but a lot of fishery, research, and management lessons have been learnt, and with these being applied there is good reason to believe that deepwater fisheries on seamounts can prove resilient, and exploitation and conservation can co-exist.

Eye Structure and Visual Physiology of the Copepod *Gaussia princeps*

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Vision in the dim light of the mesopelagic presents a challenge, which organisms have confronted with unique structural and physiological adaptations. Studies on mesopelagic visual ecology have focused on fish and large crustaceans, with little being known about the visual capabilities of smaller crustaceans, most notably the copepods. We investigated the organization and physiological properties of photoreceptors in *Gaussia princeps*, a luminescent mesopelagic metridinid copepod. Eye design in this species is unusual, incorporating three apparent reflectors into the typical copepod tripartite naupliar eye. Visual spectral sensitivity experiments conducted using an extracellular electroretinogram technique suggest *G. princeps* has a monochromatic visual system with a sensitivity maximum at 494 nm. Irradiance sensitivity and temporal resolution experiments suggest the *G. princeps* visual system is slower and more sensitive to light than those of shallow water copepod species. These results offer useful information for understanding the visual ecology of *G. princeps* and other mesopelagic copepods.

The Influence of Primary Productivity and Seasonality of Productivity on the North Atlantic Benthos: Benthic Foraminiferal Faunal and Carbon Isotopic Results

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Benthic foraminifera from 43 Holocene core tops were studied from 0-62^{o}N to evaluate the influence of primary productivity and seasonality of productivity on (i) the distribution of individual species and

assemblages, and (ii) the carbon isotopic composition of two dominant species, *Planulina wuellerstorfi* and *Epistominella exigua*. Productivity estimates, derived from SeaWiFS data, were used to calculate a seasonality index, defined as [6-t(1/2)]6, where t(1/2) is the time to generate one half of the total annual primary productivity (Berger and Wefer, 1990). The relative abundance of either *E. exigua* or *A. weddellensis* does not correlate with productivity or seasonality, but these species together show a significant correlation with seasonality. Since these species occupy phytodetritus layers, this correlation can be explained by the production of phytodetritus in areas experiencing highly seasonal primary productivity. The $\delta_{13}C$ of *P. wuellerstorfi* is not affected by primary productivity or seasonality, which supports the use of this species for paleocirculation reconstructions. Seasonality does have a significant effect on the $\delta_{13}C$ of *E. exigua*, which shows a 0.9 ‰ change over 60° of latitude. The isotopic differences of these species can be explained by their microhabitat preferences. *P. wuellerstorfi* prefers to live above the bottom on spines, spicules, etc., where the effect of phytodetritus would be nonexistent or minimal, whereas *E. exigua* inhabits phytodetritus, where the oxidation of ^{12}C-rich organic matter would result in a depletion of $\delta_{13}C$ in the pore waters of the phytodetritus. The faunal and carbon isotopic data show that seasonality has a much more pronounced effect on benthic foraminifera than absolute levels of productivity. In addition, we suggest that the $\Delta^{13}C$ of *E. exigua*, in conjunction with the $\delta_{13}C$ of *P. wuellerstorfi*, can be used to reconstruct seasonality of productivity from the sedimentary record.

New Species Records, Distribution and Phylogenetic Relationships of *Munidopsis* (Anomura: Galatheidae) from Deep-Sea Hydrothermal Vents of Indian and Pacific Oceans

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Species of the genus *Munidopsis* (Anomura: Galatheidae) are found from shallow to deep water, majority below 800m in the World Oceans. Now 122 species are known in Indo- Pacific, 62 species in Atlantic, 8 species in southern Ocean and 4 species show a worldwide distribution. With the increase in research around hydrothermal vents, many new species has been frequently reported from deep-sea hydrothermal vents, cold seeps and whale falls. Nine species has already been reported to be endemic to hydrothermal vents and have been described by various authors. Recent dives into hydrothermal vents in Pacific and Indian Ocean with manned submersible Shinkai 6500 and different ROVs have discovered many new species of *Munidopsis*. Here we report 6 new species of *Munidopsis* recorded from different hydrothermal vents such as Myojin knoll, Hatoma Knoll, Mariana Back arc, Brothers Seamount in Pacific Ocean and Kairei field in Indian Ocean. We discuss about the diversity of species and their distribution in the locality. We also examined the phylogenetic relationships of *Munidopsis lauensis* from different vent fields such as Hatoma Knoll, Eifuku Seamount, Lau Basin, Manus Basin and Brothers Seamount in Pacific Ocean and Kairei field in Indian Ocean and newly recorded *Munidopsis* sp. from three vent fields such as Hatoma Knoll, Myojin Knoll and Eifuku Seamount in Western Pacific inferred by partial sequencing of mitochondrial COI gene. We compare the morphological and genetic variations of *Munidopsis* and discuss about the biogeographic pattern.

Crustacean assemblages from bathyal environments in the Gulf of Cadiz

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Since the discovery of the first mud volcano in the Gulf of Cadiz , about 30 other sites at depths ranging from 200 to 3900m, with varying degrees of hydrocarbon-rich gas seepage activity, have been located and sampled under the IOC-UNESCO Training Through Research programme and, more recently, the EU funded HERMES project. Geological surveys are being accompanied by the study of macrofaunal assemblages and sampling includes deep-towed video, dredging, grabbing and coring. The bathyal environments, encompass mud volcanoes, carbonate chimney fields and cold water coral stands. The material collected during the past six years is significant and its study is not yet completed. Crustaceans are often the most abundant and diverse component of the fauna and have

been ascribed, up to now, to 68 families (mud volcanoes: 57; carbonate chimneys: 36; coral stands: 28), from which 22 Amphipoda, 17 Isopoda,10 Decapoda, 9 Tanaidacea, 9 Cumacea and 1 Euphausiiacea. The crustacean fauna includes both Atlantic and Mediterranean species and some undescribed ones (eg. Bathycalliax sp.). Mud volcanoes are characterised by a high number of species, low degree of endemicity and high variability in their faunal compositions. Isopods (eg. Desmosomatidae, Lepthanthuridae, Munnopsidae), tanaids (eg. Leptognathiidae, Apseudidae) and amphipods (eg. Phoxocephalidae, Pardaliscidae) are frequent in mud volcanoes but their contribution to the composition of the assemblage varies widely from one structure to another. Carbonate chimneys and corals are characterized by the abundance and diversity of amphipods (Stenothoidae, Caprellidae, Aoridae, Ischyroceridae) and isopods. The distribution of species is related to fluid expulsion activity and substrate availability. Unlike most of the sea bottom, these habitats provide additional sources of food (namely through chemosynthetic pathways) and hard substrata for the settlement of suspension-feeders and other epifaunal organisms. Habitat heterogeneity is further enhanced by the numerous dead and living biogenic structures such as sponge stalks, corals and other cnidarians that protrude from the sea-bottom and favour the diversity and complexity of the assemblages.

Behaviour and nutrition of the MAR vent limpet *Lepetodrilus atlanticus* (Warén & Bouchet 2001)

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Vent limpets of the genus *Lepetodrilus* often totally dominate the gastropod fauna at sites on the Mid-Atlantic Ridge and East Pacific Rise. *Lepetodrilus atlanticus* is the most abundant macrofaunal organism on the Menez Gwen Hydrothermal Field on the mid-Atlantic Ridge, occurring is on the shells of the vent mussel *Bathymodiolus azoricus* and on the surrounding rocks. Animals from the 850 m deep Menez Gwen site are in good condition on recovery to the surface. Specimens were studied by time-lapse video within 24 h of recovery and for longer periods in laboratory aquaria under different conditions. Video-clips of their behaviour will be shown. *L. atlanticus* show three distinctive patterns of movement: direct locomotion, without deviation to either side; a slow forward progression with a side-to-side sweeping motion, when grazing on algae or bacteria; a stacking behaviour, forming temporary towers of up to 7 animals high. We relate the latter to filter feeding activity. The stacking limpets lifted their shells well clear of the substratum and their radulas were seldom seen to be in contact with the shell of the limpet below them. Grazing limpets showed a distinct periodicity, returning to their home base after feeding.

Biodiversity of Nematoda at the Southern Ocean

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Slowly, our insight in the plenitude of habitats present at the polar margins and deep-sea is growing, allowing comparisons with similar ecosystems worldwide. Meiofauna (smallest metazoan benthic component) research in the Southern Ocean only got off the ground since the 90's. Initially, subtidal areas and shelfs were investigated, whereas recently more efforts have been done during international expeditions (ANDEEP and LAMPOS) to sample the unexplored margins and deep-sea. Benthic deep-sea productivity is mainly driven by surface primary production and transport processes to the seafloor, resulting in high (meio-)benthic standing stocks at ice margins. The deep places like the South Sandwich trench (up to 6300 m) in the Antarctic are characterized by higher meiobenthic standing stocks than abyssal areas at shallower depths. Not many new meiobenthic taxa higher than the species level were recorded. The prevailing nematode genera for instance are in accordance to what is found at other shelfs, slopes and abysses worldwide. Since the first BIANZO (BelSPo) project started in 2001, special attention was given to the biodiversity and biogeography of Antarctic species. This approach revealed the presence of many new species. It gave us insight in the high regional diversity at the Weddell Sea, with a high turn over in species composition between adjacent geographical areas. In contrast, many species show a wide bathymetric distribution not restricted by depth along the Weddell Sea slopes. Furthermore evidence is given for the distribution of species along the Scotia Arc, connecting the Peninsula with South America.

Observations of flatfish "spas" from hydrothermally active seamounts in the Mariana Arc

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During a cruise to the Mariana Islands in spring 2004, dense aggregations of small flatfish were recorded from areas of diffuse flow on two hydrothermally active seamounts known as Kasuga-2 and Daikoku. This is quite novel, as flatfish are not known to be part of vent faunas elsewhere. Based on a single specimen, it was determined to be a new species of tonguefish in the genus Symphurus, and is currently under description. In October 2005, we returned to the Mariana Arc and collected about 60 specimens from Kasuga-2, Daikoku, and a third site, Nikko Seamount. Interestingly, the Nikko specimens were about twice as large as the flatfish from Kasuga-2 and Daikoku. Current molecular work (using the Barcode of Life Data System) will determine the relationship among these populations, and verify whether they are the same species. Under the microscope, sandy sediments from the flatfish habitat are full of filamentous (likely chemosynthetic) bacteria and tiny nematodes. Our current hypothesis is that the flatfish are feeding on both and, thus, are ultimately supported by chemosynthesis, since the nematodes are likely feeding on the bacterial filaments. Stable isotope and lipid analysis of samples from these "fish spas" are currently underway. Otolith microstructure analyses will be employed to quantify individual growth trajectories and population age structure from the three sites. The observed size differences could reflect differences in food availability between the three seamounts, as Nikko Seamount appeared far more productive. However, the smaller fish may also represent recent colonization events at Kasuga-2 and Daikoku.

Depth related trends in metabolism of benthic and benthopelagic deep-sea fishes

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The rates of metabolic processes vary tremendously throughout the biosphere. The origins of this variation are a matter of active debate with some scientists touting the importance of anatomical or environmental constraints while others emphasize the diversity of ecological roles that organisms play and the associated energy demands. Here we analyze metabolism in deep-sea fishes across a depth gradient, in an effort to understand the extent and underlying causes of variation. Data for pelagic fishes have been synthesized before but data for benthic and benthopelagic species have not. We find that the metabolic rates of benthopelagic species decline significantly with depth but do not in benthic species. Due to the difficulty of working with these animals direct measurements of metabolic rates are sparse. Metabolic enzyme activities are a useful proxy for metabolic rates and these data allow for further examination of trends. Activities of lactate dehydrogenase (LDH, an indicator of anaerobic capacity) and citrate synthetase (CS, an indicator of aerobic capacity) show significant declines in benthopelagic and benthic species. Pelagic species exhibit the greatest declines followed by benthopelagic fishes and finally by benthic species. These patterns in metabolism are best explained by a relaxation of the selective pressure for strong locomotory capacity with depth as reduced light levels shorten the reactive distances between predators and prey.

Inactive sulfide mounds of Manus Basin: The invertebrate community and the potential for a chemoautotrophic food web

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Hydrothermal vents are ephemeral, extreme environments colonized by endemic invertebrate taxa. When hydrothermal activity ceases at the end of a hydrothermal cycle, the flux of sulfide-rich fluids that sustains free-living and endosymbiotic microbial primary production disappears. An inactive vent thus becomes an inhospitable environment for vent-endemic megafaunal organisms, but, in the absence of noxious concentrations of dissolved hydrogen sulfide, inactive sulfides become hospitable

to a different suite of megafaunal species. Inactive sulfide deposits are common along mid-ocean ridges and spreading centers of back-arc basins, yet there has been no deliberate study of their invertebrate communities and the trophic basis for these communities. At least 2 non-exclusive conditions could provide nutrition for the megafauna of inactive sulfide mounds: 1) the topographic relief of the mounds may result in enhanced delivery of suspended organic particulates (either chemosynthetic, from nearby active sites, or photosynthetic, from sinking particles); 2) there is in situ production of organic carbon by microbes that oxidize particulate (rather than dissolved) sulfides. Using an ROV (TST212), we explored inactive sulfide mounds of Manus Basin in January 2006 and photo-documented the megafauna. Specimens of the biomass-dominant taxa (branching corals, stalked barnacles, and hydroids) were preserved for taxonomic, molecular, and organic isotope (carbon, nitrogen, and sulfur) characterization to assess the community composition and trophic basis. Commercial mining companies have expressed an interest in inactive sulfide mounds of back-arc basins as sources of commercial-grade ores. Mining the ore involves systematic removal of the sulfides and any associated biology. It is imperative that we understand the biology of these systems before ore-body extraction proceeds beyond the test-mining stage. This work is supported by a contract from the Placer Dome Mining Company.

Pelagic shrimps (Decapoda, Caridea) on the mid-Atlantic Ridge

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Decapod shrimps comprise a significant part of the micronekton biomass in the mesopelagic zone of the oceans. The accumulated information on their distribution, migration and life histories suggests that pelagic shrimps play important roles in the vertical transport of organic matter in the oceanic system. In this paper we report on the geographical and vertical distributions of pelagic Caridean shrimps on the northern mid Atlantic Ridge in June 2004. Pelagic shrimps were sampled at 17 positions from Iceland to the Azores (~60-44°N, 25-35°W) on the MAR-ECO 2004 cruise. Depth stratified sampling revealed information on vertical distributions from surface down to 3000 m. 26 species of Caridean shrimps, belonging to 11 genera were identified: *Ephyrina* (2 species), *Systellaspis* (4 species), *Hymenodora* (2 species), *Oplophorus* (1 species), *Nostostomus* (3 species), *Nematocarcinus* (2 species), *Acanthephyra* (4 species), *Meningodora* (4 species), *Parapasiphae* (1 species), *Pasiphaea* (2 species) and *Parapandalus* (1 species) Species compositions and abundances varied both vertically and latitudinally. An increase of species richness toward lower latitudes was found and the sub-Polar Front is the major biogeographic boundary in the studied area. Factors influencing vertical and geographical distributions of the observed species along the mid-Atlantic Ridge is discussed.

Habitat preferences of deep-sea demersal nekton in the Charlie-Gibbs Fracture Zone of the Mid-Atlantic Ridge

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Manned submersibles conducted videotaped transects during 4 dives at 1700-4500 m depth in the Charlie-Gibbs Fracture Zone of the Mid-Atlantic Ridge. We recorded numbers of identifiable nekton forms and counts of environmental features (numbers of different types of sessile invertebrates, percentage of sediment cover, etc.) during 1-minute segments of the videotapes. We used multivariate analyses to identify patterns of habitat preferences of the nekton forms. The most common nekton forms were small rattails, large rattails, halosaurs, and shrimp. In shallower dives, blue hake and slickheads were also included in the analyses. We found a number of environmental features that seemed to affect nekton distribution. Trends in species preferences related to differences in their abundances relative to numbers of sessile cnidaria, numbers of infaunal features (holes, mounds, etc), and numbers of sponges. These hypotheses were used to devise tests of habitat selection for individual species. Habitat selection for a species was indicated by a mean score significantly different from the environmental mean for that axis, and/or a variance smaller than the environmental variance

for that axis. These tests showed that most of the nekton forms chose subsets of the environment based on these features. In particular, the most striking trend was that these nekton forms seemed to avoid areas with aggregations of sessile Cnidaria. While sessile cnidaria were most common in rocky areas, the response of the nekton forms was not related to the amount of rocky area in a segment, nor did most forms respond to numbers of sponges (also most common in rocky areas).

Observations of Deep-water Coral Communities on the New England and Corner Rise Seamount Chains (Western North Atlantic)

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The New England Seamount (NES) and Corner Rise Seamount (CRS) chains comprise a line of seamounts that extend from the eastern continental margin of the United States to the Mid-Atlantic Ridge. Their summits range from 1 to 3 km depth, and, except for the westernmost of the NES that arise from the continental slope, they extend to abyssal depths (4000-5000 meters). Since 2003, we have participated in four exploratory cruises using submersibles and ROV's to deep-water coral habitats of 11 of these seamounts. Among the objectives of our research group were to: assess the overall biodiversity (corals, coral associates, ichthyofauna, and other invertebrates); analyze the distribution and abundance of octocorals, antipatharians and fishes associated with seamount landscapes; investigate the colonization dynamics of corals; describe the reproductive morphology of octocorals; assess the genetic diversity of octocorals, antipatharians and selected coral associates; analyze fossil scleractinians for insights into paleoclimate; and map major seamount features using multibeam. These expeditions have provided us with approximately 500 hours of video at depths between 800-3800 meters, observations of at least 57 species of fish, and collections of samples from over 400 octocorals, 70 black corals, and 6000 specimens of associated invertebrate fauna, and more than 1000 fossil corals. This presentation will provide an overview of the expeditions and our findings.

Do ontogenetic migrators adapt to different light environments during their life histories?

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The ability to relate an organism's visual physiology to its environment has proven to be a particularly interesting topic of research in the aquatic world, due to the variety of underwater light environments. For all visually competent organisms, the driving force behind the adaptation of photoreceptors involves obtaining the best balance of resolution to sensitivity in the prevailing light regime, as an increase in sensitivity often results in a decrease in resolution. A number of aquatic species have an additional problem to deal with, in that they live in vastly different visual environments during their life histories. Metamorphosis from the larval stage to the post-larvae (juvenile) is clearly the opportune time for the photoreceptor to undergo dramatic changes in both structure and visual pigment complement to adapt to different light environment. However, a number of crustaceans have juvenile stages that are found up to 500 meters shallower than the deep living adults, and very little is known about how these two life history stages deal with these dramatically different light environments. Preliminary data will be presented here on two life history stages of the ontogenetically migrating lophogastrid *Gnathophausia ingens*. Live, visually competent juveniles (150-250 m) and adults (650-750 m) were collected with an opening/closing TuckerTrawl fitted with a closing cod-end. Electrophysiological recordings were utilized to determine the spectral sensitivity of the juveniles, as well as the temporal dynamics of the photoreceptors in both life history stages. Preliminary results indicate that juveniles have slightly greater short wavelength sensitivity than adults, but the only differences in temporal dynamics appear to be related to the warmer temperatures occupied by the shallower living juveniles. Supported by NSF Grant #IBN-0343871.

Spatial variability of megafaunal assemblages in deep-sea polymetallic nodule fields in the North-East Pacific

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Megafauna is one of the faunal components that were investigated in the baseline study conducted during the NODINAUT cruise, in the deep polymetallic nodule fields of the North-East Pacific, as it may constitute one of the most sensitive componend of the benthic community to potential impact of nodule exploitation. The structure of the megafaunal community was assessed in terms of composition, abundance and distribution in two French mining claim areas 1200 miles distant: East area where three different nodule facies (2 with nodules and 1 without) were present, and West area with a fourth different nodule facies. Three Nautile dives devoted to megafauna study on the different nodule facies on the East area and one on the West area provided data made of digital videos, photos and samples collected using the claw operated by the arm. Areas surveyed were of 2.68 ha in the E and 1.4 ha in the W stations. In total, 51 megafaunal species were recognized. Most of them belonged to 3 phyla, echinoderms (28 species, from which 23 holothuroids), sponges (9 species) and cnidarians (9 species). Differences in the structure of assemblages of megafauna were observed at two spatial scales, regional between both study areas and local among different nodule facies. The lowest total abundance was encountered in the W (147 ind./ha). On the E station both nodule facies had higher abundances (max: 300 ind./ha) than the area without nodule (157 ind./ha). The species richness also varied at both scales showing the lowest value on the area without nodule in the East, and the highest in the W. Megafauna composition at the phylum level differed at both scales with cnidarians dominating the areas with nodules and holothurians the areas without nodules in the East, while echinoderms dominated on the W station despite the presence of nodules. In terms of trophic groups, suspension feeders dominated the areas covered with nodules whereas deposit feeders were dominant on areas without nodules. The presence of nodules seems to be correlated with a lower abundance and higher diversity of deposit feeders. These observations highlight the role of habitat heterogeneity in structuring megafaunal assemblages.

Bottom fauna in the region of the HMS Titanic wreck: trawl data and submersibles observations

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Studies of the bottom fauna in the region of the Titanic wreck was carried out during six cruises of the RV Akademik Mstislav Keldysh. Direct observations of the bottom fauna from the DSRV Mir were conducted, all photos and videorecords were analyzed, samples of animals were taken, an annotated list of species was composed, and an ecological analysis of the fauna of invertebrate animals in the zone in the immediate proximity of the vessel and up to several miles apart was made. As a whole, the investigated community can be defined as a community Bivalvia-Ophiuroidea-Spongia-Ascidia. It is possible to speak about existence of at least two modifications of a single poly-mixed community. The peculiar features of meso-scale variability of the bottom community correlate to the specific character of the hydrological and sedimentation condition in the different sections of the investigated region. One of the tasks of the comprehensive studies in the region of the Titanic wreck was a description of the bottom communities in the immediate proximity of the sunken vessel and an evaluation of the influence of the consequence of the shipwreck on the bottom biota. We observed that near the ship the quantity of animals, and their diversity increase. Some organisms (9 species) obviously avoid settling on fragments of a vessel, and the others (12 species) - obviously gravitating to them. The patterns of animal distribution in the proximity of the Titanic and on the ship hull are discussed. These patterns are compared with the distribution of animals at the wreck site of German battleship Bismarck which was also investigated during our expeditions.

Patterns of benthic fauna distribution along the Mid-Atlantic Ridge in the North Atlantic

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Distribution of benthic invertebrates collected along the Mid-Atlantic Ridge on the *G.O. Sars* cruise MAR-ECO in summer 2004 has been analysed. Material used in this analysis was obtained from 17 Otter-trawl catches, 7 of them taken off the Azores, close to 43°N (Southern Box) and 10 in the Charlie-Gibbs Fracture Zone (CGFZ) area, including 5 taken South-East and 5 North-West from CGFZ. The trawls were taken at depths from 1255 to 3505 m. The number of species in the collection is around 150. Among the sampled taxa, the highest number of species was found among holothurians (36, including 4 species new to science), asteroids (25) and ophiuroids (22). These three groups were used in the present biogeographical analysis. The Southern Box and area SE of CGFZ share 25% of species of holothurians, whereas Southern Box and area NW of CGFZ have only 15% of common species. At the same time, areas SE and NW of CGFZ share only 27% of species. This pattern indicates some barrier to species distribution along the Mid-Atlantic Ridge in the CGFZ area. The Mid-Atlantic Ridge also presents a barrier to species distribution along the east-west gradient. This is especially pronounced in the Southern Box area, with a high ratio of species (48%) occurring only to the west from the ridge, and the ratio of species restricted to the east 19%. In the area NW of CGFZ the pool of 'western' species drops to 30%. A comparison of species composition at all stations using the Jaccard index and the method of paired groups clearly indicated the separation of the southern group of stations, and a less clear separation between the NW and SE CGFZ groups of stations.

Argestidae (Copepoda: Harpacticoida) of the deep Angola Basin (Southeast Atlantic). Distributional patterns, community structure and species diversity

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During the DIVA 1 cruise of RV „Meteor" in 2000 the deep-sea meiobenthos of two stations, the northern #346, and the southern #325, was sampled replicatedly using the multiple corer (MUC). One of the most abundant representatives of Harpacticoida was Argestidae Por, 1986. Argestidae are considered as "typical" deep-sea taxon, as they are not only common, but also one of the dominant harpacticoid taxa in deep-sea samples. Totally, 371 specimens were collected from 75 MUC cores. The 364 identified specimens (7 specimens badly damaged) distribute over 75 species, all of which being new to science. The portion of juveniles is remarkably low (4.9%) in comparison with general harpacticoid data and that of other regions. Females dominate clearly with approximately 76.0%. Faunistic comparison reveals that #346 is much richer in species numbers, presenting 71 (=94.6%) of the total 75 species, whereas #325 shows 12 species (16.0%). Also the abundance shows higher values at #346 (347 individuals) than at #325 (24 specimens). This correlates well with other ecological and macrofaunal data of the region, confirming a higher productivity of the northern Angola Basin. Eight species were collected from both stations. The dominating species is „Argestidae sp. 1", comprising more than 25% of all collected specimens. On the other hand, a considerable high percentage (66.7%) of species recorded with just 1 specimen is notable for both stations (#346: 47 species, #325: 8 species). Although taxonomical work is still in process, first interregional comparisons as to the specific distribution can be made.

Conservation and governance of seamount and deep-sea coral ecosystems: Primer from Miami 2005

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Obvious threats to seamount and deep-sea ecosystems include: (A) Over-fishing of highly migratory fish at summits of seamounts, thus creating the “fishing-down the food-web” (FFW) syndrome. (B) Obliteration of deep-sea coral habitats by bottom trawling, leaving scars and “rubbled deserts” on deep-sea floor. (C) Rising levels of acidity in the oceans, inducing significant shifts in “Aragonite Saturation Horizons” (ASH), thus adversely influencing calcification and growth of shallow and more so, deep-sea corals. (D) Rapid decadal climate change scenario since the 1960s with isotopic evidence from deep-sea octocoral *Primnoa resedaeformis*, clearly revealing weakening of the cold Labrador Current off Nova Scotia (Labrador Slope Water -LSW) in the Northwest Atlantic and the north as well as northeast shifts in the warm Gulf Stream Warm Slope Water (WSW) and Northeast Oscillations with profound biological implications on the deeep-sea coral reefs and seamount ecosystems. This trend was evident in the conceptual models that are now generated by George et al., 2006 for the Corner Rise Seamount in the North Atlantic Ocean, west of the Mid-Atlantic Ridge. These key threats are compounded by: (1) Incomplete knowledge of the “Planet Deep-Sea” (90% of species, primarily infauna, yet to be described, their systematic status nebulous with controversies between the dwindling tram of taxonomists as evidenced by the author's biodiversity studies (2001, 2004 and 2005 papers in the Journal of Natural History) on deep-sea asellote isopod crustacea. (2) Inadequate funds for science of the deep-ocean (bathyal, abyssal and hadal), involving in situ AUV and submersible studies and also simulated laboratory experiments. (3) Bottle-necks in reaching consensus between nationsunder the United Nation General Assembly (UNGA) and World Conservation Union (IUCN) in establishing High-Seas Marine Protected Areas (MPAs) and Science Priority Areas (SPAs). The third international symposium on deep-sea corals (3rISDSC) in Miami (December, 2005), co-organized by this author, has successfully identified major steps for conservation and governance of deep-ocean ecosystems.

Momentum toward protection of deep-sea biodiversity: fisheries and oceans negotiations in the UN General Assembly in 2006 and beyond

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The United Nations General Assembly in 2004 adopted a resolution calling for urgent action to protect seamounts, hydrothermal vents, cold-water corals and other vulnerable marine ecosystems from the adverse impacts of destructive fishing practices, including bottom trawl fishing, on the high seas. In the latter half of 2006, the General Assembly (GA) will review actions taken by States individually and collectively through regional fisheries management organizations, to implement its 2004 resolution. Where the General Assembly determines that actions taken to date have been inadequate, the GA will decide on further recommendations for action by the international community.
Unfortunately, most areas of the high seas remain without effective regulations to protect deep-sea biodiversity from the impact of deep-sea bottom fisheries. Nonetheless, there is growing recognition on the part of many countries that the threat posed by poorly regulated or unregulated deep-sea fisheries on the high seas is significant, and that more effective and precautionary action is required under international law. The General Assembly will negotiate this issue again in the latter half of 2006. Momentum is growing for decisive action, including increasing calls for a moratorium or moratoria on bottom trawl fishing on the high seas, but the outcome of the GA negotiations is by no means certain.
The scientific community has played a key role in highlighting the threats posed by deep-sea fisheries to vulnerable marine ecosystems and bringing these to the attention of decision-makers, marine conservation organizations and the wider public over the past decade. There are additional opportunities to help achieve a successful conservation oriented outcome at the UN General Assembly and in related political and regulatory bodies at the regional and national levels both in 2006 and in coming years.

Progress and priorities for high seas marine protected areas (MPAs)

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The past few years of awareness raising by scientists and conservation organizations of threats to deep sea biodiversity from fishing activities has sparked broad international consensus on the need for improved biodiversity conservation. This presentation will specifically address progress and priorities relating to biodiversity conservation and MPAs in marine areas beyond national jurisdiction (here referred to as the High Seas). This is not to suggest that deep sea areas within national waters do not also need protection. Compared to the High Seas however, action at the national level is more easily achieved: national governments can restrict access to their own waters, whereas at the international level, global agreement is necessary. Most nations now support the development of MPAs and/or areas closed to fishing to protect deep sea biodiversity on the High Seas. There is a very real possibility that in late 2006 the United Nations General Assembly will call for an interim prohibition on unregulated high seas bottom trawling until conservation mechanisms are in place to protect the most vulnerable areas. Thus it is time to consider the political and scientific aspects of identifying priority sites for protection as well as establishing MPAs and representative networks or systems of High Seas MPAs (Gjerde and Kelleher, 2005). There is a vast array of legal agreements and global and regional fora relevant to biodiversity conservation beyond national jurisdiction (Kimball, 2005). This presentation highlights some of them, with a focus on the UN Convention on the Law of the Seas (UNCLOS). It observes that while MPAs can already be designated on the High Seas consistent with UNCLOS, what is lacking is a mechanism for cooperative management and enforcement. The presentation then focuses on recommendations for action in the political and scientific realm. Priorities and paths for action at the political level include: 1) better implementation of existing international agreements by States; 2) immediate protection via a United Nations General Assembly resolution calling for an interim prohibition on unregulated high seas bottom trawling; 3) a strict and short-term deadline for action within regional fisheries management organizations (RFMOs) to bring deep sea fishing to ecologically sustainable levels and to protect biodiversity; 4) development of tools such as MPAs, codes of conduct, best practice guidelines and environmental assessments to aid integrated and precautionary management of the High Seas; 5) development of a framework or mechanism to: a) ensure that biodiversity conservation and sustainable use are common goals shared by all international and regional institutions; b) promote coordinated and coherent decision-making amongst international and regional bodies; and c) ensure transparency and stakeholder participation and consultation. The European Union has already proposed a new implementing agreement to UNCLOS to provide a framework for the identification and designation of High Seas MPAs. Scientists may take a direct role by: 1) speaking publicly on the need for enhanced protection, 2) providing the scientific background to support proposals to States and RFMOs to protect vulnerable deep sea ecosystems; 3) collaborating in the development of criteria for selection of areas for priority protection as well as for representative MPA systems; 4) advancing biogeographic classification systems as a basis for developing representative MPA systems; 5) providing information to identify and support proposals for candidate sites; 6) translating relevant research results into materials suitable for policy makers and/ or the general public; and 7) pursuing further policy relevant research..

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The 'snowboarding' scaleworm: morphology, reproductive biology and genetic structure of a stepping-stone species

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We examined the reproductive biology and genetic structure of the polychaete *Bathykurila guaymasensis* (Annelida: Polynoidae), a species recorded from both whale-falls and hydrothermal vents. The habitat of *B. guaymasensis* is quite different from other vent polynoids, being apparently a specialist feeder on *Beggiatoa* mat, rather than living commensally with mussels or on the sides of hot vent chimneys. Specimens were collected from whale-fall sites in the Santa Cruz and Santa Catalina

Basins, Southern California at depths of 1200-1600m, and investigated using a combined morphological and molecular approach. The species exhibits marked sexual dimorphism, asynchronous gametogenesis, evidence for internal fertilization and lecithotrophic larval development – all characters shared with other hydrothermal vent polynoids. Two distinct, sympatrically distributed haplotype groups *of Bathykurila guaymasensis* were identified using mitochondrial cytochrome oxidase 1 (CO1) gene sequences, indicating that there may be two species within the nominal designation *B. guaymasensis*. Broad sharing of haplotypes between the two whale-fall sites suggests high dispersal rates among basins along the California margin.

Influence of environmental factors in the population dynamics of the deep-water pink shrimp *Parapenaeus longirostris* (Crustacea: Decapoda) in the Balearic Islands (western Mediterranean)

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Deep-water pink shrimp is a demersal resource exploited in the Mediterranean. Landings of this species from the trawl fishery developed off Mallorca (Balearic Islands, north-western Mediterranean) have shown a decrease in recent years. The analysis of data obtained from six bi-monthly bottom-trawl and oceanographic surveys (environmental data), developed at two areas southern Mallorca (August 2003-June 2004), has been performed. The biology of this species (e.g. sex-ratio, maturity, gonado-somatic index, condition factor and growth) has been analysed for the first time in the area, providing useful information for the assessment of this exploited species. On the whole, the depth range of the species is 250-550 m, reaching the highest values around 350 m and showing a clear size increase with depth. Two spawning peaks have been detected, in spring-summer and autumn while the recruitment period has been observed in autumn-winter. Length at first maturity for females has been estimated at 28 mm caparace length, and growth parameters have shown high growth rates: 37.4 mm (Linf), 0.76 year-1 (k) and –0.17 year (t0). The relationships among spatial and seasonal variations of population dynamics of this species and some environmental factors (e.g. temperature, salinity, trophic resources and sediments) have also been analysed.

Feeding of large asellote isopods (Crustacea, Isopoda) in the deep-sea – are these active predators?

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Feeding of deep-water peracarids (Crustacea) is still poorly known. Recent studies of gut contents of small and intermediate sized asellote isopods have indicated that foraminiferivory is pronounced among benthic deep-water species. Video recordings of the relatively large *Munnopsis* sp., *Paropsurus giganteus*, and *Vanhoefenura pulchra* show that they actively walk long distances along the sea floor on long slender legs. While walking, *Munnopsis* intermittently stops briefly, quickly bends its legs and lowers the body to pick up a mud grab with the prehensile first pair of pereopods, then rises again and continues walking: this is interpreted as a feeding behaviour. The aim of the present study is to evaluate feeding habits of large deep-water asellotes, with long slender legs and powerful mandibles capable of crushing and tearing prey. A variety of food items were found during studies of gut contents of the large munnopsids. For instance, large whole or partially broken foraminiferan specimens, close to 2 mm in diameter, were commonly found in the guts of *Munnopsurus giganteus*. Some of these larger foraminifers belonged to *Planispirinoides bucculentus* and *Quinqueloculina seminulum*. These foram species rarely occur in grab samples but are often ubiquitous in sled samples, indicating that individuals are relatively patchy on the sea floor. This suggests that *M. giganteus* selectively picks these specimens from the sea floor and breaks their tests open with mandibles. In addition the guts of the larger specimens of *M. giganteus* were filled with scale fragments of ophiuroids. The combined evidence from mandible morphology, gut content, and behaviour suggest that at least some of the large munnopsid isopods are active predators.

Deep-Sea Planktonic Biomass and Biodiversity Using Complementary Methodologies

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Gelatinous organisms are often ignored or underestimated in studies investigating zooplankton biomass and biodiversity, and their importantance in communities and oceanic carbon flux just beginning to be understood. In a census of marine zooplankton off the coast of California, we measured planktonic biomass and biodiversity between the surface and 2500 meters. Organisms from bacteria to jellies were quantified using near synoptic water-bottle casts, two types of opening-closing nets and ROV video transects. Net tows included slow trawls with a special net and cod end in order to collect fragile gelatinous organisms in often ignored taxa (cnidarians, molluscs, worms, etc.). Our preliminary estimates indicate that gelatinous animals are major contributors to midwater diversity and biomass, accounting for over 50% of the biomass (wet weight) at some depths. Our view of ecosystem composition is strongly dependent on the sampling methodology used. MOCNESS nets sampled principally small copepods, while ROV transects detected mainly jellies, and the Tucker trawl captured a broad cross-section of these biota, with many crustaceans and gelata.

Metallothioneins in the hydrothermal vent modioles, *Bathymodiolus azoricus* and *Bathymodiolus thermophilus*

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A high biodiversity occurs at hydrothermal vents. Populations of this environment are often characterised by high densities. Modioles of the *Bathymodiolus* gender (Mytilidae) are present in these peculiar ecosystems where high metal concentrations are found that are generally toxic for animals. In this work, two modioles were studied: *Bathymodiolus azoricus* which is dominant in several hydrothermal vents identified on the Mid Atlantic Ridge and *Bathymodiolus thermophilus* which is common on the Eastern Pacific Ridge. We wondered if these animals may have settled up some peculiar adaptive strategies to colonise such an environment. To understand these adaptive phenomena, we decided to study metallothioneins which are small ubiquist proteins involved in metal metabolism. Their induction by metals has been established in numerous species. The characterization of the metallothionein gene sequences permitted to identify at least two genes (MT-10 and MT-20) in both studied species. Phyletic analyses based on the sequences of these genes emphasized the homology between the two studied modioles and with littoral molluscs. The analysis of the metallothionein gene activity permitted to show the particularism of the hydrothermal modioles. The quantification of the metallothionein levels and the levels of MT mRNA extracted from modioles exposed to different metals in hyperbaric conditions or at atmospheric pressure show that the hypothesis of the induction of metallothionein genes by metal ions emitted in various species is not clearly identified in the hydrothermal modioles. There is no explicit link between the observed stability of the MT mRNA levels and the variations identified in the metallothionein levels. Other mechanisms than those implemented by littoral molluscs may occur to permit the hydrothermal mussels to live in the hydrothermal environment.

Small-scale heterogeneity in the Arctic deep sea: Impact of small coldwater-sponges on the diversity of benthic nematode communities

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Facing the high species richness of deep-sea sediments, the question arises which processes influence species composition, abundance and biomass of benthic communities. Which processes produce and maintain diversity in the deep sea and at what spatial scales do they operate? The

concept that biogenic structures create at a small scale a heterogeneous environment that influences the structure of the communities and the dynamics of the populations of benthic meiofauna organisms provides the background of the study. As an example for biogenic structures, the influence of deep-sea sponges on small-scale distribution patterns of benthic deep-sea nematodes was investigated. The sampling was carried out with the remotely operated ROV "VICTOR 6000" at the deep-sea long-term station "HAUSGARTEN" in 2500 m water depth. To investigate the meiofauna and nematode community patterns three sediment cores around the sponge *Tentorium semisuberites* and three corresponding control cores were analysed. Within the entire nematode community, a total number of approx. 5800 individuals are distributed over 367 species, 92 genera, 31 families and 4 orders. The comparison of the nematode communities from sponge and control samples indicates an influence of the biogenic structure "sponge" on diversity patterns and habitat heterogeneity. The more homogeneous habitat conditions in the control sediments obviously offer less micro-habitats (refuges) respectively ecological niches than the heterogeneous habitat conditions of the sediments around the sponges. This seems to reduce the number of species coexisting in the control sediments. Within the nematode community from the sponge cores, a stronger interaction between the species and a higher diversity seems to allow a larger extend of resource utilisation.

Profiles of pelagic bioluminescence in the water column above over the North Atlantic Mid Ocean Ridge

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The vertical distribution of bioluminescent organisms from the sub surface layer to the sea floor along transects across the Mid Atlantic Ridge was investigated using a downward-looking low-light camera focussed on a mesh impact screen. This profiling system, mounted on a standard CTD rosette, enabled the determination of the number of stimulable bioluminescent sources in the water column. Bioluminescent emissions were observed at all depths but decreased exponentially from the surface. Differences were evident north and south from the subpolar front and excess bioluminescence was observed within a cyclonic eddy in the vicinity of the front.

Recurrent polar submergence of serolid isopods in High Antarctic waters

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The Serolidae evolved in shallow waters around early Gondwana and their phylogeny has been critically influenced by the break-up of Gondwana and the climatic change of the Southern Ocean. A phylogenetic tree based on four nuclear and mitochondrial genes reflects several key points regarding the history and origin of Southern Ocean biodiversity. There is indeed evidence for large scale extinction which eradicated most basal serolid species from the Antarctic shelf, leaving survivors only outside the Southern Ocean on the continental shelves of Australia and South America. This loss of diversity was subsequently compensated by a radiation of Serolidae on the Antarctic shelf during the miocene with Antarctic Serolidae outnumbering tropical and temperate species today. The simultaneous and independent submergence of serolids from the Antarctic shelf into the deep-sea suggests that glacial cycles on the Antarctic shelf have been instrumental not only in shaping the distribution of species but also in the formation of the species itself. The phylogeny of the Serolidae suggests that a substantial part of the Southern hemisphere biodiversity has evolved at high latitudes and under polar conditions with some of it now contributing to the diversity of deep-sea environments at lower latitudes. Recent molecular data indicate that this Antarctic biodiversity may even be underestimated still because many species previously believed to be circumpolar in reality consist of a series of cryptic species.

The Temporal and Spatial Variability in the Meiobenthos at the Arctic Marginal Ice Zone

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Ice edges and associated water column features are key areas of increased productivity in all regions of the Arctic (Smithand Sakshaug, 1990). Stability of the water column and ice edge associated currents allow phytoplankton to be retained in a defined active photosynthetic layer at the margin of the ice (Marshall 1957). In many areas, the ice edge phytoplankton bloom follows the retreat of the ice margin, and can extend to 50 km or more from the ice edge (Smith and Sakshaug 1990). Nine Arctic deep-sea stations (between 1000-5500 m depth) along this Ice Margin have been intensively sampled since the year 2000 by the Alfred-Wegener Institute with RV Polarstern and will be sampled for another 6 years. In this study meiofauna samples of the first five years are analyzed with emphasis on nematode and copepod communities which are identified up to species level. Density, biomass and length-width spectra, diversity (α- and β-diversity) are assessed and linked to biological and physical environmental variables (especially food supply). High nematode and copepod densities were found in the area due to increased sediment bound chloroplastic pigments. Topography of the area, food availability (especially bacteria) and presence of macrofaunal organisms may be important in structuring the meiofaunal communities along the bathymetric gradient. Spatial patchiness, seasonal variations in moment and intensity of the bloom and time lags in response to increased food input hamper a sound interpretation of inter-annual variations. Over 300 nematode and 20 copepod species were found, of which over 90% undescribed.

Mapping deep water habitats on Rockall Bank in view of human use and management of the area

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Rockall Bank is situated in the NE Atlantic Ocean approximately 400km west of Scotland. Despite having a long and interesting political history, biologically it remains largely unexplored. Carbonate mounds discovered in the Southern region of the bank (Logachev, Franken and Kiel Mounds) have received some research attention recently and have been found to support frameworks of the Scleractinian corals *Lophelia pertusa* and *Madrepora occulata*. A number of historical data sources suggest that there are also areas of *Lophelia pertusa* reef in the northern region of Rockall Bank as well as other benthic habitats classed as 'reef' under the EC Habitats Directive. This study investigates the distribution of benthic habitats on central and NE Rockall Bank using sidescan sonar ground-truthed with video and photographic sampling. The results are discussed in relation to the human use of the region in terms of conservation of biodiversity and fisheries management. Positional data obtained from satellite monitoring of vessels (VMS) are considered in relation to areas that may be suitable for notification as Marine Protected Areas (MPAs) under European Law.

Mechanical stimulation of bioluminescence by trawl gear

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The presence of underwater light, whether from daylight illumination in the surface waters or bioluminescence organisms is known to play an important role in visual communication throughout the World's oceans. At shallow depths trawl catch rates and sizes of many species are known to differ depending on light-varying environmental conditions. At greater depths with low or total absence of space light, the ability to visually detect trawl gear is thought to diminish. However, manipulating the visual presence through the use of trawl-mounted artificial illumination is known to alter trawl catches of certain species suggesting visual detection is taking place. Bioluminescence is known to occur readily in response to mechanical stimulation. By using low-light cameras or bathyphotometers, vertical profiles of stimulated bioluminescence have been observed at depths as deep as 4800m with the frequency of events reflecting biomass trends and decreasing approximately exponentially with depth. The occurrence of bioluminescence stimulated by moving fishing gear was investigated using an ultra low-light video camera mounted inside a pelagic and demersal trawl. These observations revealed that trawling is responsible for generating bioluminescent activity. In two Norwegian fjords, the mean number of bioluminescent events per metre of head rope per second were 5.14 ±2.17 m-

1.s-1 and 2.39 ±1.0 m-1.s-1 for a pelagic trawl at ~270 m depth and a demersal trawl at ~500 m depth respectively, travelling at 2-4 knots. By extrapolation of these data, thousands of point-source flashes of bioluminescence occur over the entire mouth of a trawl every second during a tow, considerably increasing its visual presence to fish. The occurrence of bioluminescent flashes on a trawl in deep waters may provide sufficient illumination to permit herding in the absence of ambient space light.

What is characteristic for the deep-sea sponge fauna in the Weddell Sea?

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The bathymetric distribution of Antarctic sponges is markedly different from that along other continents, probably because of the combination of special topographic and hydrographic conditions. Many elsewise shallow-shelf taxa extend to larger depths than expected, and part of the deep-sea fauna ascends onto the slope and outer shelf. During the ANDEEP I and II expeditions (26.01-4.04. 2002), 49 sponge species were taken at depths between 800 m and 5000 m: 29 Demospongiae (1 new sp., 11 new for Antarctica), 4 Calcarea (3 new spp.) and 16 Hexactinellida (5 new spp., 6 new for Antarctica). Several hexactinellid species, originally described only on the basis of a fragment, were re-described and partly revised on the basis of the new and better material (Janussen et al. 2004). Most surprising were the deep-sea Calcarea, reported for the first time in Antarctica, collected during ANDEEP II and III at depths down to 4400 m (Janussen et al. 2003). Since comparably few Calcarea taxa have been described from the Antarctic - and so far none from the Antarctic deep-sea - allmost all of these recently collected calcareous sponges are new species. The eurybathic shelf sponge fauna, mainly Demospongiae, extends down to about 3000 m, and a few deep-sea species (Chondrocladia spp.) were found at shallower depths (800 – 1000 m). Thus, the bathyal sponge fauna in Antarctica is characterized by a mixture of shallow and deep-sea fauna elements. The sponge community of the abyssal plain (4000-5000 m) is fundamentally different from that of the slope: whereas sponges in the bathyal are mostly common shelf species, the abyssal sponge community comprises, at least in certain areas, mainly carnivorous demosponges (Cladorhizidae) and shows affinity to the sponge faunas of other deep-sea areas, notably the Atlantic. During the recent ANDEEP III expedition (21.01.-06.04.2005), large scale transects at depths between 1000 and 5000 m within the following areas were sampled: Cape Basin - Atka Bay, Kapp Norwegia, central Weddell Sea, Powell Basin and Drake Passage. The first evaluation of the sponges points towards several new conclusions: The deep-sea sponge fauna off Kapp Norwegia and in the Weddell Sea differs substantially from that of the adjacent areas (Powell Basin, Drake Passage, Scotia Sea and Cape Basin): The first is highly diverse, rich in Hexactinellida and large eurybathic Demospongiae, whereas the latter comprises almost exclusively tiny (< 5 mm) carnivorous sponges (family Cladorhizidae). The occurrence of a wide-spread fauna of very small sponges in the deep-sea is known from other areas as well, the East Mediterranean (Ilan et al. 2003) and South Atlantic, Angola Basin (Cristobo et al. 2005), the latter belonging to the same family, genus *Chondrocladia*. In the Cape Basin and in the Weddell Sea, we found mainly *Asbestopluma*, probably at least 4 different species, some of which are new to science. Additionally to the Cladorhiszidae, the eurybathic demosponge genus, *Polymastia*, and particularly *P. invaginata*, are very common, especially at the NW-sites of the Weddell Sea. Although calcareous sponges are rare in the Antarctic, So far, we collected 7 deep-sea species, and they seem to constitute a constant component of the fauna. Large size of especially hexactinellid sponges in the Antarctic is not restricted to the shelf areas. At 1000 m stations we got several large Rossellidae, and at 2500 m we collected an Euplectellid sponge (*Malacosaccus coatsi*), formerly reaching more than 60 cm high over the sediment surface on its long stalk. Considering the fact that the filtering sponges play an important role in the pelago-benthic coupling, the ecological significance of Hexactinellida in the deep-sea may be re-considered. The high diversity and considerably large sizes of some Antarctic Demospongiae in the deep-sea are at least to some degree linked with the presence of hart substrates (rocks, dropstones). The deep-sea is insufficiently sampled, also in the Antarctic. Therefore, it is currently not possible to decide to which degree we are dealing with local phenomena of the Weddell Sea or with a general feature of the entire Antarctic Ocean. Literature cited: Cristobo, F. J., Urgorri, V. & Ríos, P. (2005) Three new species of carnivorous deep-sea sponges from DIVA-1 expedition in the Angola Basin (South Atlantic).- Organisms, Diversity & Evolution, 5 (2005): 203-213. Janussen, D., Rapp, H. T. & Tendal, O. S. 2003: A myth vanished: Calcareous sponges are alive and well at abyssal depths.- Deep-Sea Newsletter, 32: 17-19. Janussen, D, Tabachnick K. R. & Tendal O. S 2004: Deep-sea Hexactinellida (Porifera) of the Weddell Sea.- In: A. Brandt and B. Hilbig (eds.) ANDEEP (ANtarctic benthic DEEP-sea) biodiversity: colonization history and recent community patterns: a tribute to Howard L. Sanders, Deep-Sea Research, 51/14-16: 1857-1882.

Temporal and spatial changes in trophic patterns of benthos across the Pakistan Margin: a response to oxygen?

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This study addresses the role of the benthic mega- and macrofauna in carbon cycling in the sedimentary environment, in and below the intense oxygen minimum zone (OMZ) at the Pakistan Margin, Arabian Sea. Little temporal variability was noted in the isotopic signatures of the food sources although $\partial_{13}C$ values of organic matter in surficial sediments became heavier down-slope. Additionally chemosynthetic food sources were identified within the OMZ. Isotopic signatures of foraminifera suggest a dominant food source of phytodetritus and become enriched in $_{13}C$ down-slope, from -23.13‰ at 140 m to -20.32‰ at 1850 m. Variations in $\partial_{13}C$ and $\partial_{15}N$ composition were observed between polychaete feeding guilds and between taxa demonstrating differences in feeding mode and mobility. Most macrofaunal feeding groups display a significant increase in ∂15N with water depth across the OMZ. This may reflect increased reworking of N prior to consumption, the dominance of different feeding guilds at different depths, or selective exploitation of certain biochemical components of the available organic matter. Megafauna were found to have isotopic signatures enriched in $_{13}C$ and $_{15}N$ compared to metazoan macrofauna and foraminifera, implying that smaller organisms are better able to exploit the phytodetritus as a food source. Seasonal differences were also noted in the benthic fauna. Linopherus sp. became enriched in $_{15}N$ by 1.79 ‰ during the late-monsoon, possibly a result of ontogenetic changes. Several species of megafauna became depleted in $_{13}C$ during the late-monsoon, for example Ophiura euryplax by 3.85‰ and a natant decapod by 1.67‰. It is possible that these organisms select for the isotopically depleted lipid-rich component of phytodetritus following its arrival at the sea floor, switching feeding mode during periods of high organic matter flux.

Conservation of the deep-sea biodiversity: information and data needs

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To conserve deep sea biodiversity for conservation or scientific reference purposes, most probably by declaration of a Marine Protected Area by some mechanism, three principle types of information are required: i) data on the location and extent of the feature of interest to enable determination of an appropriate boundary; ii) information on the conservation or scientific interest of the feature to justify its protection; and iii) what sort of management is required in order to protect the feature. For areas within national jurisdictions, it will be primarily the responsibility of national authorities to collate this information and propose protection, but outside national jurisdiction it is likely to be the responsibility of International Conventions to propose such areas, supported by a number of Contracting Parties (countries) to the relevant Convention. In all cases, however, scientific data are needed in order to get action at a national or international level. Mapping of complex deep sea features such as hydrothermal vent fields, seamount habitats, etc., using a number of different and developing acoustic remote sensing techniques provides essential data on location and extent of features to protect. Data obtained by underwater videography and photography, from platforms such as ROVs, towed sledges or landers, combined with direct sampling of soft sediments by grab, ROV or dredge, can be used to identify and map the distribution of benthic species, characterise seabed habitats, and provide information on sediment type. These data can be used to assess the conservation interest of the site, but can also be used to ground validate acoustic maps of seabed types. Analysis in GIS to integrate geophysical and biological data can be performed to develop maps of biotope types. Real data on the sensitivity of the features to damage by types of activities likely to take place on the site are needed, as are data on the intensity and location of such activities. Countries are reluctant to take real action in the absence of real data on specific sites, whether through International Conventions or at a national level, so good data on specific sites is essential to achieve protection of any area.

Population structure and dispersal in deep-sea limpets from the eastern Pacific

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Lepetodrilus limpets (Gastropoda: Lepetodrilidae) are among the most abundant organisms found at eastern Pacific hydrothermal vents. A number of "named" species that co-occur in this region have very similar protoconch morphologies, which suggests that they might also share similar life histories as larvae. If this hypothesis is true, these species should also exhibit parallel patterns of genetic population structure, because they are exposed to the same geographical barriers and physical forces that impede dispersal and gene flow. To test this hypothesis, we examined genetic structure in three "named" species of limpets, *L. ovalis*, *L. pustulosus* and *L. tevnianus*, that co-occur at vents distributed between 21°N and 38°S latitude along the East Pacific Rise, Galapagos Rift and Pacific Antarctic Ridge. DNA sequences from two mitochondrial (*Cytochrome Oxidase I* and *Cytochrome B*) and one nuclear (*Phosphoglucomutase intron*) gene loci were used to assess population structure. In spite of the similarities in protoconch morphology, rates of gene flow in the three taxa are not identical across this region. *Lepetodrilus ovalis* exhibits high rates of gene flow across the entire range, with no evidence for population subdivision. In contrast, *L. pustulosus* and *L. tevnianus* clearly show significant population subdivision. Both species diverge across the Easter Microplate region (17°–31°S), but divergence is greater in *L. pustulosus*. In addition, *L. pustulosus* exhibited a second region of subdivision across the equator. Rates of gene flow among these taxa can be ranked as *L. ovalis* >> *L. tevnianus* > *L. pustulosus*. Therefore, congeneric taxa with very similar larval morphologies can have grossly differing life histories and realized dispersal abilities. Inferences about life history strategies and dispersal potential based on larval shell morphology do not consider potential behavioral differences or local adaptive pressures that might shape the population structure of marine organisms.

Is essential metal requirement of the vent mussel *Bathymodiolus azoricus* enhanced as compared to non-hydrothermal molluscs?

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The hydrothermal mussel *Bathymodiolus azoricus* is naturally exposed to elevated levels of metals typical at their habitat, and thus may have evolved specific metal-handling mechanisms in order to survive under such extreme conditions. It was therefore used as a model organism to study depuration dynamics of essential metals, and results were compared to those reported in non-hydrothermal molluscs from the literature. Tissue specific and size-dependent influences on metal loss (Fe, Cu and Zn) were revealed over a 150-day depuration period, and compared to non-hydrothermal bivalves. Unexpectedly, following transfer of mussels to clean seawater, their metal content diminished, but to a much lesser extent than in bivalves from contaminated sites allowed to depurate. There was indication for organ-to-organ transfer at the onset of depuration, and for the mucus mediated depuration of essential metals. A remarkable feature was the persistence of high Zn concentrations in tissues over 5 months depuration, which indicates that its physiological role in hydrothermal invertebrates is beyond that established in metazoans, and as a consequence, Zn homeostasis here may be genetically set at a range exceeding those reported in non-hydrothermal bivalves.

Impact of organic enrichment on the hydrolytic potential, growth, and diversity of benthic bacterial communities in the deep Arctic Ocean: laboratory and *in situ* experiments

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To assess the effect of organic enrichment on the hydrolytic potential, growth and diversity of sediment-inhabiting bacterial communities from the deep Arctic Ocean, laboratory and *in situ* experiments were accomplished. Surficial sediments from the deep-sea long-term observatory HAUSGARTEN (see Soltwedel et al.) were enriched with chitin and artificial phytodetritus. The analyses during the laboratory experiment were based on the measurement of the enzymatic activities (chitobiase and β-glucosidase). Changes in bacterial abundance and biomass were observed over a period of 28 days. An induction of enzyme production and a slight increase in bacterial abundance was recorded twelve days after chitin enrichment. The addition of phytodetritus did not affect bacterial abundance or the β -glucosidase activity. *In situ* enrichment experiments were conducted at the same station (2400 m water depth) using colonization trays attached to free-falling devices, which were filled with different types of sediment as well as different concentrations of chitin and artificial phytodetritus. There was no significant increase in bacterial abundance or chitobiase activity one week after deployment of the sediments enriched with chitin. However, activity level of β-glucosidase and bacterial abundance showed a visible response to the addition of artificial phytodetritus. While a significant increase in bacterial abundance and chitobiase activity was found for all sediment types enriched with chitin following one year of incubation no such response was found for those enriched with phytodetritus. For the characterization of microbial diversity, we applied the quantitative molecular technique of terminal restriction fragment length polymorphism (T-RFLP). The onging analysis of community T-RFLP patterns should allow to detect potential variations in bacterial community structures.

Heterochrony in the deep-sea: species of Ischnomesidae show progenesis

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Heterochrony may be defined as changes in the relative time of appearance and rate of development of characters already present in ancestors. One type of heterochrony, progenesis, has been observed in species of the deep-sea isopod family Ischnomesidae. Progenesis may be described as an earlier stop than is usually observed in the development of a particular feature. In this case, the development of pereopod VII and the corresponding pereonite are affected, as a phylogenetic trend within the Ischnomesidae. Some species of the family have a seventh peropod and pereonite similar in size to the preceding one. Many species, however, have the last pereonite and leg reduced, while other species have failed to develop these features completely. This trend is most frequent in the genus Haplomesus, where five species lack pereopod VII and pereonite 7 is completely undeveloped, including 2 species, *Haplomesus celticensis* and *Haplomesus hanseni* from the Celtic Sea south west of Ireland and the Argentine Basin, respectively. This syndrome has also been observed in the ischnomesid genus Stylomesus. Similar trends are observed in other deep-sea groups such as the Lipomerinae (Munnopsidae) and non-asellote families such as the Gnathiidae and Anthuridae. The reasons for this trend remain unclear. We can conclude that the current diversity at the higher level of crustaceans is related to their developmental plasticity, so much so, that the heterochronies seen in the deep-sea isopods may bea fundamental evolutionary trend within this group.

Temporal variation in the nutritional condition of deep-sea macrourids in the North-east Atlantic: A seasonal study between 1300 and 4300 m

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The foremost temporal signal to the deep benthos, where temperature and light conditions are relatively constant, is a seasonal pulse of organic carbon sinking from the photic layer. In the Porcupine Seabight region of the NE Atlantic this flux begins during late spring and early summer (Lampitt 1985), though the timing and intensity of the peak varies annually (Newton et al 1994). A rapid response to this nutrient input is most apparent amongst bacteria and benthic meiofauna which can directly utilize the carbon. The question remains as to whether this temporal signal is largely dissipated through the food chain to have little or no effect at higher trophic levels. Extensive investigations of the nutritional condition of macrourid fish in the deep North Pacific suggest that the seasonal influx of carbon is of little or no consequence to generalist scavengers/predators near the top

of the trophic heirarchy (Drazen 2002). However RNA:protein ratios in the white muscle of the armed grenadier *Coryphaenoides armatus* caught at slope depth in the North Atlantic are significantly higher in autumn than in spring, indicating an increased capacity for growth following the flux of phytoplankton to the deep. The spring bloom in the North Atlantic is more intense and widespread than anywhere else in the oceans and is not adequately grazed by zooplankton (Longhurst 1998, Levin and Gooday 2003) It is possible that the seasonal influx of carbon may indeed be a strong enough signal in this ocean to affect, and possibly entrain, aspects of the life cycles of these fish.

Breaking From the Moveable Feast: The Evolution of Prey Choice and Foraging Strategies in the Loosejaw Dragonfishes (Stomiiformes: Stomiidae: Malacosteinae)

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Diel vertical migrations (DVMs) from the mesopelagic during the day to the epipelagic at night is the predominant foraging strategy exhibited by the deep-sea dragonfishes, family Stomiidae. Several authors have suggested that the most derived stomiid subfamily Malacosteinae, or loosejaws, do not employ this strategy. To evaluate these suggestions, the diel vertical distributions of three loosejaw genera (*Photostomias*, *Aristostomias*, and *Malacosteus*) were analyzed from capture records of nearly 300 specimens in the North Atlantic Ocean. To account for broad temporal and geographic scales encountered in this study, local time of capture was transformed to a corrected time representing position in a solar day. Species of *Photostomias* and *Aristostomias* undertake asynchronous DVMs characterized by a residence in the mesopelagic zone during the day and separate migrating and non-migrating subpopulations at night. In species of *Aristostomias*, few specimens were caught in the mesopelagic zone during the day. This suggests that species of this genus bypass the mesopelagic, migrating from below the 1000-m bathycline. In contrast, *Malacosteus niger* was distributed below 600 m and did not regularly migrate to the epipelagic zone. To trace the evolution of these provocative DVM patterns, new insights into the phylogenetic relationships of the loosejaws are brought to bear.

Demersal ichthyofaunal composition in two contrasting productivity regions of the Crozet Plateau

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The Crozet Plateau (Southern Indian Ocean) provides an area of seafloor that despite relative topographic continuity and similar bathymetric and physical profiles receives markedly different nutrient input due to the presence of a steep annual north/south productivity gradient. The region therefore provides an ideal environment for deep-sea benthic biologists to investigate the effect of overlying productivity without the influence of depth and extensive distance between study sites. Demersal ichthyofaunal biodiversity, abundance and biomass at a eutrophic site (M5), 4160 m, depth, and oligotrophic site (M6), 4190 m depth, were sampled by trawl from the research vessel RRS Discovery, December 2005 – January 2006. Demersal fish species richness at both M5 and M6 were equal with 12 demersal fish taxa present in trawls. Between regions the same major taxonomic groups were present, with the macrourids dominating the overall catch in both abundance and biomass. The trawl composition at both sites displayed similar patterns, with the macrourids and *Bathypterois* sp. dominating catches numerically, and the macrourids (particularly *Coryphaenoides* (*Nematonurus*) *armatus*) dominating biomass. Biomass was 375 $kg.km^{-2}$ at site M5 and 199 $kg.km^{-2}$ at site M6 and corresponding abundances were 1300 $fish.km^{-2}$ at M5, and 900 $\mathbf{fish.km^{-2}}$ at M6. Length-weight relationships between M5 and M6 follow similar patterns in more than one species (*Bathypterois* sp. and *Coryphaenoides* sp.) indicating no differences in condition factors and furthermore hepato-somatic indices showed no differences between regions M5 and M6 for *C.* (*N.*) *armatus*. From previous experiments using baited autonomous landers approximate swimming speeds of *C.* (*N.*) *armatus* are known to be 0.05-0.077 $m.s^{-1}$, suggesting that it would take approximately 2 months to swim the 160 nm from the oligotrophic M6 to the eutrophic M5. The prevailing current direction is from M6 to M5, and this combined with the current lack of notable difference in the morphometric data and condition indices leads us to believe that the rattail fishes are transient between the oligotrophic M6 and the eutrophic M5, and do not consider the sharp productivity gradient a barrier to migration. We

thank George Wolff, principal scientist, and the shipboard party, officers and crew, Crozet cruise, RRS Discovery, and acknowledge support from the UK Natural Environment Research Council.

Deepwater polychaete assemblages in the North-Western Ross Sea: are they affected by iceberg disturbance?

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Iceberg disturbance has been identified as the most influential and widespread natural physical disturbance for benthic macrofauna assemblages of Antarctic continental shelves. However, since evidence of substantial ice scour has recently been observed in depths of >200 m in the Northwest region of the Ross Sea, it appears ice scour is also one of the driving forces structuring assemblages in deeper waters. Environmental and biological data were collected during a biodiversity survey in 2004 in the deeper waters of the north-western Ross Sea area between Cape Adare and Cape Hallett. Macrofauna assemblages were sampled by bottom trawl, epibenthic sled and van Veen-camera grab. Acoustic multibeam swathing was carried out to characterise the seabed in the vicinity of the sampling stations. Polychaetes are the taxonomic group thought most likely to be responsive to disturbance and thus we conducted a multivariate analysis of assemblage data of this group, the preliminary results of which are presented here. In order to quantify the influence of iceberg disturbance on polychaete assemblages, indices of ice scour disturbance for benthic macroinvertebrate assemblages - using measures such as scour density, % cover of scours, nearest scour distance - were derived from multibeam data (bathymetry and backscatter) for each sampling station. As well as indices for iceberg disturbance, other environmental parameters (e.g., sediment characteristics, chlorophyll a content of sediment and surface waters, max. bottom current speed) were also included in the analysis to elucidate which environmental and biological factors best explain the observed spatial patterns in polychaete assemblage composition.

Recent bivalve molluscs of the genus Calyptogena (Vesicomyidae): morphology and distribution

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The genus C*alyptogena* includes highly-specialized bivalves living in symbiosis with sulphur-oxidizing bacteria. The genus comprises 10 recent species distributed in the Pacific, Atlantic and Indian Oceans from 489 m to 3136 m. Species of the genus are united by similar conchological and anatomical features and common adaptive strategies. Most species (8) occur in areas with methane seepage. A single species was found at the Piip's Volcano in the Bering Sea, where the geochemical settings are very similar to methane seeps. One more species occurs at a hydrothermal vent, southwest of the caldera of Axial Seamount on the Juan de Fuca Ridge, however quite probably it is not specific to hydrothermal vents but rather restricted to bathymetric depths at which venting also occurs. Most of *Calyptogena* species are distributed along continental margins suggesting that these are major spreading pathways. The earliest fossil records of the *Calyptogena* are dated from the beginning of Miocene in the north-west and north Pacific. Later records from the uppermost Miocene are known from the east Pacific. The earliest fossil records in combination with the observed high diversity of recent species in the north-west Pacific indicate that the genus originates from this area. The modern distribution of *Calyptogena* s.s. suggests that the dispersal of the genus took place from the north-west Pacific in two main directions: to the east Pacific along the continental margin of the North America and to the west into the Indian Ocean via abundant seep sites in the Indo-West Pacific. Colonization of the Atlantic Ocean could take place along the continental margin of Africa.

Unexpected novel lineages of abyssal Metazoa

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The Nematoda are the quintessential deep-sea metazoan, dominating both the meiofaunal and the macrofaunal size classes. The taxonomy of this fauna is largely unknown but studies on formalin fixed data sets using morphological criteria suggest that novel clades exist mostly only at the species level. The genera and families encountered appear to be similar to shallow-water varieties. We amplified 18S rRNA genes from 97 nematode specimens fixed in chilled 95% ethanol sampled from soft sediments in two locations in the central equatorial Pacific; 15^{o}N, 119^{o}W at 4050 m depth, and 9.5^{o}N, 150^{o}W at 5000 m depth. We demonstrate novel phylogenetic lineages at higher taxonomic levels contrary to the morphological evidence. This suggests cryptic clades at higher taxonomic levels. It also has implications for our understanding of the evolution of deep sea fauna.

Bathymetric patterns of free-living nematode diversity in the Aegean Sea, eastern Mediterranean

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Nematode diversity patterns were analysed in relation to surface primary productivity from the littoral and the upper sublittoral down to the bathyal zone of the Aegean Sea. The analysis was done by means of rarefaction curves which showed that there was a non-linear relationship between depth and diversity. Nematode diversity increased gradually from the littoral zone (0 metres) down to the bathyal zone (>1000 m) where the highest diversity was found. Apart from the rarefaction curves, several other diversity indices were calculated, both weighted for species richness and equitability. All of them displayed a similar increasing pattern of diversity with depth. Nematode diversity also showed a positive link with surface primary productivity, which is in agreement with findings from other deep-sea environments. When compared to samples from other areas of the eastern Mediterranean, it appears that nematode diversity starts to decline beyond the bathyal zone thus displaying a parabolic-type distribution pattern which is similar to that reported for many other groups.

Fatty acid analysis reveals the importance of foraminifera in benthic organic matter cycling within an oxygen minimum zone

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Global warming and eutrophication are currently changing the global ocean oxygen regime, driving an expansion of hypoxia in the world oceans. This may lead to an increase in the abundance of organisms which tolerate low-oxygen conditions and an overall decline in global marine biodiversity. With this in mind, community and trophic responses of foraminifera were investigated at two contrasting sites in the upper boundary (140m) and core (300m) of an intense mid-water oxygen minimum zone (OMZ) on the Pakistan Margin, northeast Arabian Sea. Diversity of live foraminifera was low and an opportunistic and highly competitive calcareous species, *Uvigerina* aff. *semiornata*, dominated communities at both of these sites. Fatty acid biomarkers suggest that the diets of foraminifera may vary between species. *Uvigerina* aff. *semiornata* and some other calcareous species ingested a substantial proportion of phytodetrital material, whereas agglutinated species favoured bacteria. Moreover, *Uvigerina* aff. *semiornata*, responded rapidly to a simulated pulse of $_{13}$C-enriched diatom detritus in laboratory and *in situ* pulse-chase experiments at the 140m site following the SW monsoon (dissolved oxygen 0.5 ml $^{l-1}$). This enabled the uptake and processing of organic matter (OM) to be tracked in the foraminiferal cell into individual fatty acids using Gas Chromatography - Mass Spectrometry. *Uvigerina* aff. *semiornata* appears to play a central role in OM cycling on the sea-floor in the upper part of the Pakistan margin OMZ, where dissolved oxygen is 0.5 ml $^{l-1}$. More generally, these results suggest that foraminifera may become key players in benthic OM cycling across increasing areas of the sea-floor, as areas of hypoxia continue to expand in the world's oceans.

Distribution and diversity of cumaceans (Crustacea, Cumacea) in the North Atlantic – effects of the GIF Ridge

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The northernmost part of the North Atlantic is very interesting in regard to zoogeography. The Greenland-Iceland-Faeroe Ridge (the GIF Ridge) with its saddle depth of around 830-860 m shapes the area extensively, separating the deep basins (> 4000 m deep) of the North Atlantic and the Arctic. One of the main characteristics of the area is also the diverse composition of water masses. Previous studies have shown that the Ridge shapes the distribution of many groups of animals and numerous species have their northern- or southern distribution limits at the Ridge. The cumaceans (Crustacea, Peracarida) are an excellent group to evaluate the effects of the Ridge on the distribution of the organisms, being fairly diverse in the area. Cumaceans were studied at more than 100 stations in the North Atlantic as part of the BIOICE project (Benthic Invertebrates of Icelandic Waters). The samples were collected in 19 cruises in the years 1991 to 2004 with a Rothlisberg-Pearcy epibenthic sled. The distribution of cumaceans in the GIF area is very much limited by the Ridge and the associated water masses. Many species of the genus *Campylaspis* occur only at the southern side of the Ridge, in warmer water masses. Several species are limited to colder water masses, but the diversity of deep-water species north of the Ridge is very low. The study supports the notion that the GIF Ridge is one of the most remarkable zoogeographical barriers in the world oceans. The effects of the Ridge may be most pronounced on groups, which occur deep in the North Atlantic proper.

Benthic megafauna distribution at the southeastern Brazilian continental margin: Campos Basin

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Compared to the North Atlantic, the deep-sea ecosystems of the South Atlantic continental margins are little known. Most oceanographic studies done along the Brazilian coast concentrate on the continental shelf down to 100m. As part of the 'Campos Basin Deep Sea Environmental Project/PETROBRAS', this study has aimed to characterize the abundance and diversity, including species richness, of the benthic megafauna sampled at the Brazilian Campos Basin continental margin. During February and August (summer and winter, respectively) 2003, 36 sampling trawls were undertaken using an Otter Trawl Semi-Balloon (OTSB), with a 5.5m^2 opening and 16mm mesh size, at three different depths (1100, 1300 and 1600m). A total area of 1.2 Km^2 was sampled. A high number of taxa have been identified so far (280), but showing low mean density (~0.008 ind.m^{-2}), and low biomass (0.05g.m^{-2}), the former being 10 times lower than values found at depths between 600 to 1600m in other parts of the world. Echinoderms (ophiuroids and asteroids), crustaceans (decapods and isopods) have been the most diverse and abundant groups especially at 1100m. The most abundant species at this depth have been the ophiuroids *Ophiura ljungmani* and *Ophiophycis mirabilis*, and the isopod *Serolis insignis*. Small solitary corals, *Deltocyathus* cf *italicus*, were dominant at 1600m. Various taxa found in the region are considered deep-sea cosmopolitans, and several species have been registered as new occurrences for Brazil (e.g., 38% of the crustaceans and 64% of the sponges). The community composition, richness and abundance at 1100m have been different from those found at 1300 and 1600m. A temporal variation has also been detected, but further studies are necessary to identify which factors have been responsible for differences found in specific composition of the megafauna. It is important to increase the temporal sampling effort and also widen the sampling bathymetric range to better estimate diversity changes in the study area. A continued taxonomic refinement has been carried out, and this should improve comparisons with other regions of the world.

Structure of megafaunal community associated with deep-sea corals on carbonate mounds and distribution at regional scale

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Five carbonate mounds located between 600 and 1000 m depth along the Irish continental margin were explored by the ROV Victor 6000 that revealed large biological communities associated to reef-builders species (*Lophelia pertusa* and *Madrepora oculata*). This ecosystem is often compared to shallow water reefs for its morphological complexity and species diversity but deep sea reef community is still under description. Post-processing of video records along transects using specific Geographic Information System (ArcGis with Ifremer ADELIE extension) allowed spatial description of invertebrate and fish megafaunal community (>5 cm). Geo-refenced and quantitative observations include i) species identified in their environment according to morphology, colours, behaviour, in-situ still photographies and comparison with some samples ii) sedimentary facies and coral cover. Spatial patterns will be presented with an inter-site and intra-site comparison. Subjected to high hydrodynamic disturbance, the coral ecosystem seems to be characterized by species zonation along gradients, like other environments controlled by strong external forces such as intertidal zone or mountain flanks. Indeed, zonation along the mound flanks was observed for sessile organisms like sponges, gorgonians or antipatharians. Influence of coral cover on megafaunal distribution at the mound scale was also tested to search for different species associations on dense living corals, isolated coral patches or coral debris. Community structure at regional scale were compared in order to i) test the hypothesis of an influence of the mound development stages defined from sea bed appearance (Huvenne et al, 2005) and seismic surveys (De Mol et al, 2002) and ii) test potential latitudinal effect. Aggregation of benthic fish species (*Lophius* sp, *Neocythus helgae*, *Helicolenus dactylopterus* and *macrouridae*) will also be presented as another evidence of difference between mounds and relationship with coral reef extension. Several hypotheses to explain differences in faunal distribution, including inter-specific competition for space or resource and succession patterns, are proposed. Ref: De Mol B, Van Rensbergen P, Pillen S, Van Rooij D, McDonnell A, Ivanov M, Swennen R, Henriet JP (2002) Larger deep-water coral banks in the Porcupine Basin, southwest of Ireland.Mar Geol 188: 193-231 Huvenne VAI, Beyer A, de Hass H, Dekindt K, Henriet JP, Kozachenko M, Olu-Le Roy K, Wheeler A. (2005) The sea bed appearence of coral bank provinces in the Porcupine Seabight, NE Atlantic : result from side scan sonar and ROV seabed mapping. In: Freiwald A, Roberts JM (eds) Cold-water Corals and Ecosystems. Springer, Berlin Heidelberg, pp 535-569.

Hydrothermal vent Fauna in the Midatlantic Ridge. Is the Romanche Fracture Zone a biogeographic barrier? Lessons from meiofauna

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The presence of active hydrothermal vents in the north Atlantic Ocean along the Midatlantic Ridge (MAR) is know since several decades. Until now no hydrothermal activity had been reported from the South Atlantic Ocean, thus biogeographic comparisons were made between North Atlantic and Pacific Areas only. Active vent sites were discovered and sampled recently at 5° S and 7°S in the MAR. This leads to the question whether the Romanche Fracture Zone which is the major gap in the Mid-Atlantic Ridge at the equator is a biogeographic barrier for the vent fauna in the Atlantic deep-sea. To answer this question we studied the Meiofauna communities of sites in the North Atlantic (Logachev) and South Atlantic (Turtle Pits and Red Lion). We compared three different components at species level: The Dirivultid Copepods (Siphonostomatoida), which are endemic to vents and associated with vent macrofauna, the benthic Harpacticoid copepods which are not associated with macrofauna and the Nematodes. Results are surprising and will be discussed in a global biogeografic context.

Estimation of microbial and *Bathymodiolus* sp. production at vent sites of the Mid-Atlantic Ridge using a C-flux model

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A carbon flux model was developed for two of the constituents of the trophic chains of Mid-Atlantic Ridge vent sites: microbial populations (methanotrophs and thiotrophs) and *Bathymodiolus*. Model accounts for the uptake of H_2S and CH_4 by B*athymodiolus* and the transfer to symbionts, the oxidation of H_2S and CH_4 by the symbionts and the subsequent energy transfer to *Bathymodiolus*. Flow units are mg $C.l^{-1}.d^{-1}$. Production estimates are calculated by ordinary differential equations, which integrate through time the inputs and outputs for and from each state variable (thiotrophs+ methanotrophs and *Bathymodiolus*). H_2S and CH_4 concentrations available for *Bathymodiolus* filtration and consequently for symbiont oxidations were based on both measured and estimated theoretical values. Predicted microbial production is well within values found in the literature. However, predicted *Bathymodiolus* production is, in general, lower than reported values. One possible explanation for this result may be related with *Bathymodiolus* mixotrophy, which combines both the assimilation of energy resulting from endosymbiont's metabolism, plus the filtration of organic carbon from other sources. The model is used to explore this hypothesis.

The Island Rule and the Evolution of Body Size in the Deep Sea

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When isolated on islands, small-bodied species exhibit gigantism and large-bodied species become dwarfed. Here we test the island rule of body size, in a non-insular but analogous system; shallow and deep-water gastropods from the western Atlantic Ocean. Many species are hypothesized to have colonized the deep sea relatively recently from shallow water following an extinction event in the Cenozoic and undergone substantial body size changes from their hypothesized ancestors. Our results indicate that, consistent with the island rule, gastropod genera with small-bodied shallow-water species have significantly larger deep-sea representatives, while the opposite is true for genera that are large-bodied in shallow water. Bathymetric body size clines within the deep sea are also consistent with predictions based on the island rule. Like islands, the deep sea is characterized by low absolute food availability, leading us to hypothesize that the island rule is a result of selection in a resource poor environment.

Demersal fish assemblages off the Seine and Sedlo seamounts from longline surveys (Northeast Atlantic)

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Data collected during OASIS fish longline surveys were used to describe the demersal and deep-water fish assemblages of the Seine and Sedlo seamounts (Northeast Atlantic) from the summits to the 2000 m depth. A total of 41 fish species from 24 families were caught in Seine seamount (Madeira area) and a total of 30 fish species from 19 families were caught in the Sedlo (Azores area). In general fish fauna have high affinities with the Eastern North Atlantic and Mediterranean Sea, not diverging from those found in the Azores, Madeira and other Macaronesian areas including the Great Meteor seamount. In general, the abundance, the biomass and diversity indices decrease with depth. Abundance and biomass are higher at Sedlo seamount at the interval 700-1200 m and similar to Seine at deeper waters. Reproductive aggregations of *Beryx splendens* and *Epigonus telescopus* were found over Sedlo. Global mean size to increase with depth, with a peak around 1200 m in Sedlo.

Dominant species varies along depth, between seamounts and between longline types. The species *Mora mora* is a ubiquitous and dominating species between the 700 – 1200 in the two seamounts, while the deep-water sharks dominate on the deepest bottoms. In the neritic layer of Seine seamount the species *Trachurus picturatus* dominates, and some typical shelf species of Madeira and Azores islands are absent, which is in agreement with similar seamount areas of the Azores. Main large scale fish assemblages structures follows depth-aligned patterns coincident with the prevailing large scale hydrographic structure of the study areas.

Structure of nematode communities from a deep-sea polymetallic Nodule site

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Meiobenthic samples from 24 deep-sea stations (16 ones outside nodule area (Area I), and 8 within the nodule area (Area II)) were collected using multicorer during the french cruise NODINAUT in the Northeastern Pacific (14 gr 02 min E, 130 gr 07 min W) in May-June 2004. In total, 2022 nematodes were examined belonging to about 250 species from 110 genera and 33 families. Nematode communities in both areas are characterized by a high alignment of biodiversity and high species diversity. In Area I 185 species were found, while 138 species were distinguished in Area II. Mean species number per sample was 36.0± 2.2 (from 19 to 50) in Area I and 36.6± 1.5 (from 33 to 43) in Area II. General Simpson's diversity index was 0.04 (from 0.05 to 0.13 in separate samples) for Area I and 0.04 (from 0.04 to 0.10 in separate samples) for Area II. Species composition considerably varied between areas and bitween sites within each area. The most abundant species in Area I were *Theristus discolensis* (10%), *Desmoscolex* sp. (6%), *Thalassomonhystera* sp. (4%), and *Manganonema* sp.1 (3.5%). In Area II the most abundant species were *Thalassomonhystera* sp. (10%), *Theristus discolensis* (4.3%), *Euchromadora* sp.1 (4%), and *Desmoscolex* sp. (3.8%). The MDS analysis of species abundance using the Bray-Curtis Dissimilarity index showed that there is a good separation between one group of samples from Area I and one group from Area II, there is however also an intermediate group composed of samples from Area I and II. Mean Jaccard's similarity index (for qualititative data) was 0.216 ±0.006 (from 0.083 to 0.333) for Area I and 0.204 ±0.008 (from 0.126 to 0.311) for Area II. The work was supported by CeDAMAr and CoML.

Using biological parameters in a geological model of the Pacific manganese nodule province: Applications for biodiversity preservation

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Abundance and metal content of manganese nodules within the Pacific nodule province are thought to be correlated with biogeochemical processes at the seafloor. In particular, the flux of particulate organic carbon (POC) may influence nodule abundance and grade, because sinking POC is a likely carrier of metals from the surface ocean to abyssal sediments. Thus, seafloor POC flux is potentially a useful proxy for nodule abundance and/or grade to be included in a geological model of nodule formation being developed for use by the International Seabed Authority. Unfortunately, the flux of POC to the abyssal seafloor is very difficult to measure directly. However, because the abyssal seafloor biota is “food limited” and depends on the rain of POC from surface waters, a variety of biological parameters are tightly correlated with seafloor POC in the deep sea. These parameters may, in turn, serve as useful proxies for nodule grade and abundance, and provide important inputs into a predictive geological model of manganese nodules in the deep Pacific. Benthic biological data from published literature, as well as from contracting agencies with mining claims in the nodule region, have been compiled and standardized for inclusion in the model. These data are being incorporated into a GIS system to produce digital maps of parameter values within the nodule province, and to allow geostatistical analysis of relationships with geological parameters, such as nodule abundance and metal content. Data will be synthesized to provide a description of habitat distributions and biogeographical patterns for use in establishing protected areas for preservation of biodiversity. In addition, the database can be used to test predictions regarding processes structuring deep-sea communities and patterns of biodiversity, such as the abyssal sink hypotheses (e.g., Rex et al., 2005).

Developments of Tissue Culture Cell from Deep-Sea Organisms and the Life-Support System "DEEPAQUARIUM" to Keep the Deep-Sea Organismes

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The deep-sea organism, not only a microbe but the multicellular organism lives in deep sea. The relationship of deep-sea environment and deep-sea multicellular organism, especially to clarify about correlations in single cells were the purpose of this research. We carried out the following developments; the capture device of multicellular organisms in deep sea, keep system in captivity under high pressure water, and the optical microscope system for tissue cultured cell observation under high pressure environment. Furthermore, we have tried keeping of the multicellular organism of deep sea under atmospheric pressure environment, development of the primary cultivation of the multicellular tissue and cell of deep sea, and biological response research of the cultured cell under high-pressure environment. The capture device was carried out in the payload pallet of research submersibles, and operating was confirmed. We captured *Simenchelys parasiticus*, *Alvinocaris* shrimp, *Buccinidae* sp. and *Zoarcidae* sp. by using keep-pressure tank from the seabed of deep-sea. The capture which maintained pressure by adjustment of switch valve and improvement of a procedure was 80% of success rate. By the high-pressure environmental keeping experiment for three months using "DEEPAQUARIUM" (equipment which considers keeping as capture of deep-sea organisms), 60% of keeping was possible. The cause of extinction originated in the equipment trouble. Especially the liquid leak of the tank and the circulation unit's, and junction part from the plunger ring by superannuation of a pressurization pump was a fatal problem. "DEEPAQUARIUM" continues to repeat improvement. The primary culture of a fibroblast cell was performed from the fillet of *Simenchelys parasiticus*. The fibroblast cell of *Simenchelys parasiticus* was cultivated by using L-15 medium with 20% FBS. Because of research of a single cell, the tissue culture technology of a cell is required. Optimal temperature of the fibroblast cell of *Simenchelys parasiticus* was 15ºC, and doubling time of cell was $0.02h^{-1}$. We observed cell growth under the high-pressure environment, and tolerance of pressure. New tissue culture cell ($KMHA^{-1}$) is cultivated and kept frozen storage in the laboratory. Functions peculiar to a multicellular organism are cytoskeleton structure formation, specialization, etc. We tried search of a new phenomenon in the environment reproducing deep sea using the cultured cell of experimental animal. We considered correlation of pressure and its structure formation using the nerve cell, which specialized the cytoskeleton.

Long term rearing of deep-sea animals in chemosynthetic ecosystem using artificial hydrothermal vent system

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Keeping deep-sea animals from chemosynthetic ecosystems in captivity is very useful in studying these animals, as researchers can conduct experiments anytime without deep-sea diving cruises. However, the rearing of deep-sea hydrothermal vent animals has been difficult due to problems maintaining high pressure, low pH, H_2S concentration, high $C0_2$ concentration, low dissolved oxygen, no light and low temperature conditions. These are opposite to normal rearing conditions of fishes in aquaria. Hydrothermal vent animals are now being kept and displayed at atmospheric pressure with an artificial hydrothermal vent system in Enoshima Aquarium. The artificial hydrothermal vent system is composed of a heating tank, a hot water outlet with added Na_2S as a source of H_2S, and added CO_2 for chemosynthetic bacteria and pH regulation. When the need arises, a DO control unit is attached. The hydrothermal vent animals that we are now rearing are: The hydrothermal vent crabs Austinograea yunohana (450m, Nikko Seamount, Japan) and A. rodriguezensis (2422m, Rodriguez Triple Junction, Indian Ocean), the galatheid crab Shinkaia crosnieri (1300-1500m, Okinawa Trough, Japan) the vestimentiferan tube worm Lamellibrachia satsuma (100m, Kagoshima Bay and 450-500m, Nikko Seamount), shrimps Opaepele spp. (450m, Nikko Seamount and 1300-1500m, Okinawa Trough), barnacles Neoverruca sp. and Ashinkailepas cf. seephiophila (1300-1500m, Okinawa Trough and 1200m, Myojin Seamount), and tonguefish Symphurus sp. (450m, Nikko Seamount). In the

artificial hydrothermal vent tank, shrimps and crabs have been observed to cluster close to the artificial hydrothermal vent. In particular, large (adult) crabs needed a heat source to live in aquarium over the long-term. Additionally, some species have spawned and hatched in captivity. It is likely higher water temperatures are needed for egg and larval development compared to adult temperature requirements.

Black corals of the Northeastern Atlantic: an overview

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Black corals are only sporadically collected in higher latitudes of the Northern Hemisphere and they are especially rare in the pre-Atlantic sector of Arctic. In contrast, the antipatharian fauna of the north-eastern Atlantic exhibits greater diversity and includes about 25 nominal species. In the cruises of P.P. Shirshov Institute of Oceanology RAS to the Reykjanes Ridge north to the Charlie-Gibbs Fracture Zone three more species of *antipatharians* were identified. An account of newly reported species from the Reykjanes Ridge is given and the patterns of distribution of black corals in the Northeast Atlantic are discussed. Species previously reported from Northeastern Atlantic as *Parantipathes larix* and *Stichopathes gracilis* considered to be new. Most of species of antipatharians of the Northeast Atlantic faunas are panthalassic. At the same time the fauna of open oceanic regions is richer in species than the fauna of near continental regions. The diversity of the antipatharian fauna in the far northern Atlantic near the Arctic is dramatically lower than that further south. Only four species have been reported north of 52º N, whereas 12 are known in the area from Gibraltar to the English Channel, and 15 from the vicinity of the Azores. Work supported by RFFI grant 06-04-48764.

Exploration of Seamounts and Banks in the Northeast Atlantic

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To the west of the UK, the seamounts and banks in the Rockall Trough region of the NE Atlantic were explored in detail for the first time in August – September 2005. Under the auspices of the Department of Trade and Industry, a Strategic Environmental Assessment of Area 7 was undertaken with the aim of sampling seamounts and banks within this area. A second cruise in the region was undertaken by the Fisheries Research Services and the Joint Nature Conservation Committee, adding sampling stations to the areas targeted by the first DTI cruise. Epifaunal diversity and abundance was assessed using drop down camera systems and a sledge system for Anton Dohrn seamount, parts of Rockall Bank, Hatton Bank and George Bligh Bank. Sampling sites ranged in depth from 141 m on Rockall Bank to ca. 1800 m off Anton Dohrn seamount. The diversity and abundance of epifauna varied, with the greatest faunal similarity being found between George Bligh and Hatton Banks at depths of 500-900 m. Extensive areas of reef framework created by Madrepora oculata and Lophelia pertusa were found to support a rich associated sessile epifauna such as the antipatharian corals Leiopathes sp. and Stichopathes sp., hexactinellid sponges and the large anemone Phelliactis sp. The sand plains seen in some areas on the summits of Anton Dohrn and Rockall and George Bligh Banks had low epifaunal diversity and were dominated by echinoids. The exposed areas of bedrock on Anton Dohrn, and to a lesser degree George Bligh Bank, were colonised by barnacles and brachiopods. On Rockall Bank the soft sediment in the southeast was dominated by echinoids and Nephrops burrows, the hard substrata on the eastern section was colonised by encrusting bryozoans and sponges with some L. pertusa reef, whilst the northwest and western regions also supported L. pertusa reef. We would like to thank the DTI, FRS and JNCC for making this data available for us to use.

Degradation and synthesis of $_{13}$C-labeled organic matters by benthic foraminifera and bacteria in bathyal Sagami Bay, Japan

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The fate of organic matter on the deep-sea floor is crucial for understanding carbon cycle in the ocean. Since benthic foraminifera often dominate large biomass on the deep-sea floor, they are expected to play a significant role in organic carbon consumption at the sediment-water interface. Here, we examined the degradation and alteration of organic matters by benthic foraminifera and bacteria by operating in situ $_{13}$C-tracer experiments. The in situ $_{13}$C-tracer experiments were operated in Sagami Bay (water depth 1450m) by supplying $_{13}$C-labeled organic matters (*Dunaliella tertiolecta* as a model of phytodetritus, *Vibrio alginolyticus* as a model of bacteria in the sediments) onto the surface sediments in closed culturing cores. We examined the incorporation of $_{13}$C-labeled carbon into total biomass and each lipid compound extracted from the bulk sediment and benthic foraminiferal cell. Our results demonstrated that the phytodetritus deposited on the seafloor was either degraded by bacteria or fed by foraminifera in few days. On the other hand, different fate of $_{13}$C-labeled bacteria was observed in the sediments, suggesting that organic matter cycling in the sediments is rather complex system.

Bacteria orchestrate metane and metal concentrations in seawater: examples from the Central Indian Ridge

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As part of our studies to explore the occurrence of hydrothermal plumes along a segment (07°40' S and 10°40' S) at the Central Indian Ridge (CIR), the distribution of pertinent physiological groups of bacteria (heterotrophs, metal-tolerant bacteria and nitrifiers) and their relationship with ambient methane and dissolved metal species like manganese were examined. The slow spreading ridge segment with a half spreading rate of 18-21mm yr^{-1}, a 6-10 km wide rift valley floor and neo volcanic zones, is a potential site for hydrothermal activity. As bacterial proxies are more persistent spatially and temporally than physico-chemical signatures of hydrothermal inputs, their distributive patterns were assessed. The retrievability of heterotrophs ranged from Non-detectable (ND) to 9.6 x 10^5 Colony Forming Units (CFU)l^{-1} while that of manganese and cobalt-tolerant forms ranged from ND to 7.6x10^5 CFU l^{-1} and ND to 5.9x10^5 CFU l^{-1} respectively. The abundance of nitrifiers varied from ND to 3.5x10^6 CFU l^{-1}. At CIR, the dissolved methane and manganese ranged from 1.59-6.026nM and 0.15-4.42nM respectively. The distribution of cobalt-tolerant bacteria in the ridge waters covaried with methane concentration ($n=19$; $p<0.05$). Manganese-tolerant bacteria brought about 13% variation ($n=19$; $p<0.1$) in the methane concentrations. These observations suggest a common source for the methane and metals. Nitrifiers were selected as proxies for methane as they can use methane when the level of ammonia is comparatively low. Since nitrifiers share a similar enzyme system for oxidizing ammonia/methane, the relationship between methane and nitrifiers is expected ($n=19$,$p<0.02$). Besides, a significant relation between methane and dissolved manganese ($n=19$, $p<0.1$) strengthens our suggestion that they enter the water column through a common source, probably hydrothermal. These inter-relationships suggest the potential role of bacteria in orchestrating the chemistry of the water column in the Central Indian Ridge.

Bivalvia of the Oxygen Minimum Zone of the Oman Margin

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Bivalvia were collected from trawls and box cores along a transect through the OMZ from 150 m (O_2 at 0.2 ml^{-1}) to 3400 m (O_2 at 3.0 ml^{-1}), with a minimum of O_2 of 0.13ml^{-1} at 400m. Bivalves were found at all depths except around 400-700m. Within the OMZ, (O_2 less than 0.5ml^{-1}) species diversity was low but at the suborder level included Protobranchia, Pteriomorpha, Heterodonta and Anomalodesmata. Families included Nuculidae, Nuculanidae, Mytilidae, Propeamussidae, Crassatellidae, Lucinidae, Thyasiridae, Veneridae, Vesicomyidae and Cuspidariidae. Trophic groups included suspension and deposit feeders, chemotrophs and carnivores. There was no discernable correlation between depth or oxygen concentrations and taxonomic or trophic group. Comparisons between those species from the OMZ and sister taxa from normal marine conditions revealed no morphological adaptations specific to the OMZ environment save for the widespread presence of haemoglobin in the tissues of the OMZ

inhabitants. Comparisons of the taxa inhabiting the Oman OMZ with those from other OMZs indicated that there are no specific OMZ indicators at the supraspecific level. At the species level many are endemic to the OMZ of the North Arabian Sea. Chemosymbiotic taxa, *Lucinoma*, *Thyasira* and *Vesicomya* are partly pre-adapted to exploit the organically enriched environment but are not exclusive to the OMZ. At the abyssal site, oxygen concentrations had risen to 3.0 ml^{-1} and here the bivalve fauna was typical of this deep sea setting with numerous protobranch species but also included the cosmopolitan abyssal suspension feeding species *Limopsis tenella* and *Bentharca asperula* in large numbers.

A phylogenetic hypothesis for the Munnopsidae (Isopoda, Asellota) based on three genes and introduction of new pelagic members

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Munnopsid isopods are uniquely useful for study of diversification in the deep-sea and the evolution of pelagic living. In order to examine these issues, we must first develop a hypothesis of the relationships between members of the family Munnopsidae. My goal is to reconstruct the phylogeny of the Munnopsidae using molecular, morphological and behavioral information with particular focus on resolving the pelagic members of the group. The molecular progress to date is presented with a discussion of the usefulness of three gene sequences: complete nuclear small subunit 18S RNA, D1 region of the large subunit 28S RNA, and partial COI mitochondrial sequences. Sequences are analyzed as separate genes and as a combined dataset, using both parsimony and Bayesian methods. The subfamily Munnopsinae is shown to be monophyletic with members of *Paramunnopsis* most basal. The members of *Syneurycope*, *Acanthocope* and Storthyngurinae form a well-supported clade. The unique, holopelagic *Munneurycope* are shown to be as molecularly divergent from all other Munnopsidae as they are divergent in their morphology and behavior. The clades that appear to be most closely related to the *Munneurycope* are one of the paraphyletic *Eurycope* groups and members of the Bathyopsurinae. Two striking new pelagic munnopsids are described and placed within the reconstructed phylogeny. The implications for the evolution of water-column use are discussed in the relation to the placement of *Munneurycope*, the Munnopsinae, and the two novel munnopsids.

High occurrence of the elasipod holothurian *Penilpidia ludwigi* (von Marenzeller 1893) in bathyal sediment traps moored in a western Mediterranean submarine canyon

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Many specimens of the elasipod holothurian *Penilpidia ludwigi* (von Marenzeller 1893) were found among the swimmers captured by several sediment traps moored above the seafloor in La Fonera submarine canyon (Catalan Sea, north-western Mediterranean) between 1200 and 1700 m depth. This was the only holothurian species trapped and the fifth most abundant swimmer over the whole sampling period (March-November 2001) after copepods, polychaetes, salps and pteropods. This elasipod was mostly caught in Spring (139 specimens collected from late March to early July) during the main downward flux of organic particles in the canyon. This coupling suggests that *Penilpidia* may aggregate during these events making food availability a plausible explanation of the seasonal occurrence. One of the most intriguing aspects of this finding is to know how this non-swimming species reached the mouth of the sediment traps placed 22 metres above the bottom. Resuspension caused by high current speeds and perhaps by trawling activities appear the mechanisms behind this uncommon occurrence. The taxonomic identification of swimmers can provide relevant information on bathyal pelago-benthic populations. This endemic elasipod is recorded for the second time after its description 113 years ago.

Acid-base balance in the deep-sea decapod crab, *Chionoecetes tanneri*: the mediating role of oxygen availability

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The ecological consequences of continued acidification of the oceans due to the influx of carbon dioxide will be based on the physiological responses of marine species to hypercapnia, acidosis, and possibly hypoxia. The individual and interactive effects of these factors are not known well for most marine taxa, and were examined in part for a common deep-sea decapod crab. *Chionecetes tanneri* collected from the Monterey Canyon at depths of ~ 1000 to 1150 m, were held in the laboratory in chronically low (~ 30 µM) matching *in situ* oxygen minimum zone levels), or high (~300 µM) oxygen levels. Acid-base regulatory capacity was tested in each group of crabs by imposition of moderate exercise. Following 5 minutes of forced exercise, crabs were sampled over a 24 h recovery period. One hour post-exercise, crabs held in low oxygen exhibited a combination of respiratory (minor increase in postbranchial blood PCO_2) and metabolic acidoses, resulting in a 0.2 unit depression of postbranchial blood pH. pH remained similarly depressed for 4 h post-exercise, eventually recovering by 24 h. In contrast, crabs held in high oxygen exhibited an elevation (0.15 units) in blood pH caused by a reduction in blood PCO_2. At 24 h post-exercise, these animals retained a slightly elevated blood pH despite a substantial titration of serum bicarbonate (- 5 mM at 24 h) during the recovery period. Similar experiments are underway to assess the role of oxygen availability in mediating response of *C. tanneri* to hypercapnic exposure. The data suggest that *in situ* oxygen level is a critical consideration in determining the potential impacts of predicted future changes in ocean chemistry on deep-sea benthic decapod crustaceans.

Prokaryotic Community Structure in the Benthic Boundary Layer

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The global ocean has an average depth of 3796m and an average temperature of 3.9°C. Such temperatures and pressures, coupled with a severely limiting nutrient supply represent a challenging environment for microorganisms in the deep ocean. Nevertheless, bacteria are relatively abundant and exhibit a high degree of diversity and adaptation to this extreme environment. 3H-Thymidine and 3H-Leucine incorporation assays have shown that microbial communities in the benthic boundary layer of the deep NE Atlantic may exhibit similar levels of in-situ activity (on a cell-specific basis) as those near the surface, and that activity is piezophilic at a community level. This paper will discuss the structure of prokaryotic communities in the abyssal benthic boundary layer, with special reference to spatio-temporal variability. Results of community structure analyses on deep water samples taken in the NE Atlantic will be presented. Most of these samples were taken during the period 1993-1998 (BENGAL and DEEPSEAS projects). Preliminary results from the recent Benthic CROZET cruise in the Southern Indian Ocean (December 2005) will also be discussed. Cloning and sequencing of 16S SSU rRNA genes in conjunction with RFLP, DGGE and T-RFLP analyses revealed a large and diverse community of Eubacteria and Archaea present in deep near-bottom waters. Clone libraries included a wide range of genera but were numerically dominated by a small number of clones representing the α and γ subdivisions of the proteobacteria. Variation in community structure was most obvious when comparing the deep communities with those in intermediate and surface waters. There were strong similarities between the population structures of communities at the same depth, but at different sites in the Atlantic. Temporal changes in community structure were observed, but could not be linked to seasonal events.

Patterns of polychaete biodiversity in the abyssal Pacific - comparison of morphology and molecular results

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Studies of infauna in the manganese nodules zones of the deep sea are aimed at describing how biodiversity changes spatially. The results of these studies are important as they will form the basis of sustainable managment plans for the future exploitation of the mineral resources found there. It is, therefore, critical that we gain an understanding of how b-diversity changes across the abyssal province. To test whether the fauna is widely dispersed or locally endemic, samples from three regions of the Clipperton Clarion Fracture Zone were studied. In addition to morphological assessments a

study was initiated to assess genetic diversity of a few key families of polychaetes. The results presented will compare molecular data with morphological. This is the first attempt at such a comparison from an abyssal system.

Bipolar gene flow in deep-sea Foraminifera

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Biodiversity in deep-sea sediments is extraordinarily rich at a local scale. It is disputable, however, to what extent the high local species richness of abyssal faunas can be extrapolated to larger spatial scales. The accurate assessment of regional and global deep-sea diversity is impeded by a lack of data on dispersal ranges of species at the ocean floor, particularly at the genetic level. To test the capability for long distance dispersal of deep-sea species we examined the genetic diversity of Arctic and Antarctic populations of three common deep-sea rotaliid foraminifera Epistominella exigua, Cibicides wuellerstorfi and Oridorsalis umbonatus collected during recent R/V Polarstern cruises including the ANDEEP II and III campaigns in the Southern Ocean. Our analyses revealed no significant genetic differences between polar populations of the examined morphospecies, even in an extremely variable ITS region of the ribosomal DNA. This result provides strong evidence that a high gene flow occurs between populations of deep-sea species separated by long distances. The genetic homogeneity of Arctic and Antarctic deep-sea foraminifera suggests that deep-sea biodiversity may be more modest at regional and global scales than present estimates suggest.

Habitat conditions of mesopelagic fishes of the Irminger Sea

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Based on the data collected during the two Russian summer research surveys in the Irminger Sea (2003 and 2005), the habitat parameters (depth, temperature and salinity) for the Irminger Sea fishes are considered. The ranges, mean values and values where the highest catches were observed are provided for all fish species. The occurrences of different species to certain water masses were analysed. Relationships between the habitat conditions and the distribution patterns were investigated for some species.

Effects of physical disturbance associated with deep-sea drilling on scavenger activity in temperate and tropical Australia

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Scavengers are a ubiquitious component of deep sea fauna and are frequently found in higher abundance in systems that have been physically disturbed. We have been examining the pattern of scavenger use of disturbed and undisturbed habitats in temperate and tropical Australia. Video surveys have been conducting using the Clansman 2 ROV from the Jack Bates drilling rig in both Bass Straight and the Northwest Shelf. 100 m transects were flown on randomly selected headings using the point of drilling as a reference through areas of heavy, light and no drill spoil. Analysis of Lebenspurren indicates that epibenthic activity was greatest outside the drill spoil area except for the number of hermit crab ploughs in the temperate region and isopod tracks in the tropics, which was greatest at the edge of the drill spoil. Deployments of baited traps outside and inside of the drill spoil area detected similar activity of scavengers and the presence of drill spoil did scavengers in either system. Our results indicate that in bioturbation by scavengers may be an overlooked component of the dispersion of drill spoil within days of the initial disturbance.

The magnitude of prokaryotic diversity in deep-sea sediments

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Until recently, assessment of naturally occurring microbial diversity was impossible because of the inaccuracy of culture-dependent techniques. The development of molecular-based techniques has revolutionized the field of microbial oceanography. Sequencing of rRNA and genes coding for rRNA (rDNA) have greatly enhanced our insights into the phylogeny and taxonomy of bacterial populations. Considering that 71% of the earth's surface has an average depth of 3,800 m, deep-sea environments have attracted much attention because of their ability to host microbial life with exploitation potential. In the present study, by using the distribution of clones in different operational taxonomic units of each clone library originating from various deep-sea surface sediments we make an attempt to estimate the species richness of the different deep-sea environments using the Web-based Rarefaction calculator software. 16S rDNA clone libraries for bacterial communities originating from the South Ionian Sea, Eastern Mediterranean (at a depth of 2,790 m), the Japan Trench (6,400 m), the Suruga Bay (1,159 m) and the Nankai Trough (3,843 m) were used for this analysis. The calculated species richness was much higher for the deep South Ionian Sea station (~ 1306 ± 187) whereas much lower values were recorded for the other stations ranging from 5 ± 1 for the Archaeal clone library to 59 ± 14 for the Bacterial clone library originating from the Japan Trench. A very interesting outcome of this comparison is that in deep sea sediments archaeal diversity was found to be much lower than bacterial diversity reaching maximum values of 5 to 10 species in clone libraries of high coverage. Knowing the phylogeny and occurrence of different bacterial populations is a first step towards understanding the biogeochemical function and ecology of these largely uncultivated microbial communities as well as the extent of genetic diversity that can be found in sediment bacteria across the globe.

Absence of Sharks from the Abyss: Factors Determining Depth limits of Fishes

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In a recent review of global data sets Priede et al (2006) showed that pelagic chondrichthyes are never found deeper that 1500m, the deepest chondrichthyes are demersal species; the shark *Centroscymnus coelolepis* down to 3700m and the deepest ray, *Rajella bigelowi* found down to 4156m. These maximum depths are deeper than the normal depth distribution of the species and chondrichthyes are rare in the abyss at depths greater than 3000m. The reasons for this are not clear since bioenergetic modelling indicates advantages for large for carrion feeders in the abyss (Collins et al. 2005), indeed teleosts such as the grenadiers *Coryphaenoides* (*Nematonurus*) *armatus* are very successful in the abyss. Studies on the Mid Atlantic Ridge indicate remarkable depth fidelity of different species despite steep topography in which mobile species could readily move into different depth strata (King et al. 2006). The absence of sharks in the abyss is discussed in relation to the general phenomenon of depth zonation in deep-sea fauna. Priede IG, Froese R, Bailey DM, Bergstad OA, Collins MA, Dyb JE, Henriques C, Jones EG, King N. (2006). The absence of sharks from abyssal regions of the world's oceans. Proceedings Of The Royal Society B. doi:10.1098/rspb.2005.3461 Collins MA, Bailey DM, Ruxton GD, Priede IG (2005) Trends in body size across an environmental gradient: A differential response in scavenging and non-scavenging demersal deep-sea fish. Proceedings Of The Royal Society B 272: 2051-2057.

Benthic impact experiments in the Clarion-Clipperton Fractura Zone (equatorial NE Pacific): a comparison of meiofaunal responses to seafloor disturbance in two nodule-bearing areas

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In connection with anticipated mining of polymetallic nodules and the necessity to predict the extent of the environmental impact that mining activities will have on the deep-sea ecosystem, field experiments aimed at assessing responses of seafloor communities were carried out in the Clarion-Clipperton field (equatorial NE Pacific), the world's largest polymetallic nodule repository. We are comparing results obtained from the study of meiofaunal responses in two such experiments: the NOAA Benthic Impact Experiment (NOAA BIE) of 1993-1994 and the Interoceanmetal Benthic Impact Experiment (IOM BIE) of 1995-2000. The disturbance in both involved the disruption of the sedimentary cover and the creation of a sediment plume in the water column. Changes in meiofaunal community abundance and structure were followed by comparing data collected prior to and after the disturbance as well as during follow-up cruises. Nematodes and harpacticoid copepods, the two most important meiofaunal components, were identified to the genus level and changes in the composition of the two taxa were compared. Although the meiobenthic abundances did show a post-disturbance reduction in both test series, and some of the samples pointed to a very severe impact, in neither study was the overall decrease statistically significant. The possible reasons are discussed. Taxonomic analyses provided evidence of a high (genus-level) diversity of both nematodes and harpacticoids and pointed to the sensitivity of diversity indicators to sediment disturbance and to events such as episodic phytodetritus sedimentation.

Biodiversity and spatio-temporal variations in the biomass and abundance of non-decapod invertebrates in the bathyal continental margin of the North-western Mediterranean Sea

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The biodiversity and spatio-temporal variations in biomass and abundance of non-decapod bathyal invertebrates were studied in the North-western Mediterranean margin during the RETRO project (1991-1992). Three sites were sampled using the Maireta trawl system: upper canyon (~450 m), middle slope (~650 m) and lower slope (~1200 m). The first two sites are used traditionally by fisheries of the red shrimp *Aristeus antennatus*. The deeper site has not received any fishing impact to date. Three trawls were conducted at each of the sites in four seasons (autumn, winter, spring and summer). The samples were sorted to the species level, counted and weighed. The fishes and decapod crustaceans were analysed in a different study (Sardà et al., 1994). Here, we present the data obtained on the diversity, biomass and abundance of non-decapod invertebrates. A total of 140 species from 12 phyla were described from the 3 study sites. Of these, the Mollusca, Echinodermata, Polychaeta and Cnidaria were the most speciose groups. The echinoderms were dominated by the echinoid *Bryssopsis lyrifera* and in some cases the holothurian *Molpadia musculus*. The molluscs were dominated by cephalopods and gastropods. Mean total biomass and abundance were an order of magnitude higher in the upper canyon site than the middle and lower slope sites. Multifactorial ANOVA comparing the biomass and abundance of each phylum for each depth and each season showed significant differences only in the dominant groups. There were significant differences in the mean biomass of four groups: cnidarians, polychaetes, molluscs and echinoderms. The biomass of cnidarians was significantly higher in the lower site at all seasons, while the biomasses of polychaetes and echinoderms were significantly higher at the upper canyon site. The molluscs presented a high variability, with significant differences caused by site, season and the interaction. There were significant differences in the mean abundance of three groups: polychaetes, molluscs and echinoderms. The 3 groups were more abundant in the upper canyon site. The abundance of polychaetes and echinoderms did not show differences amongst the different seasons, but molluscs were most abundant in autumn. The abundance and biomass of all the non-decapod invertebrates together was significantly lower than that of fishes and decapod crustaceans analysed in a previous study. The role of canyons on the diversity and abundance of invertebrates is discussed.

Genetic diversity within benthic deep-sea Asellota (Crustacea: Isopoda) of the Southern Ocean: opening Pandora`s box?

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Despite its extreme environmental conditions, the deep sea harbours a unique and species-rich fauna. Nevertheless, our knowledge of phylogeny, speciation, radiation and evolution of the animals inhabiting the deep sea is poor. Although the number of specimens brought back from deep-sea expeditions is great, it has often been assumed that the deep-sea environment was homogenous, with communities largely comprised of opportunistic habitat generalists. During the 1960s and 1970s it became apparent that species diversity was much greater than had been expected. Within the crustaceans, the isopods and in particular the Asellota are some of the most numerous and important elements of the abyssal benthos in all oceans. Globally they are one of the most species rich macrobenthic taxa of abyssal plains. This is especially conspicuous in oligotrophic oceanic regions, and their study has led to several hypotheses about the origin of deep-sea taxa and about mechanisms that trigger evolution of high species diversity. Asellotes are usually small animals (less than 10 mm length), of reduced mobility (even though some can swim they very rarely appear in the water column), and they have no pelagic larvae. This probably reduces gene flow and increases the probability for speciation events. However, some morphospecies seem to have a wide distribution. Nonetheless, molecular studies on selected taxa reveal high degrees of genetic variability, supporting the concept of cryptic speciation. Due to the high diversity of deep-sea asellotes molecular methods (DNA barcoding) will become essential for the identification and study of deep-sea biodiversity in the future.

Observations of seeps and inter regional benthic macrofauna on the Northern Australian Continental Slope

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A southern hemisphere biodiscovery program, led by the Australian Institute of Marine Science, has provided opportunities to observe benthic assemblages of macrofauna relative to depth, latitude and coastal proximity at previously unvisited eastern Indian Ocean sites. Surveys extended over ten degrees of latitude and longitude from study sites near North West Cape toward the Timor Sea Shoals region. The Shoals area is a diverse province of submerged formations along the shelf edge that includes many biogenic mounds and mini seamounts that hypothetically at some point in time have been or are still strongly associated with hydrocarbon reserves and seeps. A number of mid-shelf areas in the region have displayed evidence of hydrocarbon seeps and a survey of one such specific site Cornea, (13º 39.26' S, 124º 42.68' E) was included in the project to provide direct observations of an active seep. Within the broader regional exploration program, three main locales hundreds of miles apart were selected as reference sites. Ship based surveys using conventional as well as some unorthodox drop camera techniques provided image data while benthic sleds were deployed to collect voucher specimens. New data is presented on a variety of continental slope habitats, the associated mobile and sedentary macrofauna with trends identified among species composition and abundance in relation to substrate type and depth. Visual evidence is also provided of bubbling methane both at the surface and the seabed along with high bioactivity near seabed plumes. These surveys have produced some of the first in situ observations and records of deeper water seabed macrofauna in this region. Preliminary analysis suggests a trend as depth increases toward more similar benthic community composition at a regional scale, however even at the deeper continental slope sites community differences were observed on a relatively fine spatial scale and appear to be more closely linked to substrate type and local physical environmental conditions. The observations of natural seeps and strong plume activity associated with high bioactivity are significant and as they also occur in relatively shallow water, will lend themselves to future detailed studies of the interaction between hydrocarbons and adjacent biodiversity.

The Bathypelagic Community of the Monterey Canyon

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We used the ROV Tiburon to conduct quantitative video transects at depths between 1000 and 3500 m over the axis of the Monterey Canyon. During 15 dives over three years, we measured the vertical distribution and abundance of the bathypelagic fauna as taxonomic groups, as trophic groups, and by species. Analyses of the data show a repeating pattern of four distinct regions in the vertical plane.

The upper bathypelagic (1 – 1.8 km depth) had the greatest diversity and overall abundance; species diversity and abundance declined in the middle region (1.9 – 2.6 km); then increased again in the lower bathypelagic (2.7 – 3.1 km); and rose substantially in the benthopelagic layer (3.1 – 3.5 km). The principal detritivores in the upper region were copepods, doliolids, larvaceans and the aberrant polychaete Poeobius. In the middle range this trophic category was dominated by Poeobius. In the lower bathypelagic and benthopelagic layers, larvaceans were the primary detritus feeders. Discarded larvacean houses ("sinkers") occurred consistently through the entire water column. Chaetognaths were most abundant in the two upper strata and declined along with their copepod prey at depths below 2.7 km. Diphyid siphonophores occurred throughout the depth range examined, while other siphonophores were discontinuous. Medusae also appeared throughout the water column but there was considerable variability of species with depth. During these dives we discovered a number of "new" animals that differ significantly from their shallower-living relatives.

Trophic relationships of chemosynthetic species and the role of prokaryotic endosymbionts in the nutrition of Solemyidae and Lucinidae bivalves from mud volcanoes in the Gulf of Cadiz

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The specialized benthic communities associated with cold seeps are sustained by rising hydrocarbon-rich fluids that serve as microbial energy sources. The high production of organic carbon sustains high biomasses and typical macro-invertebrates that host chemosynthetic endosymbionts. The endosymbiotic bacteria produce organic matter with hydrogen sulfide and/or methane as the primary energy sources, which are supplied as substrates to their host. The most widespread chemosynthetic species in the mud volcanoes from the Gulf of Cadiz are siboglinid polychaetes (*Siboglinum* sp) and solemyid bivalves (*Acharax* sp) but lucinid and thyasirid bivalves could also be found at some sites. Stable isotopes analyses ($_{13}C$, $_{15}N$, $_{34}S$) of the most conspicuous species collected during TTR14 from Captain Arutyunov, Kidd and Yuma mud volcanoes were carried out aiming to determine trophic relationships. The first results suggests the occurrence of a dual symbiosis in *Sibloginum* sp with the dominance of methanotrophic bacteria and the occurrence of sulphur-oxidizing bacteria in *Acharax* sp. Furthermore 13C values measured in a heterotroph crab (*Monodaeus* cf. *guinotae*), are indicative that chemosynthesis is an important source of primary production to the macro-invertebrate communities in the area. Molecular identification of chemosynthetic prokaryotic endosymbionts associated with Solemyidae (*Acharax* sp.) and Lucinidae bivalves collected from Mercator mud volcano, during TTR15 was carried out using PCR-DGGE analysis of bacterial and archaeal 16S rRNA genes. Bacteria and Archaea were detected in the gills of both species and preliminary results suggest that these bivalves contain a diverse range of prokaryotic endosymbionts, including sulphur-oxidizer related bacteria. Further investigation is being carried out using bacterial and archaeal clone libraries to evaluate the full diversity of endosymbiotic prokaryotes and their role in Solemyidae and Lucinidae bivalve nutrition.

Management of the deep-oceans: Moving from reactive to proactive

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Conservation of the marine environment has traditionally focused on coastal and shallow-water. There has been a perception that the natural resources of the oceans beyond the continental shelves are so vast and widely distributed that there has been little need for regulation of activities that potentially impact deep-sea habitats. These activities include fishing, extraction of mineral resources including oil, dumping, laying of cables and pipelines and scientific research. Fishing, more than any other activity, has been shown to rapidly deplete target populations of deep-sea fish and to seriously impact the benthic environment. Historical dumping has also widely affected the deep sea by altering the nature of the substrates available for benthic organisms. Other activities have also impacted the benthic environment although their geographic extent is limited. Estimating the potential for future acitivities to impact deep-sea communities, populations and species and managing them depends on a

comprehensive knowledge of the distribution of the biota on the continental shelves, abyssal plains and other habitats. Such knowledge depends on synthesis of current data, “gap”-targeted collection of new information, and the modeling of distributions of deep-sea communities. This work inevitably requires new technologies and approaches (e.g. DNA-barcoding) and support of basic scientific activities, such as taxonomy.

Patterns of macro-invertebrate biodiversity on seamounts in the New Zealand region: not quite what you might expect

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Seamounts are prominent and widely distributed features of the New Zealand marine environment, and also the focus of important commercial fisheries and some exploratory mineral mining. Ten seamount-specific voyages were conducted between 1999 and 2004 to sample and characterize the macro-invertebrate assemblages, and their habitat, of forty seamounts throughout the New Zealand region. Samples were taken with the same type of gear at over 200 stations in water depths of ~200 to 3000 m. Over a 1000 benthic macro-invertebrate taxa were recorded. The preliminary results of an analysis of data from this regional sampling will be presented and discussed with respect to ecological theory and the observed patterns of biodiversity. These patterns include those observed for assemblage composition within seamount complexes (a cluster and a chain) and between more geographically isolated seamounts; measures of taxonomic distinctness for taxon groups with different life history characteristics; estimated species richness and environmental heterogeneity; species range size with water depth. Some of these patterns do not appear to conform to ecological theory as currently applied to seamount habitats.

Carbon cycling by deep, northern Gulf of Mexico food webs

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The standing stocks and biological exchanges between the living components of the benthic boundary layer in the northern Gulf of Mexico have been assembled into a hypothetical, interactive food web based on recent cooperative investigations. Estimates of standing stocks of bacteria, Foraminifera, metazoan meiofauna, macrofauna, invertebrate megafauna, and demersal fishes allow comparison of these different stocks, as well as total biomass, across a 3 km depth gradient. The carbon demand of each “size” or functional group has been estimated from models of respiration rate based on size and temperature, supplemented by direct measurements in the laboratory. Total community carbon demand has been constrained by measurements of Sediment Community Oxygen Consumption (SCOC). The rates and stocks have been incorporated into a set of coupled equations that represent carbon flow into and out of the system. A comparison of the upper continental slope food webs (450 to 1000 m depth) with the Sigsbee Abyssal Plain (3.4 to 3.7 km depth) illustrates the distinct decline in all groups with depth. The decline however is more abrupt in the larger forms (fishes and megafauna), resulting in a relative increase in the predominance of smaller sizes (bacteria and meiofauna). Rates and stocks appear to be lower in the deep GoM than at comparable depths on other continental margins where similar comparisons have been made, reflecting modest pelagic production characteristic of the surface waters of the GoM.

Abyssal Megafaunal Community Responses to Interannual Climate Fluctuation in the NE Pacific

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Long-term studies of abyssal ecology have indicated that dominant epibenthic megafaunal populations can undergo order of magnitude shifts in abundance over interannual timescales. The study site (Station M; 4100 m depth; 34°50'N, 123°00'W) has now been shown to experience seasonal, as well as interannual variations in particulate organic carbon flux to the seafloor. The resulting fluctuation in food supply is driven, in part, by changes in surface climate related to the El Niño/Southern Oscillation (ENSO). Abundance and body sizes for the dominant epibenthic megafauna were estimated from fifty-two photographic transects from 1989-2004. Intraspecific correlations between body size and abundance suggest that increases in abundance are associated with increases in the abundance of smaller individuals and size frequency distributions indicate several possible recruitment events. Shifts in size frequency distributions also indicate that growth rates for smaller adult stages could reach several mm per month for some holothuroids and echinoids. Relative abundances, evenness, and species composition also significantly shifted during the study period and the changes are all linked to fluctuation in the sinking food supply. The results provide evidence of niche-based influences on relative abundances. Links between climate-related disequilibria like ENSO and extant communities have now been observed in most parts of the world. Ecological theories that include differential responses to variable resources over time could help elucidate what controls fundamental community descriptors such as relative abundance.

Structure and dynamic of Le Danois Bank deep-sea ecosystem

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Le Danois Bank deep-sea ecosystem is described using a mass-balance model of trophic interactions (Ecopath), in order to understand and quantify the direct and indirect links among component species and estimate the impact of fisheries. The study was based on two multidisciplinary surveys (ECOMARG project, www.ecomarg.net) carried out in the Bank, where endobenthic, epibenthic, suprabenthic, bathyal zooplankton and demersal communities were sampled. Moreover, diets of the main species groups of fish and decapods were analyzed and used to construct the diet matrix. The model has 34 functional groups, corresponding to carnivorous (ichtyophagous, plancktophagous and benthophagous), suspensivorous and detritivorous species of fish and invertebrates also including three detritus groups (marine snow, deposit detritus and fishery discards). Taxonomically speaking 12 trophic groups of fish, 10 groups of crustaceans and 12 of other invertebrates (anthozoans, sponges, echinoderms, molluscs, etc.) were described. Marine snow is the main production input in the Bank. Its importance is mainly due to the low level of feeding pressure on phytoplankton that occurr in the photic layer of the Cantabrian Sea. In consequence, the biomass of suspensivorous groups is higher (41.7%) than deposit feeders ones (11.2%). Besides, planktophagous fish and invertebrates are the second component of this deep-sea ecosystem (26 % of total biomass). The main energy flow is canalized through marine snow, copepods and euphausiids, zooplankton-feeders shrimps, planktophagous fish (myctophids, blue whiting, etc.) and finally large demersal fish. The highest trophic level found (5.6) corresponds to white anglerfish (*Lophius piscatorius*). Summaries are given to illustrate the flow distributions between groups. A significant proportion of biomass of suspensivorous groups is sessile organisms, since they take advantage of the low sedimentary coverage of the rocky structure of the Bank and of the currents that provide them food. These organisms (mainly cnidarians and sponges) show a low ecotrophic efficiency, since they accumulate biomass that does not pass to the following trophic levels. Nevertheless, they form biogenic vulnerable habitats (sponge aggregations, gorgonian fields and cold water corals reefs) that imply the adoption of urgent measures of protection to fishing activities. Nevertheless, the results indicated a low fisheries trophic impact level in relation to the nearby (at 25 km) Cantabrian sea shelf ecosystem.

Habitat complexity, prey availability and other environmental factors determining spatial distribution of epibenthic communities in the Le Danois Bank (Cantabrian Sea, N Spain)

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Le Danois Bank, the most relevant of the Cantabrian seamounts, is constituted by an almost flat surface located at a depth of 450-640 m, slightly sloped to the coast, but separated from the continental shelf by a deeper inner basin (850 m). The integrate study of the benthic-demersal

ecosystem of this bank is the main objective of the ECOMARG project. Demersal fish and large epibenthic fauna were sampled using an otter trawl and smaller epibenthos was sampled with a 3.5 m beam trawl. A clear faunal boundary has been established between the top of the bank (stratum 1= S1) and the inner basin (stratum 2= S2). Whatever the sampling method, epibenthic communities of S2 are richer and more diverse than S1 ones, whereas biomass and abundance values are higher in S1. Otter trawl samples are clearly dominated by fishes in both strata, while beam trawl samples are mostly dominated by filter-feeders, molluscs and brachiopods in S1, and sponges, echinoderms and cnidarians in S2. The top of the bank is typified by the brachiopod *Griphus vitreus*, the bivalve *Limopsis aurita*, and the urchin *Phormosoma placenta*, in beam trawls samples, and by the fishes *Chimaera monstrosa*, *Galeus melastomus*, *Micromesistius poutassou* in otter trawl samples. The inner basin fauna is characterised by the large sponge *Pheronema grayi*, an unidentified antozoan and the fish *Lepidion eques* in beam trawls, and the sharks *Deania calcea* and *G. melastomus*, also together with *L. eques* in otter trawls. Most of these species are indicative of a low fishery impact on the Bank communities (e.g. sponges, macrourids and deep water sharks). These faunal differences are a consequence of the existence of two differential environmental scenarios. The shallowest samples are located at the top of the bank (450-640 m), with higher temperature and lower salinity, and characterised by coarse, medium and fine sands of low organic content. The inner basin samples are the deepest ones (640-1050 m), with lower temperature and higher salinity, characterised by organic-enriched silts. Prey availability varied from S1 to S2, for instance suprabenthos and infauna are higher in S1 while meso-bathypelagic shrimps were more abundant in S2. According to bottom photogrammetry, habitat complexity is higher in S1, where there are a higher proportion of rocky habitats together with the vertical development of sponges and cnidarians populations. On the contrary, the inner basin landscape is characterised by silt beds and its complexity is mostly biogenic (sponges, corals). The relation of fish and crustacean predator species with the availability of prey species is also analysed. Likewise, the links between habitat complexity and richness, diversity and density indices are studied, as well as with the abundance of some species. These analyses show how more complex habitats (S1) are inhabited by a higher number and biomass of suprabenthic, endobenthic and small epibenthic species, which support a higher biomass of predators. On the other hand, higher richness and diversity of deeper S2 could be in relation to its position at a bathymetric boundary between shelf break fauna and upper bathyal fauna, and also because S2 is located close to the head of an important submarine canyon (Lastres canyon).

Integrated In-Situ Approaches to Determine the Role of Fluid Chemistry and Microbial Biofilms on the Colonization and Distribution of Hydrothermal Vent Fauna

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Biologists have long proposed that the chemistry of hydrothermal vent fluids induces settlement of larvae and ultimately controls the distribution and composition of vent fauna. Over the past six years, we have utilized in-situ chemical sensors in conjunction with experimental studies of colonization as well as observational studies of established communities at deep-sea hydrothermal vents. Our experimental work involves studies of how microbial community composition and the development of microbial biofilms at vent openings vary in response to vent fluid chemistry, and potentially facilitate or inhibit the settlement of macrofaunal species; and our observational studies have focused on the spatial and temporal characterization of the fluid chemistry of tubeworm, mussel, and amphipod habitats. We are using time-series studies that combine molecular genetic characterization of microbial communities and metazoan colonists and in situ measurements of fluid at the East Pacific Rise Integrated Study Site and the Galápagos Rift in complementary studies that address temporal scales specific to each site. Colonization substrates (native and non-native basalt panels, blocks, and a combination of panels and blocks) were deployed for periods of days to months with in-situ chemical sensors that recorded H_2, H_2S, pH, and temperature at the EPR and H_2S, O_2, HS-, and temperature at the Galápagos Rift. The position of the settlement substrates and the in-situ chemical sensors was documented using digital time-lapse camera deployments. Preliminary results of the pattern of microbial and metazoan colonization indicate that: 1) microbial biofilms formed on native and non-native basalt substrates in less than two weeks; 2) the species composition of the biofilms notably shifted within three days, and 3) macrofaunal colonization and active grazing on biofilms by limpets began within one week following deployment. Through integrated biological studies with real-time measurements of H_2, H_2S, pH, and temperature, we hope to assess patterns of short-term microbial community development, evaluate the role microbial communities and fluid chemistry play in the

macrofaunal colonization of basalt, and the relative importance of fluid chemistry on structuring the diversity of vent-endemic communities.

Gradients in macrofauna community structure along a latitudinal transect within the Northern Seas region

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The Northern Seas is defined as the region extending north from the Wyville-Thomson Ridge, NE Atlantic to the marginal ice zone off Svalbard. Previous studies investigating the benthic macrofauna within the region have focused on sample collection with various versions of the box-corer. However, it is now well known that both the meiofaunal and macrofaunal communities are under-sampled by the box-corer when compared to communities sampled using the hydraulically dampened multi/mega-corer. Drawing comparisons between previous studies are difficult because of differences in sampling programme design, sampling gear and sample sorting techniques. For this study, replicated quantitative samples were collected using the SMBA multi-corer and NIOZ box-corer in the summer of 2002 from four continental margin stations along a south-north latitudinal transect. Stations were selected at similar depths on the Vøring Plateau, Bear Island Fan, Svalbard Margin and the Yermak Plateau. Changes in macrofauna community abundance and biomass structure were investigated along this latitudinal transect. Results suggest previous studies in the region may have underestimated macrofaunal abundance but not macrofaunal biomass.

Deep-sea benthic community responses to pulsed food supply in the Arctic Ocean

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Polar regions feature prominent ‘hot spots’ of tight pelago–benthic coupling, i.e., certain meso-scale patterns in hydrography and sea-ice cover, which regionally enhance pelagic and/or sympagic primary production and the food supply to the increased production in ice-covered seas. Several studies in both Arctic and Antarctic waters have demonstrated that a large amount of the organic matter produced in the marginal ice zones tends to sink out of the euphotic layer in strongly pulsed sedimentation events and is thus exported as potential food for the benthos. Recourses for those strong offspring of particulate organic matter are not only phytoplanktonic ice-edge related blooms in a classic manner but also huge mats of under ice algae. These mats detach from melting ice floes and promote a strong pelago-benthic coupling because of their rapid sedimentation through the water column. Decomposed large animal carcasses may act as a further source delivering large pulses of organic material to the seafloor. All these described food-fall events are spatially and temporally highly discrete and thus hardly to detect in the deep-sea realm. So we deployed two deep-sea landers at 2500m and 5500m water-depth to allow comparisons of the changes in two totally different deep-sea habitats as a reaction on the food input. Both landers were equipped with one half of a sagitally sectioned whale carcass (porpoise, *Phocoena phocoena*) and with a huge plastic ring filled up with a fluid of phytoplanktonic algae simulating a massive food pulse on the deep-sea floor. The observation by time-lapse camera-systems, mounted on the lander frames, allowed insights about the speed of food consumption and about the epibenthic scavengers itself. After almost three weeks of deployment, we revisited the experimental setups with the remotely operated vehicle VICTOR 6000 and performed an extensive targeted sediment-sampling. This paper presents the results of both experimental setups turning the attention especially to the different community reactions of the smallest benthic organisms on the deployed food-falls at mid slope depths (2500m) and at Arctic’s abyssal Molloy Deep (5500m).

Megabenthos diversity in submarine canyons: aspects of sponge richness and distributions in deep-sea canyons off Tasmania (Australia)

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Submarine canyons are spectacular topographical features that intersect the margins of the world's oceans. Canyons comprise unique habitats in terms of complexity, instability, material processing (e.g. conduits of particle exchange and accumulation) and hydrodynamics. They may also harbor diverse benthic assemblages similar to the conventional wisdom of the speciose deep seafloor. Yet, quantitative data on the diversity of the megabenthos in canyons are scant. Consequently, we documented the diversity of sponges (a key- and dominant group of the megabenthos) in five submarine canyons off Tasmania at depths from 95 to 525 m. Richness of the fauna derived from a series of dredge hauls was remarkable: Demospongiae comprised the bulk of the fauna (92 % of specimens) and were represented by 160 species, 68 genera, 40 families, and 10 orders, while Calcarea were much less diverse at 13 species. The canyons were characterized by high topographical complexity and substrate diversity, resulting in a mosaic of habitat patches with different environmental conditions. This habitat diversity translated into a patchwork of distinct sponge assemblages that were characterized by i) high species turnover (beta diversity) both between sites in single canyons and between canyons, and ii) extremely compressed geographic ranges of most species ('spot endemics'). We complemented the physical collections (bottom dredges) with photographic (high-resolution still and video) transects to describe small-scale patterns of distribution and diversity. These image-based techniques showed sharp spikes in local diversity and abundance often over very narrow depth bands. These patches are likely generated by localized changes in topographic and sedimentary features, and possibly the occurrence of other benthic groups such as bryozoans. The non-destructive, image-based methods thus revealed patterns at a finer grain than physical collections with towed gear can. By contrast, they suffer from low taxonomic resolution that may limit their scope in documenting taxonomic diversity on a regional scale, but may be efficient tools to broadly characterize the benthos when rapid assessments are required.

Deep-sea downunder, species richness, habitat and distributional patterns of New Zealand squat lobsters (Chirostylidae, Anomura, Crustacea)

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Members of the anomuran family Chirostylidae (squat lobsters or pinch bugs) most commonly live at depths beyond the continental shelves and are found along slopes, ridge systems and seamounts of all oceans. They can be a conspicuous and ecologically significant component of the local fauna, most notably in areas with deep-water coral where they are often found clinging among the branches. More than 180 species in six genera are known worldwide, of which only 22 in three genera occur in the Atlantic. Of the remaining species, 124 are distributed in the western Pacific. Despite this apparent diversity, only seven species have so far been recorded in New Zealand waters (five of which are considered endemic). This study is the first comprehensive effort to identify and document the chirostylid fauna in New Zealand and adjacent waters based on collections taken since the 1950s. So far, 64 species have been found, spanning a wide range of water depths and benthic habitats. New records include widespread Indo-Pacific species as well as range extensions of species previously known only from Australia, New Caledonia or Fiji. In addition, possibly half of the species appear to be new to science and potentially endemic to New Zealand highlighting the lack of knowledge of New Zealand's offshore macrofauna. A geographical analysis of the species distribution shows a number of patterns related to habitat and depth as well as a north–south gradient of species richness with the most diverse fauna along the ridges, seamount chains and in proximity to active hydrothermal vents north of New Zealand. In contrast only seven species have been collected south of 45°S, indicating a latitudinal gradient potentially influenced by surface primary production and cold Antarctic deep-water currents.

The polychaetes of the Antarctic deep sea - results of the expedition ANDEEP I/II, 2002, to the Scotia and Weddell Seas

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The abyssal plains of the Southern Ocean belong to the least explored parts of the earth. The expedition ANDEEP I/II in 2002 was designed to get a first insight into the community structure of the micro-, meio-, macro-and megabenthos. Samples from depths rangin from 753–6333 m were taken along transects in the Scotia and Weddell Seas. International specialists are since analyzing the samples and identifying the different taxa. As a part of this effort 13 selected polychaete families from 10 epibenthic sledge samples were identified to species level, and first studies on biodiversity, ecology and zoogeography were carried out. When selecting the families emphasis was laid upon high species abundance within these families and the coverage of all benthic life strategies except parasitism. This way the influence of abiotic factors, such as sediment type and depth on the distribution of species shall be observed. As for most macrobenthic organisms only few studies have yet been carried out on deep-sea polychaetes, especially on those from the Southern Ocean. The Polychaeta however are one of the numerial dominant taxa in abyssal depths. The knowledge on this group is therefore of major importance to understand and categorize macrobenthic communities. In the Southern Ocean this knowledge can contribute substantially to the reconstruction of the origin of the deep Antarctic fauna. Before this background the species richness and distribution of the identified polychaete species are presented. Possible connections to depth, sediment structure and Pacific/ Atlantic zoogeographical influences are discussed.

Whale-fall communities, whaling and species extinctions at the deep-sea floor

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Dead whales are the largest, most energy-rich detrital particles in the ocean (typically containing >1 million grams of organic carbon) and form persistent, energy-rich habitat islands at the deep-sea floor. Whale-sinking experiments demonstrate that whale falls in the bathyal northeast Pacific can support a succession of communities, with enrichment opportunist and sulphophilic stages lasting for years to many decades. There is evidence that adapative radiation may have occurred in whale-fall habitats within the bone-eating siboglinid genus *Osedax* (> 7 species) and the polychaete family Dorvilleidae (possibly 15 new species at whale falls). At most recent count, 28 macrofaunal species and three new genera are known only from whale falls, and we review the evidence that these may be whale-fall endemics. Commercial whaling drastically reduced the populations of large whales in all oceans, and decreased the abundance of whale-fall habitats at the deep-sea floor. We trace the temporal pattern of whale exploitation in the various oceans, and model the effects of whaling on the abundance of deep-sea whale falls over time. We then use conservation biology theory, including species-area relationships and metapopulation modeling, to explore the potential for species extinctions of whale-fall specialists resulting from whaling. We find that species extinctions among deep-sea whale-fall specialists are likely to be most severe in the North Atlantic where great whales were decimated in the 1800's, and may be ongoing in the Southern Ocean and northeast Pacific, where intense whaling occurred into the 1960's and 1970's.

Sequential frame analysis of fishes associated with Lophelia reefs in the Gulf of Mexico

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Frame grab software was employed to convert continuous submersible video to a sequence of still images of known area. Serial images from standardized timed submersible transects were scored for quantitative analyses of relative abundance and abundance per unit area of the demersal fishes of *Lophelia pertusa* and hardground habitats in the northern Gulf of Mexico. This quantitative analysis is the first for the fish fauna associated with *Lophelia* reefs in the western North Atlantic region. The fauna analyzed from video frames consisted of 38 demersal fish species, apportioned into two distinct

bathymetric groups (at 325 and 500 m). Dominant taxa determined from video frame analyses included Stromateidae, Serranidae, Trachichthyidae, Congridae, Scorpaenidae and Gadiformes. The zeiform micro-predator, *Grammicolepis brachiusculus*, was important over *Lophelia* reef habitat at the deeper horizon and may be reef-dependent. Typical soft-substrate open-slope taxa (e.g., Macrouridae and Squalidae) began to replace hardground species on the deeper horizon. Large mobile predators dependent on visual foraging were limited mainly to the shallower horizon. Sit-and-wait and hover-and-wait strategists (e.g., Scorpaenidae, Congridae, Trachichthyida) predominated at both depth horizons, along with generalized foragers (Gadiformes). Although *Lophelia* thickets were extensively developed on the deeper depth horizon, fish abundance was low, only 95 fish/hectare.

Dynamics of epibenthic megafauna on the deep West Antarctic Peninsula shelf viewed from time-lapse photography

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The deep West Antarctic Peninsula shelf is characterized by an intense deposition of phytodetritus during spring/summer months. We deployed a time-lapse camera at 600 m depth for a period of nearly one and a half year in order to observe the dynamics of epibenthic megafauna in response to the arrival of organic matter at the seafloor. Photographs were taken every 12 or 24 hours and the camera array was recovered and deployed every 3 months during five cruises to Antarctica on board RV Laurence M. Gould and RV Nathaniel B. Palmer from November 1999 to March 2001. Density and movement rates were measured for the main epibenthic megafauna, including holothurians and sea urchins. Identifiable echinoderm species included the echinoids *Amphipneustes* spp. and *Ctenocidaris perrieri* and the elasipod holothurians *Protelpidia murrayi* and *Peniagone vignoni*. The latter were the most abundant megafaunal organisms in the area and important surface deposit feeding species. Fecal cast production, including total number, size and volume, was estimated for *P. murrayi* as a measure of feeding intensity and sediment reworking capabilities. Mean life times of fecal casts were measured in order to have an estimate of the time microtopographic features persist on the bottom. The phytodetritus arrival at the seafloor was qualitatively measured. There was no apparent deposition of phytodetritus from spring/summer 1999/2000 to winter/2000. A huge pulse of phytodetritus was observed on spring/summer 2001 on photographs, corroborating data gathered from sediment traps and megacorers.

Bathypelagic fish association with the Mid-Atlantic Ridge

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The bathypelagic zone, Earth's largest living space, is essentially boundless in three dimensions for most of its extent, structured only by fluid features (e.g., salinity, temperature) of the seawater itself. However, near certain topographic features this zone intersects the seafloor. The mid-ocean ridge system is by far the largest of these features. Unlike the ecosystems of the continental margins, the mid-ocean ridge systems do not receive terrigenous nutrient inputs. Thus, the deep-water fauna associated with mid-ocean ridges ultimately depend on the generally limited local surface production. Despite this limited surface production, there is evidence that near-ridge demersal fish biomass is increased above the mid-Atlantic Ridge (MAR). Two processes by which organic matter can be transferred to the benthic boundary layer include: 1) sinking of aggregates and the carcasses of larger animals, and 2) vertical migration of living animals. To understand the dynamics of the latter process, deep-pelagic and demersal fishes were studied during the 2004 G.O. Sars Expedition, a field campaign of MAR-ECO. MAR-ECO, a Census of Marine Life project, is an international study of the animals inhabiting the northern Mid-Atlantic. Utilizing multiple technologies the water column (to 3500 m) and benthic realms were sampled. Taxonomic analysis to date has revealed over 300 fish species, with ongoing analysis expected to reveal more species, some new to science. Pelagic sampling collected 207 species, with typical orders dominating. Bottom trawling collected ca. 175 species, with typical demersal families, but also pelagic families occurring in numbers higher than would be

expected by contamination alone. Discrete, near-bottom pelagic trawls confirmed this observation. In all, 84 species were caught in both pelagic and bottom trawls, with some species showing enhanced abundances in the near-bottom boundary layer, suggesting that overlap of deep-pelagic and demersal faunas is likely a key process regulating mid-ocean ridge community structure.

The deep-sea connection: past climate change and the colonization of Antarctica

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Living in Earth's largest freezer has challenged marine life since the onset of Antarctic cooling as late as about 35 million years ago. As a consequence of Antarctic cooling, many taxa became extinct or were strongly reduced in diversity due to their failure to adapt their physiology and life history to the selective harsh polar conditions. In particular the disappearance of large pelagic and benthic predators, such as sharks, skates, teleost fish, and true crabs, has contributed to the unique benthic community structure characteristic of today's shallow and deep waters in Antarctica. Despite a general overview of the long-term consequences of Antarctic cooling on marine biodiversity at southern high latitudes, our understanding of the effects of climate oscillation at shorter Milankovitch timescale of thousands of years, characterized in glacial-interglacial cycles, on Antarctic ecosystems is far from being understood. During the present interglacial, iceberg-scouring reaching down to about 500 m on the Antarctic continental shelf is the main physical impact, locally devastating benthic communities. Contrarily, it is now becoming evident, from geology and geophysics that during past glacial periods the physical impact of ice was an order of magnitude than seen today. The glacial periods were a time of mass destruction, as continental ice sheets advancing across the continental shelf wiped out whole seafloor communities, whilst mass wasting and turbidity flows around Antarctica impacted the continental slope fauna. Previously, it was assumed that whole seafloor ecosystems somehow dodged extinction by re-colonizing from nearby habitats such as the Antarctic continental slope that had escaped obliteration. It is now postulated that most benthic animals might have only been able to survive in deep-sea shelters or around Southern Ocean islands, facilitated by floating life history stages or active adult migration. Some species might have survived in local shelters of the Antarctic continental shelf, considering that ice advance and retreat must have taken place indeed diachronously. However, due to permanent sea ice cover, such shelters exposed environmental conditions similar to those of the deep sea (except pressure) and should have required similar ecophysiological adaptations.

Protection of Scientific Investments - Science Priority Areas

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Attested right is the freedom of the high seas and this pertains to much of the deep sea, concerning both, the seafloor and/or the water column. Although the area is of enormous dimensions, competition for space may occur and may disturb scientific investments. Various stakeholders may be interested in the same region, but prior consultations and advance notices should allow settled regulations. Particularly for studies with repeated observations and measurements at permanent stations and with long-term character specific provisions should be accepted. Science Priority Areas (SPAs) should be established to secure scientific investments like installations of technical equipment, but also to warrant undisturbed natural conditions. Research in the deep sea and beyond national jurisdiction is supported by national funding organizations and also requested by the United Nations Convention on the Law of the Sea. In the interest of society at large, scientists are responsible to secure optimal results from the intrinsically high investments. Other stakeholders may come from the mining, oil and gas drilling or fishing industries, from industrial and community waste treatment, but also from nature protection, a well justified goal. Within less than a decade many Marine Protected Areas may be established, and the NGOs strive for the protection of 20 - 30 % of the oceans. This may severely limit scientific activities, because the knowledge necessary for the establishment of Marine Protected Areas (MPAs) covers only a rather small area in total. Science as stakeholder with the interest in deep-sea regions beyond national jurisdiction should be aware of such effects, establish Science Priority Areas and organize them independently from Marine Protected Areas. A special legal status needs to be proposed to and applied for at various discussion and decision levels of the United Nations.

Simulated sequestration of industrial carbon dioxide at a deep-sea site: effects on species of harpacticoid copepods

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Global warming could be alleviated by sequestering large amounts of industrial carbon dioxide on the deep-sea floor, but the environmental consequences are poorly known, in particular, for animals living in the sediment. During an experimental sequestration off northern California (36.378° N, 122.676° W, 3262 m depth), ~80% of the individuals of our target taxon (the harpacticoid copepods) were killed, but some survived. Because knowledge of which species survived and how they did so could clarify the effects of sequestration on the fauna, we identified the individuals to species. Although most were adversely affected, species differed significantly in the degree of their susceptibility. Unexpectedly, six species showed no effect and may be resistant. The hypothesis that harpacticoids could escape the effects of carbon dioxide-rich seawater by moving deeper into the seabed was not supported. Exposure to carbon dioxide-rich seawater created an area where most of the harpacticoids (and perhaps other taxa) were killed, but we found no evidence that disturbance-exploiting harpacticoid species invaded during the recovery of the affected area. Because the environmental effects of the carbon dioxide (e.g. unusually acidic pore water) were still present, however, the opportunity for invasion might not yet have occurred. Differences among species in susceptibility increase the complexity of the effects of carbon dioxide sequestration on the deep-sea fauna.

Predicting global habitat suitability for Scleractinian corals on seamounts

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Our understanding of the factors that drive the distributon of deep-sea corals on seamounts is limited due to the relative paucity of sampling. Range modelling techniques allow us to use the data that we do have to (1) examine which factors are important in driving the distribution of these organisms on seamounts, and (2) produce predictive maps of habitat suitability. We examine global habitat suitability for Scleractinian corals (the best sampled coral taxonomic group) on seamounts using Environmental Niche Factor Analysis (ENFA), a range modelling technique requiring only presence data, and thus suitable for data-limited systems. We then use spatial regression to model the fit of habitat suitability to seamount fishery catches in order to assess likely impacts.

An emergent fungal epizootic in hydrothermal vent mussels

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Pathogenic black yeast infections of mussels at hydrothermal vents in Fiji Basin represent the early stages of an epizootic event that is likely to result in massive mussel mortality and to alter the nature of primary production in the vent field. The fungal disease progresses from a brown-spot stage, where mantle tissues are locally infected with fungus, to a black-body stage in which dense populations of microscopic fungal blastoconidia infect mussel connective tissues throughout the body. The disease agent is related to ascomycetes that are ubiquitous and sometimes pathogenic in shallow-marine, freshwater, and terrestrial environments. The fungus so far appears to be specific to mussels; it has not been observed in histological examination of mussel-associated invertebrates, including other large mollusks at the vent site (*Alviniconcha hessleri*, *Ifremeria desbruyeresi*), scale worms commensal with the mussels (*Branchipolynoe* sp.), and the dominant polychaete (*Amphisamytha* sp.) and limpet (*Lepetodrilus schrolli*) in the mussel-bed assemblage. Movement of submersible assets

from site to site has the potential to accelerate the spread of this and other marine pathogens and microorganisms in the deep sea.

Long-distance larval dispersal of the cold-seep gastropod *Bathynerita naticoidea*

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Bathynerita naticoidea (Gastropoda: Neritacea) is a bathyal species endemic to hydrocarbon seeps in the Gulf of Mexico and the Barbados accretionary prism at depths from 400-1700m. Cold seeps in this region are isolated habitats separated by tens to hundreds of kilometers. A previous study of *Bathynerita naticoidea* development provided evidence that this species undergoes direct development and hatches from capsules as crawl-away juveniles. However, direct development provides no obvious mechanism for the colonization of new seeps or for genetic exchange among existing seeps. This conundrum led to a reinvestigation of the early development and larval ecology of *Bathynerita naticoidea*. Egg capsules are deposited seasonally. Encapsulated embryos develop for four months at ambient temperatures of 7 to 8 ºC then hatch as swimming veligers in the spring. Veliger larvae can swim vertically at speeds up to 0.14 cm/s. Larvae were collected in MOCNESS plankton tows in February 2003 in the top 100m of the water column, suggesting that larvae may disperse for at least one year in the plankton. Larvae from the surface collections are morphologically identical to those collected in sediment traps on the sea floor and indicate that this species triples in size during dispersal. Veligers are tolerant of temperatures up to 30 ºC and a range of salinities from 15 to 60 ppt. The teleplanic dispersal capability, broad geographic distribution, presence of larvae in the upper water column and wide physiological tolerances of *Bathynerita naticoidea* suggest the potential for long distance dispersal, and provide strong evidence for ontogenetic vertical migration.

Meiofauna at deep-sea cold seeps: diversity, adaptation and trophic position

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While megafaunal seep communities are relatively well described, studies on seep meiofauna are scarse and have been restricted to bulk measurement of abundance, biomass of major taxa to examine patterns of diversity or composition. Our present work on the methane-seeping Haakon Mosby Mud Volcano (HMMV, SW Barents Sea slope, 1280 m) and the seep site of the Angola Basin (South Atlantic Ocean, 3150 m) describes the metazoan meiofauna in different sub-habitats at two isolated seep areas. Based on these studies and previous investigations at seeps and hydrothermal vents, we try to answer the following questions: 1) What is driving the biological patchiness at seeps? At HMMV, one single nematode species (*Geomonhystera* sp.) was thriving with extremely high numbers in the bacterial mat site. At the Angola Basin, the seep site seemed to be dominated by another nematode genus (*Sabatieria*). 2) What is the trophic position of the meiofauna? Stable carbon isotope analyses of the HMMV meiofauna revealed a trophic link with chemosynthetically derived food sources. 3) How is the meiofauna adapted to the extreme seep conditions? The ovoviviparous reproduction of Geomonhystera sp. at HMMV has been identified as an important adaptation of parents securing the survival and development of their brood in this anoxic environment. Recently made transmission electron microscopy photographs of this species revealed endosymbiotic bacteria, which could be a detoxification mechanism for the high sulphide levels in the sediment. 4) What is the origin of seep-meiofauna species? Therefore the fauna from different locations worldwide is compared, in addition to the fauna from adjacent less extremer sites in order to estimate the importance of local adaptation and the distribution of taxa. Apparantly no particular meiobenthic taxon can be found in all the various reduced seeps across the oceans, indicating a high degree of endemism and suggesting a large impact of processes of local adaptation.

Deep-sea Bioturbation and the Role of the Sea Urchin *Echinocrepis rostrata*

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One of the most active and abundant epibenthic organisms found at abyssal depths in the eastern North Pacific is *Echinocrepis rostrata*, an irregular sea urchin with three distinct morphotypes ranging in observed widths from 50 to 150 mm. This animal mediates bioturbation through its locomotion and feeding behaviors, which create visible and distinctive trails centimeters deep in the sediment that can persist for weeks to months (Kaufmann and Smith 1997). A recent study (Ruhl and Smith 2004) has shown that *Echinocrepis* species were more abundant during 2001-2002 compared to previous years, which may be linked to the effects of climate on surface productivity. Ongoing studies using a long-term time-lapse photographic archive, new ROV-placed time-lapse camera deployments, sediment mixing analysis and genetic comparisons of morphotypes will allow further quantification of changes in deep-sea bioturbation processes with surface and water column processes. Specifically, this research examines the differences between the *Echinocrepis* morphotypes, whether bioturbation rates and feeding strategies of *Echinocrepis* sea urchins at Station M change significantly over time, and if any changes are correlated to food supply.

Sex-ratio in the deep sea – a paradise for male copepods?

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There exists a variety of studies which discuss the sex-ratio of benthic copepods in the deep sea. A tendency towards a dominance of females has been reported by several authors until now and explanations range from ecological to sampling-technique influences: Samples biased highly towards a female dominance might be artefacts caused by the use of inadequate sampling gear which creates strong bow-wave effects. A selective displacement of the normally smaller males might be the result. On the other hand published data from multicorer-samplings, a device with reduced bow-wave effect, do support the assumption that selective predation on males or even parthenogenesis in some families might be the reason for the biased sex-ratio. Our data stem from two 5400 m deep stations in the Angola Basin where samples have been collected during the DIVA 1 cruise (CeDAMar) in 2000. Altogether 75 sediment cores containing 7087 Harpacticoida (2222 adults) were examined. These animals belonged to 673 species with overwhelming 99,4 % of the species new to science, as was detected for another study by a team of 8 specialists. Similar mean percentages of males in total adults of about 24 % can be reported for the two stations. Interestingly, there is great variation in sex-ratio on family level with 12,0 - 47,4 % males. As most of the species are represented by only a few specimens a reliable sex-ratio is only available for 18 species. In 11 species the ratio of adult females to adult males is 3:1 or higher. Although parthenogenesis, a common strategy in freshwater, might exist in some families, we give new explanations for the biased sex-ratio and why females are dominant in deep-sea benthic copepod populations despite an expected 50:50 birth ratio.

Biotic interactions define the temporal stability of deep-sea wood-falls in the North Pacific

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The fate of natural deep-sea wood-falls would appear to be fairly invariant. Wood-boring clams of the Xylophaginae colonize fallen wood and transform its energy and nutrients into animal matter that sustains a species assemblage for some period of time determined primarily by the size of the wood. Experimental deployment of replicate wood blocks at seven Northeast Pacific sites at least 240 km from the continent tested this hypothesis. Dramatic differences existed both among and between recoveries at 10- and 24-months. At two sites, recovered wood could be crushed by hand. At five other sites, the wood maintained its integrity despite hosting a diverse fauna, including four new species of boring clams. Two biotic differences were identified. First, the crushable wood had been heavily colonized by *Xylophaga* n. sp. B; second, the crushable wood lacked the apparent bivalve predators that were dense elsewhere. This pattern suggests that biotic interactions define wood-fall longevity. All wood-boring clams consume and live inside wood. They appear to have the same fundamental ecological niche, yet with up to three species in the same piece of wood, they violate the Competitive Exclusion Principle. Predation may act to moderate competition among wood-boring clams. Despite the perceived rarity of deep-sea wood falls, specialized clam predators were abundant

on wood that retained its integrity and absent from wood colonized (and destroyed) by *Xylophaga* sp. B. The vulnerability of this clam species to predation may allow competitively inferior clam species to survive sympatrically. Additional collections of wood-falls with all associated fauna and (as importantly) input from a taxonomist can test these hypothesized biotic interactions.

Towards an OSPAR network of marine protected areas

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The ministers for the environment of the member states of the OSPAR- and Helsinki- conventions agreed in 2003 in Bremen (Germany) to develop a network of well-managed MPAs by 2010. Earlier the European Community decided to cover with its protected area network (Natura 2000) also marine areas and recently further agreed to include MPAs of the Exclusive Economical Zones (EEZs) of its member states by 2008. This goes well with the global agreement of the World Summit of Sustainable Development (WSSD) at Johannesburg 2002 that called for establishment of a worldwide network of protected areas by 2012. The presentation will demonstrate how the intentions of this international forum are brought together in Northern Europe to finally end up with a MPA-network of the OSPAR Contracting Parties. Further the selection criteria, management needs and restrictions, the current status and first contours of the network covering territorial seas, EEZs and High Seas will be presented. The OSPAR maritime area includes also large parts of High Seas, which makes here the establishment of MPAs particularly challenging. The OSPAR Commission started its respective work in 1999. The most recent report (2006) on the status of the OSPAR network will be presented showing 81 sites covering approx. 25.000 sq. km. As a final point the necessary next activities and steps will be described to complete the networks, to make them ecologically coherent and to achieve an appropriate management of relevant human activities. The question will be raised to what extend and in which way the community of deep sea scientist working in the OSPAR convention area is interested and willing to get actively involved and contribute to this challenging international cooperation.

Distribution of the larvae of vent animals around the vent fields on Myojin Knoll, in the Izu-Ogasawara Arc

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The larvae of vent animals are important for two reasons: they can select a settlement place for their life-long habitat, and they connect vent and non-vent ecosystems, as they can be transported to non-vent environments. Therefore, detailed distributions of most of the larvae of vent animals are required. This study used an efficient sampling method to determine the distribution of larvae. First, we examined the efficiencies of two sampling nets on a remotely operated vehicle (ROV): an improved MTD net with a suction sampler and an improved VMPS net. We obtained well-preserved samples using the improved MTD net with a multi-bottle canister, a method that appears to be suitable for small-scale detection of the distribution of larvae in a vent field,. The filtering efficiency was 250 L/min. From the plankton samples collected, we focused on the larvae of barnacles, as their morphologies have been revealed in rearing experiments. The density of larvae averaged one individual per 171.5 L in the near-bottom layer (0-15 m in altitude). Early and last naupliar and cyprid stage larvae were collected from this layer but no third to fifth stage naupliar larvae were found, suggesting that they leave the vent field. In addition to plankton sampling, current direction and speed and the distribution of the hydrothermal plume were surveyed on the vent field of Myojin Knoll. Based on the chemical and environmental data collected, we discuss the detailed dispersal process of the larvae of vent animals on Myojin Knoll. To identify larvae with unidentifiable morphology, we applied fluorescence *in situ* hybridization (FISH). The progress and efficiency of this technique are also discussed.

Gorgonian octocorals and their invertebrate commensals of the New England and Corner Rise seamounts

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Octocorals and associated invertebrate symbionts were collected or observed on videotapes taken during 40 dives on 13 peaks in the New England and Corner Rise seamount groups. About 45 species of gorgonians are so far known from these seamounts. The species found belong to several distributional groups. Some are widespread across the Atlantic, some were otherwise known only from the Florida Straits and West Indies, and some are known from both the Indian and Pacific Oceans or have sister taxa in those areas. Some species that are well-known in the eastern Atlantic were not common on the seamounts investigated, possibly because of the large differences in depths investigated (predominantly shallow in the east and much deeper in the west). Invertebrate symbionts included primarily ophiuroids and scale worms. Most have very strong affinities with one or a few octocoral species. A species of Asteroschema is documented that settles on the octocoral Metallogorgia melanotrichos when both are young and it is hypothesized that they grow up together.

Diversity, distribution and abundance of demersal scavenging fish on the Angolan Margin

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The diversity, distribution and abundance of demersal scavenging fish were investigated at two localities on the West African continental margin off the coast of Northern Angola. Arrivals at a baited camera system were recorded within a depth range of 1473-2059m. 9 deployments were completed across the two sites with the camera set-up in both suspended and landing modes at each site. The suspended mode, with downward-facing camera 2m above the seabed, is used to record arrival times and peak abundances of scavenging fauna. The landing mode, with camera parallel to the seafloor provides high-resolution images of target organisms allowing a more accurate identification to species level. Both the diversity and abundance of scavenging fishes was comparable to productive temperate systems previously studied on the European continental margins. Patterns of diversity and abundance are discussed in relation to bathymetry, seabed topography and the influence of high organic input from the Congo River fan.

Biodiversity of the Arafura Sea: a transitional deep-sea fauna on a tropical outer shelf

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The Arafura Sea is an important seaway between the Pacific Ocean and the Indian Ocean that influences climate, oceanography and biological features of both oceans. Despite this importance, the benthos of this region has received little study, other than fisheries research by vessels from Australia and other nations. During a geological survey of the Arafura Sea on the R/V Southern Surveyor, two biologists from the Australian Museum and CSIRO processed more than 100 grabs, epibenthic sled and rock dredge samples from depths of 70-230m. A broad range of benthos was collected, ranging from hard substrate filter feeder-dominated assemblages in high energy regions to primarily infaunal assemblages in more quiescent hemipelagic ooze habitats. This region has a high energy, often turbid benthic boundary layer owing to a high tidal range and the Indonesian Throughflow Current. Sea floor temperatures at 100m may rise as high as 20-24°C, and reach 15°C below 200m. The macrofauna are still being analysed (as of April 2006), so diversity data are currently unavailable. Approximately 245 species of megafaunal organisms were identified during the cruise: a species accumulation curve suggests that many undiscovered species in this size range occur in this region. Initial analysis of the Isopoda (suborder Asellota) identified deep-sea groups from samples as shallow as 100 metres. The Desmosomatidae was the dominant deep-sea asellotan family, but other typical deep-sea groups in the samples included Munnopsidae (subfamilies Eurycopinae, Lipomerinae), Nannoniscidae, Thambematidae and Ischnomesidae. Shallow water taxa were represented by Munnidae, Joeropsidae

and Paramunnidae, although these families can be frequent components of bathyal faunas. These observations appear to contradict the assumption that deep-sea asellotan isopods are cold-water stenotherms.

Biotic and abiotic control of vertical distribution in an abundant glass sponge on the flank of Mauna Loa Volcano, Hawai'i

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Sericolophus hawaiicus, a stalked hexactinellid sponge recently described from the bathyal tropical Pacific, occurs at high densities in a discrete band between 350 and 450 meters depth on the Western flank of Mauna Loa Volcano, near Kona, Hawai'i'. Living and dead sponges are interspersed in the same areas, with their stalks anchored securely in volcanic and carbonate sediments that accumulate in grooves between volcanic lava flows. The stalks of the sponges are always inclined toward the downstream (oscular) side of the sponge, with the incurrent (ostial) side pointed upstream. Like planar gorgonians and stylasterine corals on the rock surfaces nearby, the sponges are oriented into a prevailing current that is deflected downslope from Kohala Point. *S. hawaiicus* are found rarely either north or south of this point. Using a collection device with paired spring-loaded syringes operated with two manipulator arms, we collected simultaneous water samples immediately upstream and downstream of sponges. Flow cytometry was used to characterize the particles and organisms that were cleared by the sponges. These data, which constitute the first information on the in situ natural diet of a deep-sea hexactinellid, showed that sponges consume a variety of heterotrophic bacteria and small eutrophic prokaryotes. CTD sampling indicated that these foods peak in the depth range of the sponge zone. The sponge band is centered just above the oxygen minimum zone, within the steepest part of the oxycline, and at a temperature of 6 to 8 degrees C just below the steepest part of the permanent thermocline. Sponges were experimentally transplanted to depths of 337 and 480m to determine if adults could survive outside the normal distributional range. Survival of the deep transplants did not differ significantly from survival of control sponges transplanted within the bed, but sponges transplanted into slightly shallower water (and higher temperatures) all died. We concluded that vertical distribution may be controlled by temperature or some covarying physical factor at the upper end, but that neither low oxygen nor temperature sets the lower limit. Because adults can survive deeper than they occur naturally, the lower boundary is probably determined by processes occurring during early life-history stages.

Poster Abstracts

Application of Deep-Sea Biological Research to Offshore Oil and Gas Resource Management Decision Making

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The development of oil and gas resources has been identified as a potential threat to deep-sea benthic biota, especially cold-water corals and cold seep chemosynthetic communities. The Minerals Management Service (MMS), within the U. S. Department of the Interior, is responsible for permitting and regulating oil and natural gas activities in federal offshore waters within its Exclusive Economic Zone. Densely populated cold seep chemosynthetic communities and the cold water coral *Lophelia pertusa* (Linnaeus, 1758) have been found in the Gulf of Mexico (GOM) in deepwater areas with increasing oil and gas exploration and development activities. The most significant accumulation of *L. pertusa* known in the northern GOM lies on the upper slope of the DeSoto Canyon at a depth of around 440 m. The MMS is sponsoring an ongoing three-year study to characterize non-chemosynthetic megafaunal communities that live on deepwater hard substrates and to describe the environmental conditions that result in the observed distribution and development of high density communities, particularly extensive areas of *L. pertusa*. Another current project sponsored jointly by MMS and NOAA, "Investigations of Chemosynthetic Communities on the Lower Continental Slope of the GOM", includes the study of both known and newly discovered chemosynthetic communities as well as other hard bottom habitats including deepwater corals. Objectives include assessment of the comparative degree of sensitivity to anthropogenic impacts, how the deeper habitats are similar or different from their shallower counterparts, and how the detection of these kinds of habitats can be improved using remote sensing information. To use such information MMS provides guidelines to offshore operators regarding the implementation of special lease stipulations and regional requirements. One mechanism for providing these guidelines is the Notice to Lessees and Operators (NTL). There are currently two NTL's used in the GOM that provide protection for deepwater benthic communities. The Deepwater Chemosynthetic Communities NTL (No. 2000-G20) requires that activities disturbing the seafloor in water depths of 400 m or greater maintain a separation distance of at least 457 m from features or areas that could support high-density chemosynthetic communities for each proposed drilling muds and cuttings discharge location and at least 76 m for all other proposed seafloor disturbances, including anchors, anchor chains, wire ropes, seafloor template installations, and pipeline construction. The Remotely Operated Vehicle (ROV) Surveys in Deepwater NTL (No. 2003-G03) requires the acquisition of biological and physical information from ROV surveys before and after certain oil and gas exploration and development activities below 400 m depth in the GOM. This presentation includes discussion of the application of scientific study results to resource management decisions for the deep GOM. Protective measures already implemented for chemosynthetic communities serve as a model for protection of deepwater corals.

The Portuguese submarine canyons - 'hotspots' of benthic biodiversity?

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Submarine canyons provide important habitats for the deep-sea fauna. They tend to be isolated systems because of their topography (v-shaped), hydrography, sedimentology, biogeochemistry and biology. Compared with the relative environmental stability of the abyssal plains and open slopes, canyons are known to be unpredictable zones. Canyon faunas are often high in numbers of endemic species. As more is learnt about canyons, it is becoming increasingly obvious that patchiness in organic matter supply (in both space and time), the variety of substrates and the interaction of topography and the deposition of OM, leads to great faunal diversity. Within the framework of the European Integrated Project HERMES, two of Europe's largest submarine canyons systems, Nazaré and Setúbal, located on the Portuguese margin are being studied to answer the question 'Are canyons hotspots of biodiversity?'. The Nazaré Canyon was sampled during the RRS Discovery cruise 297 in August 2005. Three replicate USNEL Box-core samples were taken at two stations located at 3400 m and 4300 m depths. Preliminary results on the biodiversity, community structure and vertical distribution of the benthic faunal assemblages indicate that polychaetes, peracarid crustaceans,

aplacophorans and holothurians were the most abundant taxa. The deeper station of the canyon presented a higher abundance of polychaetes and crustaceans than the shallower one where aplacophorans were much more abundant. Three other cruises are already planned for the next research period; the RRS Charles Darwin (National Oceanography Centre Southampton, UK) cruise in April-May 2006 and summer 2007 (using ROV) and a shorter research cruise will also take place on RV Pelagia (The Royal Netherlands Institute for Sea Research) in the summer of 2006. Additional cruises may take place on the Andromeda and D. Carlos (Instituto Hidrografico) in July 2006. New findings are expected, providing important insights of the role of canyons in the ecosystem functioning.

The Effect of Physical Disturbance Associated with Deep-Sea Drilling on the Nutritional Ecology of Deep-Sea Scavengers

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Nutritional ecology focuses on the exchange of nutrients between individual organisms and their environment (Raubenheimer and Simpson, 2004). In general animals must ingest multiple nutrients simultaneously to meet their nutritional needs. Dealing with this requirement for multiple nutrients requires a modelling framework that takes account of multiple nutrients simultaneously and their interactions. A geometric framework will be used that provides such an approach and can unravel the complexities that underlie an animal's needs to achieve a nutritionally balanced diet (Raubenheimer and Simpson, 2004). Scavengers in the deep-sea rely on pulsed mono-specific food fall events to satisfy their nutritional requirements (Tamburri and Barry, 1999). Therefore, is it possible for them to regulate the intake of multiple nutrients thus achieving a nutritionally balanced diet? A series of experiments will be conducted to investigate the complexities of deep-sea nutritional ecology and also the impact that anthropogenic disturbance events have on deep-sea communities. The goals of this investigation are (1) to quantify the natural diet of deep-sea scavengers using stable isotope analysis, (2) to qualify the differences in foraging behaviour for protein, carbohydrate and lipid in disturbed and undisturbed habitats, (3) to quantify the intake target of deep-sea scavengers, and (4) to quantify whether the intake target in actively defended.

Some biological aspects of three lantern sharks: *Etmopterus spinax* (Linnaeus, 1758), *Etmopterus pusillus* (Lowe, 1839) and *Etmopterus princeps* Collet, 1904 in Azores Islands

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Species of the genera Etmopterus are frequently caught as "by-catch" in the deep-water longline fisheries in the Azores islands. The vertical distribution and some aspects of the biology of the species *E. spinax*, *E. pusillus* and *E. princeps* were investigated using data collected in several longline fishing surveys (1995-2005). Specimens of *E. spinax* were captured in depths ranging from 300 to 1100m. A peak of abundance was identified at depths between 450 and 650 m. The mean length shows an increasing trend from 300 to 600m depth, decreasing afterwards. The overall observed sex ratio was 1.00: 2.25 (M:F). The estimated length at first sexual maturity for females was 34.2 cm (TL). Males at lengths greater than 36 cm were all sexually mature. Maturity stages were observed between March and November where the majority of both males and females were mature. *E. pusillus* ranged from 250 to 1350 m depth, with highest catch rates between 500 and 1050 m. The length range was 21.5–49 cm for females and 22-47 cm for males. The overall sex ratio was 1.00: 0.83. *E. princeps* were captured at a wider depth range, from 1100-2500 m. It was observed to be more abundant at depths between 2000 and 2500 m. The length range was 21- 69 cm for females and 27.5- 62 cm for males and the sex ratio was 1.00: 1.76. The mean length shows a trend to decrease with depth. All the species are sexually dimorphic and data suggest that females attain to a larger body length than males. In general these species still poorly known and more biological and ecological information is needed, especially for *E. pusillus* and *E. princeps*, for assessing the impact of fisheries on those populations.

Distribution and some biological aspects of *Deania profundorum* (Smith & Radcliffe, 1912), *Centrophorus squamosus* (Bocage & Capello, 1864) and *Centroscymnus crepidater* (Bocage & Capello, 1864) from Azores Islands

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Deania profundorum (Smith & Radcliffe, 1912), *Centrophorus squamosus* (Bocage & Capello, 1864) and *Centroscymnus crepidater* (Bocage & Capello, 1864) are abundant "by-catch" species in deep-water longline fisheries in the Azores islands. The vertical distribution and some biological aspects of these species were investigated using data collected in several longline surveys (1995-2005). *D. profundorum* ranged from 450 and 1100 m. The peak catch rates of this species lay in the 700-800 m. The length range was 47 to 98 cm for females and 50 to 76 cm for males. The overall sex ratio was 1.00: 0.92 (M:F). Sex ratio favored males at greatest depths (> 700 m) and females at shallower waters (< 700 m). *C. squamosus* was most abundant at depths 900 and 1100 m (range 600-2100 m). The length range was 84- 146 cm for females and 102-124 cm for males. For this species there was a general trend for a decrease in mean length with the increasing depth. The overall sex ratio was 1.00: 0.28. *C. crepidater* has a depth range from 850 to 1600 m, with highest rates at 1050-1200 m. Males were just registered at depths 1000 and 1200 m. The mean length increase with depth. The overall sex ratio was 1.00: 1.13. The length-weight relationship was fitted for all these species. Since these species are vulnerable to fishing pressure more biological information is needed, especially regarding their reproduction and growth features, in order to assess the sustainability of the resources.

Diversity and spatial distribution of deep-sea Octocorallia (Cnidaria) from Campos Basin, Brazil

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The knowledge on octocorals occurring in Brazilian deep waters is still poor, with only a few works conducted so far. We present here data and analyses on the octocoral fauna from the continental slope (1000-1600 m) of Campos Basin, Brazil. The Campos Basin presents great environmental interest for it holds many economical activities, specially related with oil exploration and production. Specimens of octocorals and scleractinians herein studied were collected between 21ºS and 23ºS, by "Campos Basin Deep-sea Environmental Project" coordinated by CENPES/PETROBRAS. Three distinct aspects of the fauna of Octocorallia were studied: 1) analysis of the octocorals within Campos Basin, evaluating their bathymetric distribution; 2) co-occurrence of octocorals with scleractinian corals; and 3) distribution of octocoral-coral communities with water masses. Eleven families, 14 genera, and 16 species or morphotypes of octocorals have been found in Campos Basin. Analyses indicate that richness on the Campos Basin slope is similar to that of other regions of the world. Spatial distribution of the species characterized two distinct areas, bathymetrically separated by water masses (Antarctic Intermediate Water – AAIW – and North Atlantic Deep Water – NADW). The cluster dendrograms and the MDS graphs indicated that areas of the middle slope (1000-1200 m) were more heterogeneous regarding species composition, while deeper areas of the slope (1200-1600 m) were fairly homogeneous. Our analyses showed the co-occurrence of octocoral and scleractinian species reported to deep-sea reef environments. All these indicator species occurred exclusively within the AAIW depth range. These species have been obtained from depths greater than previously reported in Brazil.

Deep ocean Environmental Long term Observatory System (DELOS): Long term monitoring of the deep ocean demersal community in the vicinity of offshore hydrocarbon operations

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The deep-sea environment into which BP operations are gradually extending is generally poorly understood with surveys regularly discovering new habitats and communities of animals previously unknown to science. By establishing long term monitoring of the deep sea physical environment and biological activity in that environment it should be possible to compensate to a large degree for previous lack of knowledge. Hitherto only two deep-sea sites in the world's oceans have been the subject of long-term studies exceeding 5 years, Station M in the NE Pacific Ocean (Smith et al. SCRIPPS Institute of Oceanography, University of California) at 4100m depth, studied since 1989 and the Porcupine Abyssal Plain (Bengal) station at 4800m in the NE Atlantic Ocean. At both stations important annual cycles have been observed with considerable variability from year to year and changes in dominant fauna over decadal time scales. In an oil production area such spontaneous changes need to be distinguished from any anthropogenic influences imposed on the deep-sea environment. The DELOS system comprises two environmental monitoring platforms situated in the Atlantic Ocean at 1400m depth in block 18 off Angola: - one in the far field (approximately 5 miles form sea floor infrastructure); and one in the near field (within 50metres of a sea floor well). The aims are to: - Describe long-term natural environmental conditions at deep water site in block 18 offshore Angola; - Compare near and far field sites over long term to describe any impact of offshore operations, and assess the effect of the structures themselves (reefing effect); - Contribute to increased understanding of mechanisms linking climate to deep-ocean ecology. Each platform comprises two parts: - the sea floor docking station that is deployed on the sea floor at the start of the monitoring program and remains for the 20 year project duration; and a number of observatory modules that are designed to perform specific environmental monitoring functions. One of each observatory module will be available to each platform. Once deployed each observatory module will have enough battery and storage capacity for autonomous operation for at least 6 months. Towards the end of the 6 month deployment period each platform will require WROV intervention to recover observatory modules to the surface for service, calibration and data offload. During this service period no monitoring will be possible at the sea floor however, long periods of monitoring will be possible (months), interrupted by short service periods (days). The DELOS system is to be installed in June/ July 2007.

ChEss – Biogeography of deep-water chemosynthetic ecosystems - a Census of Marine Life pilot project

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ChEss(www.noc.soton.ac.uk/chess) is one of the 14 pilot projects within the Census of Marine Life initiative (www.coml.org). The aim of ChEss is to determine the biogeography of deep-water chemosynthetically-driven ecosystems and to understand the processes driving them. The main objectives are to assess and explain the global diversity, distribution and abundance of species from chemosynthetic systems including hydrothermal vents, cold seeps, whale falls, sunken wood and oxygen minimum zones where they intersect the deep seafloor along certain ocean margins. ChEss follows two approaches: 1- development of a web-based relational database for all species from deep-water chemosynthetic ecosystems; 2- development of a long-term international field programme for the exploration for, and investigation of, novel chemosynthetically-driven communities at key locations. Finally, ChEss is also developing a strong outreach and education component. ChEssBase (www.noc.soton.ac.uk/chess/database/database.html) ChEssBase is a dynamic relational web-based database. The aim is to provide taxonomical, biological, ecological and distributional data for all species described from deep-water chemosynthetic ecosystems, as well as information on specific samples and collections. In 2005, the InterRidge biological database was merged with ChEssBase and in January 2006 ChEssBase was integrated with OBIS (www.iobis.org). Field Programme (www.soc.soton.ac.uk/chess/field.php) Within a single programme, it is not practicable to investigate the full extent of the two domains (Mid-Ocean Ridges and Ocean Margins) where vents, cold-seeps, OMZs and large organic falls occur. Instead, the ChEss programme has chosen to select a limited number of key target areas where specific scientific questions most pertinent to biogeographic issues can be addressed. To assess the biogeography and biodiversity of chemosynthetic ecosystems it is essential that all the reducing systems be studied in combination. Furthermore, determining the evolutionary and ecological relationships amongst their fauna is crucial to understanding the processes that shape the distribution of species from chemosynthetic ecosystems at the global scale. There are now 5 top-priority regions for concerted ChEss research. The first represents a band of study areas spanning the breadth of the Equatorial Atlantic Ocean and adjacent seas. The second is focused on the exploration and study of the SE Pacific Ocean in the region where the East Chile Rise

intersects the Peru-Chile Trench. The third will investigate chemosynthetic sites around New Zealand. The fourth aims at developing research on the Polar regions, both Arctic and Antarctic, in relation with the IPY. And finally, the most recent addition to the ChEss project is the support of research in the Indian Ocean Ridges. ChEss has also identified a suite of additional areas, requiring a lesser degree of international coordination for progress to be achieved. Outreach & Education (www.noc.soton.ac.uk/chess/education/edu_home.php) ChEss is developing and/or participating in several O&E activities, mostly in collaboration with other programmes: 1- Multilingual educational web site; 2- Virtual cruises; 3- Comics book about the history of vent and seep exploration (with deep-sea CoML projects); 4- Deep-Sea Guide Book and travelling exhibition (with deep-sea CoML projects) and 5- School Network project – GLOBE (with R2k, IR and deep-sea CoML projects).

Diel Vertical Migration of Lightfishes (Teleostei: Stomiiformes) in the Western North Atlantic Ocean

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In this study, we characterize the diel vertical migration (DVM) for 45 of the known 51 genera of the teleost order Stomiiformes. Our analyses are based on over 16,000 discrete capture records from the Western North Atlantic. To account for the broad temporal and geographic scales encountered in this study, local time of capture was transformed to a corrected time representing position in a solar day. Nearly all genera exhibited DVM; several were characterized by asynchronous patterns. From these results, we assess what stomiiform taxa are driven to migrate by predator avoidance and or hunger-satiation models. By characterizing DVM patterns of an entire order we attempt to trace the evolution of behavioral and trophic characteristics within a diverse group of deep-sea fishes.

Population structure of *Ophiura ljungmani* (Lyman, 1878) (Echinodermata: Ophiuroidea) from Campos Basin off Brazil, SW Atlantic

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Two oceanographic campaigns from the "Campos Basin Deep Sea Environmental Project/PETROBRAS" in the southeastern Brazilian margin during February and August (summer and winter, respectively) 2003, provided megabenthic material from 36 sampling trawls. An Otter Trawl Semi-Balloon (OTSB) was used at three different depths (1100, 1300 and 1600m). A total of 2,432 individuals of *O. ljungmani* were sampled only at 1,100m. The literature has shown that this species has also been found abundantly in the NE Atlantic, where its recruitment period is in the summer, corresponding to the winter period in the SW Atlantic. The main objective of this study was to find out if there was a significant difference between the *O. ljungmani* population collected in the summer and winter in the southern hemisphere regarding its density (ind.km^{-2}), size frequency distribution and biomass (g.km^{-2}). Size has been noted as disk diameter (mm). A tendency to a density increase was found from summer (X ±SD=3,381.31±2,011.46, n=6) to winter (X±SD=6,929.32±2,531.88, n=6). It could have been that during the summer there was a highest competition pressure through predation by other organisms. But, during the winter there was a significantly higher number of smaller individuals then in the summer (ANOVA, f=196.214, p<0.001). Biomass was also highest in the winter possibly because of the higher number of individuals found. It is possible that recruitment occurred just before the sampling was undertaken in August (winter in the southern hemisphere). If this is the case, the hypothesis that *O. ljungmani* recruitment occurs in the summer because of the highest organic matter input to the deep sea during this season needs to be reviewed. Most likely, the recruitment phase of *O. ljungmani* is intrinsic to the species, independently of its ocean region habitat, as different hemispheres, for instance, are subjected to time-lapse differences in organic input to the deep-sea.

Towards a revision and phylogeny of the genus *Paramphinome* M. Sars in G. O. Sars, 1872 (Polychaeta: Amphinomidae)

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The genus *Paramphinome* (Polychaeta: Amphinomidae) are small-bodied forms characterized by a short, plate-like caruncle; bearing tufted branchiae in the anterior chaetigers; and dorsal cirri as single projections (Fauchald, 1977; Kudenov, 1995). This genus is further distinguished by stout, recurved notochaetae arising from the first chaetiger. Members of this genus occur from shelf to deep-sea depths worldwide. No comprehensive revision or phylogeny existed prior to this study; therefore, available specimens (type and reference) were secured and examined to develop and analyze phylogenetically-relevent morphological characters. Owing to a number of nomenclatural issues, a taxonomic revision of the taxa was also undertaken. The revision has resulted in, among others, a redescription and designation of a lectotype for *P. jeffreysii* (McIntosh, 1868) with comparisons to its junior synonym *P. pulchella* M. Sars in G. O. Sars, 1872, and a redescription of *P. australis* Monro, 1930 based on the holotype with recognition of a putative new species from Antarctic waters and off Chile.

Effects of hypercapnia on the metabolic rate of a deep-sea sediment community

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Fossil fuel emissions are expected to accelerate through much of this century, leading to an increase in the passive flux of carbon dioxide into the ocean surface. Efforts to stabilize climate may also involve direct carbon sequestration in the deep ocean. Both processes will increase the carbon content of the oceans, promoting hypercapnia and pH reduction. The physiological response of most marine taxa to these perturbations and their consequences for populations, communities, and ecosystems are not yet understood. In this study, we measured oxygen consumption by a deep-sea sediment community under normocapnic (total carbon = 2314 µM, pH = 7.9) and mild hypercapnic (total carbon = 2345 µM, pH = 7.8) conditions over a 1 month period, to assess potential changes in rates of sediment community metabolism. In situ respiration systems with multiple chambers were deployed at 3100 m depth off the California coast. Bottom water enclosed in 'treatment' chambers was injected with CO2-rich SW to produce a 0.1 unit reduction in pH. Chambers were flushed with ambient water when oxygen levels dropped to 85 percent of normal (after ~36 h). This process was repeated for ~30 days, with continuous recording of oxygen and pH within treatment (n=3) and control (n=3) chambers. Respiration rates varied among treatment chambers, and were either similar to control chambers or exhibited a distinct initial reduction, after which oxygen consumption rose to levels comparable to controls. These results suggest that a modest increase in ocean carbon levels may impact carbon turnover in deep-sea sediments. Future deployments will involve larger perturbations of total carbon and closer examination of changes in the composition and activity of microbial and faunal communities in response to hypercapnia.

Is there a case for the Subfamily Axinopsidinae (Bivalvia: Thyasiridae)?: revising the taxonomy of the minute thyasirids of the genera *Adontorhina*, *Mendicula* and *Axinulus*

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The bivalve family Thyasiridae has representatives found in all parts of the world and in all ocean depths. A new species *Adontorhina keegani* exhibits a markedly different morphology than the type species for the *Thyasira* genus *T. flexuosa*. This species exhibits a trend of modified morphology that has become apparent with the discovery of more elongate forms of *Adontorhina* and *Mendicula* species in recent years. The presence of ectoprocts on the new species' dorsal margin would suggest the thyasirid is not a deep burrower – in contrast to the traditionally held view of deep burrowing thyasirids. The classification of the family Thyasiridae is contentious at present, with new species challenging the traditionally held view of what constitutes a member of this family. The subfamily

Axinopsidinae Bernard, 1983, was proposed to incorporate minute thyasirids, but did not achieve universal acceptance. This study investigates whether the morphological differences within the family, such as the reduced demibranch, elongation of the longitudinal axis and reduction in body size are sufficient to divide the taxa at subfamily level and whether traditional generic groupings stand up to phylogenetic analysis. Attempts are being made to amplify 28s rRNA gene fragments from formalin preserved minute thyasirids, with some success. A tentative phylogeny of the minute thyasirids will be presented.

Automated generation of geo-referenced mosaics from video collected by deep-submergence vehicles: an example from Rosebud vent (Galapagos Rift)

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Many advances in understanding biological processes at the deep seafloor are facilitated by direct observation. Mosaics of seafloor imagery have significant advantages over collections of still photographs and video footage as they are able to capture large areas while retaining sufficient resolution to identify small-scale features. With mosaics of the seafloor, deep-sea biologists are able to "see" the distribution of disjunct communities in a larger spatial context. Importantly, geo-referenced seafloor mosaics allow for assessment of community development over time on repeated surveys at target sites. Here, we present the initial results of a project to automate the process of creating geo-referenced seafloor mosaics from video and navigation data. This methodology is designed for the submersible Alvin, but may be modified for use with other underwater vehicles. Our processing consists of four stages: (1) using navigation data (position and altitude) to determine 15-m segments of imagery from an entire dive, (2) acquiring video sequences from DVCAM tapes, (3) processing of frames and pair-wise registration, and (4) constructing a geo-referenced mosaic, ready to incorporate into a Geographic Information System (GIS). During a cruise to the Galapagos Rift in May 2005, we utilized the above software with video and navigation data from Alvin to mosaic the seafloor at Rosebud vent (0 48' N, 86 14' W). For validation of the automated processing, we compared automatically-generated video mosaic segments to manually-constructed still camera mosaics. Rosebud, discovered in May 2002, is a relatively nascent vent field (on the order of several years old). We are now poised to use the above software to generate geo-referenced mosaics of the seafloor at Rosebud from "legacy video" during Alvin dives in 2002, to quantify the temporal changes in vent community distribution.

Short-Term Variability in Larval Supply to Hydrothermal Vents: a Comparison of Sediment Traps and Plankton Pumps

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Studies of larval dispersal are important for understanding community development at hydrothermal vents. We investigated larval supply to hydrothermal vents at 2500-m depth on the East Pacific Rise at 9N in Nov. 2004. We had two objectives: 1) a technical comparison of two types of larval collection devices: large-volume plankton pumps and time-series sediment traps, and 2) to examine short-term variability in larval supply. Part of our motive for these objectives is development of a sampling design for use at observatories planned for mid-ocean ridges. We deployed the sediment trap for a 10-day time series, with plankton pumps deployed every other day for a total of 5 days for comparison. Moorings were configured with sample opening at 4mab and a current meter at 10mab. All samples were concentrated onto 63um sieves prior to sorting individuals to taxon group. Sediment trap fluxes ranged 2-fold from 39 - 99 total larvae $0.5m^{-2\ d-1}$, with gastropod and polychaete larvae representing an average of 73% and 16%, respectively. Concentrations of larvae in the pump samples ranged 2-fold from 386 - 723 ind. $40m^{-3}$, with gastropod and polychaete larvae representing an average of 39% and 60%, respectively. There was no correlation between the pump and trap in the total number of gastropod or polychaete larvae collected during the simultaneous deployments. Overall, our technical comparison indicates that the sediment trap collects a much higher ratio of gastropods to polychaetes than the plankton pump. *Cyathermia naticoides* was the most abundant gastropod species in the trap (49% of gastropod larvae), but *Lepetodrilus* spp. were most abundant in the pumps (38% of gastropod larvae). The remarkable range in number of larvae collected on day-week time scales and the

differences between sampling devices have implications for a sampling design to assess seasonal- and long-term changes in larval supply.

EXtreme ecosystem studies in the deep OCEan: Technological Developments – EXOCET/D

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Deep-sea research is expensive and depends heavily on technological progress much in the same way as the exploration of space. In addition, the reduced size of extreme or punctual deep-sea ecosystems make them difficult to study with conventional instrumentations deployed from surface vessels as it is done in sedimentary ecosystems. In 2004, the European Commission therefore funded a three-year project, EXOCET/D, to develop, implement and test specific instruments aimed at exploring, describing, quantifying and monitoring biodiversity in deep-sea fragmented habitats as well as at identifying links between community structure and environmental dynamics. Another objective is to develop novel data integration tools and to improve payload inter-operability. EXOCET/D involves partners from ten European research institutions and three small and medium enterprises. Here, we present the programme of the seven work packages. The working fields include: video and acoustic imagery, *in situ* analysis of physico-chemical factors, quantitative sampling of macro- and micro-organisms, *in vivo* experiments, integration of multidisciplinary data and implementation on European submersibles. Experimental devices onboard will complement the approach, enabling experiments on species' physiology. In August 2006, the project will go into a final phase of technical and scientific field validation during the MoMARETO cruise to the Azores Triple Junction.

Assessing benthic megafauna abundance through image analysis: contrasting results from a time-lapse and an underwater video camera

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Digital images were taken seasonally (FOODBANCS Project) between Nov-1999 and March 2001 on the West Antarctic Peninsula Shelf using two different imaging devices. An underwater video camera recorded images of three different sampling stations (~600m depth) for about 1 hour each. Time-lapse (TL) photography was used to register the mega-epibenthic fauna dynamics on a single station at the middle of the shelf taking oblique photographs at definite time intervals (12 or 24 hours). Image analysis was used to investigate the response of the mobile epibenthic megafauna to the phytodetritus arrival on the seafloor. Two elasipodid holothurians, *Protelpidia murrayi* and *Peniagone vignoni*, were the most conspicuous megafaunal individuals found on both images (up to 90% of relative abundance). Megafaunal data from video images showed low densities between the first two cruises (~24.0 ind. 100 m-2). However, there was a marked abundance increase in Jun-2000 with the highest values occurring in Oct-2000 (51.2 and 94.8 ind. 100 m^{-2}, respectively). The TL data showed a similar abundance pattern during the period although in the first two deployments (Dec-99 to May-00), these values were much higher (~200%) than those observed in video images. There was a low number of individuals during winter 2000, but a marked increase occurred between Nov-00 and Feb-01 (up to 84.5 ind. 100 m^{-2}). Together with the raise in faunal density, there was an increase in chlorophyll-a fluxes of 1 order of magnitude from spring-summer 1999-2000 to 2000-2001. Analysis over the 16-month period revealed an accentuated interannual variation on megafaunal abundance, which is likely to be related to the massive POC flux measured for the same area during the spring-summer 2000-2001 season. The different faunal abundance found between TL and video data might be related to the method's distinct spatial and temporal design coupled with a change in holothurian's activity in response to the food available.

Primary productivity, export flux and abyssal megabenthos community structure

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In December 2005 a cruise to the Southern Ocean around the Crozet Islands compared two abyssal localities (c. 4200m), one east of the islands (c. 46°S 56°E) and the other south of the islands (c. 49°S 51°E). The sites were only 250km apart and had similar environmental settings with the exception of the characteristics of the overlying productivity regime. The southerly site lay under an oligotrophic HNLC (High Nutrient Low Chlorophyll) region while to the east of the islands the seabed received a large seasonal pulse of fresh organic matter (eutrophic conditions). Sediment trap observations showed significant differences in mass downward flux between the two sites, although the oligotrophic site received a larger input of organic matter than had been anticipated. Seabed photographs showed the presence of phytodetritus patches on the seabed in the eutrophic region. Four otter trawl samples were taken to the east of the Crozet Islands and two to the south. The invertebrate megafaunal wet weight biomass was three times greater at the eutrophic site than at the oligotrophic site. Holothurians accounted for 90% and 70% of the megafaunal biomass respectively. Asteroids, ophiuroids and actiniarians were also important components. The dominant holothurian species at each site were different. *Psychropotes* (aff. *P. longicauda*), *Peniagone affinis*, *Pseudostichopus villosus* and *Oneirophanta mutabilis* dominated at the eutrophic site. The latter two species did not occur at the oligotrophic site. Here, the samples were dominated by *Peniagone* (*aff. P. incerta*). The relative abundance of the most abundant holothurian families at the eutrophic site showed a remarkable similarity to the community structure present in eutrophic NE Atlantic abyssal depths. The Crozet eutrophic site showed greater affinity to the NE Atlantic, 9000km distant, than to the nearby oligotrophic locality.

Deep-sea bony fishes caught off Madeira (NE Atlantic Ocean) between 750 and 2500m

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A collection of deep-sea Osteichthyes from the waters of the archipelago of Madeira was studied. The specimens were caught between 1000 m and 2500 m during two research cruises in 2004 and 2005, using bottom longlines and baited fish traps set off the islands of Madeira and Porto Santo and at Unicorn (34º 35'N, 14º 28'W) and Seine seamounts (33º 45'N, 14º 22'W). Twenty seven species of Osteichthyes were identified, belonging to 12 families: Alepocephalidae, Berycidae, Chiasmodontidae, Congridae, Gempylidae, Macrouridae, Moridae, Phycidae, Ophidiidae, Scorpaenidae, Synaphobranchidae and Trichiuridae. For some of the species caught and due to its rarity, data regarding depth of occurrence, sexual matury and morphometry are given. This research was co-funded by the EU in the framework of the Initiative INTERREG III-B (Madeira, Azores, Canaries), projects PESCPROF-1 (MAC/4.2/M12) and PESCPROF-2 (03/MAC/4.2/M8), and Câmara Municipal do Funchal.

Tanaidacea (Crustacea; Peracarida) from Hydrothermal Vents: The Juan De Fuca Ridge, Northeast Pacific and The Lucky Strike Field, Midatlantic Ridge

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The materials for the study were collected in the most active areas close to the vent openings and chimney walls where steep gradients of physical and chemical conditions occur during submersible dives or ROV operations at the Juan De Fuca Ridge (Northeast Pacific) and The Lucky Strike Field (Midatlantic Ridge). The material from the Juan de Fuca was taken by the submersible Alvin, the ROV Jason and by trawls deployed from the RV Atlantis (grant # DEB-0103690, Dr. J. Voight). The material from the Midatlantic Ridge was collected by Dr. M. R. Cunha during geological surveys onboard the RV Prof. Logatchev (Training Through Research program, IOC-UNESCO). The tanaidaceans collected from the Juan de Fuca Ridge were clearly dominated (over 99%) by *Protanais ligniamator*.

This species was only found at the wood deployments or the sediment collected by the suction sampler from underneath the wood both inside and outside the vent field. Tanaids were found in 14 out of 29 grab samples collected inside the vent field and in two of five grab samples collected in the Lucky Strike segment outside the vent field (Midtatlantic Ridge). Only *Mesotanais styxis* was found both inside and outside the vent field. Three apseudomorphs (table below) with a wide distribution in the NE Atlantic occurred only in stations outside the vent field and in one station at the periphery of the vent field. The remaining seven species were found only inside the vent field, six were new species and two other (*Pseudotanais vulsella*, *Agatotanais ingolfi*) were previously recorded from non-vent environments. The most frequent tanaid inside the vent field was *P. vulsella*. All the species found during this study belong to previously known genera, including the newly created genus *Obesutanais* was found before although not described. This suggests that the tanaid fauna in hydrothermal vent habitats is not dramatically different from the surrounding deep-sea habitat.

Distribution patterns of epi- and mesopelagic teleost fish from eastern Brazilian coast

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Pelagic fishes from 14-910 m between 11-22o S were sampled with mid-water trawls during an accoustic survey off eastern Brazilian coast aboard N/O Thalassa (IFREMER). The area includes the Abrolhos reef complex, numerous shallow oceanic banks (<100 m) with bases submerged at great depths, and the Vitória-Trindade Chain. A total of 38 families and 96 species were captured. Diodontidae was dominant in catches (62,7%), mainly in epipelagic trawls (80%), due to mass recruitment of pelagic juvenile Diodon holocanthus. Contribution of Sternoptychidae and Myctophidae to overall catches were similar (13-15%). Sternoptychidae, restricted to mesopelagic catches (62%), was represented by compact schools of *Maurolicus stehmanni* (>24,000 individuals) at 21^{o}-22^{o}S. Myctophidae accounted to 10% in epipelagic and 35% in mesopelagic trawls. Myctophidae was the most diverse family (24 spp.), followed by Carangidae (11) and Sternoptychidae (6). *Diaphus* was represented by at least 8 species, including the most abundant (*D. garmani*), the most frequent (*D. dumerilii*), and a new record for Brazilian waters (*D. adenomus*). Except for *D. adenomus* (amphi-Atlantic pattern), only thermophilic species (broadly tropical, tropical and subtropical patterns) of myctophids were captured. The maximum species diversity per trawl (16 spp.) obtained in a southernmost trawl, near Cabo de São Tomé, is characteristic of high productivity areas. Diversity of myctophids between 5-8 spp./per trawl and massive catches of *D. garmani* were associated with oceanic banks, despite their latitude (16-20^{o}S). This fact suggests that local mesopelagic community benefits from greater concentrations of potential food items available as a result of increased primary and secondary production in response to flow disturbance caused by the island-mass effect. Classification and ordination methods resulted in five groups of stations, one with monospecific catches of *Canthidermis sufflamen* (A); one with *Diodon holocanthus*, mostly or exclusively (B); one with reef-associated (*Balistes capriscus*, *Aluterus monoceros*, *C. sufflamen*), pelagic (*Engraulis anchoita*) and benthopelagic (*Trichiurus lepturus*) species (C); one with high-oceanic species (*Diaphus brachycephalus*, *Pollichthys mauli*); one with mesopelagic species (Myctophidae, Sternoptychidae).

Deep-sea Bythocytheridae (Crustacea, Ostracoda, Cytherocopina) from Antarctica

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Three new genera and eight new bythocytherid species are described from seven samples collected in the Weddell and Scotia Seas, Atlanctic Sector of Antarctica. These samples were gathered during the projects EASIZ (186m depth) and ANDEEP (2889.2 to 4782.5m depth) in four cruises of the R.V. Polarstern. These eight new species are described and illustrated. Twenty-seven bythocytherid specimens analyzed comprise the following taxa: *Bythocytherini* gen nov. 1 sp. nov. 28; *Bythocytherini* gen nov. 1 sp. nov. 112; *Bythocytherini* gen nov. 1 sp. nov. 113; *Bythocytherini* gen nov. 2 sp. nov. 70; *Jonesiini* gen nov. 3 sp. nov. 57; *Flabellibythere* sp. 48; *Retibythere* (*Bathibythere*) sp. nov. 71; *Retibythere* (*Bathibythere*) sp. nov. 72. The distribution of most of these species is punctual, which might reflect the relatively small sampling efforts on the Antarctic deep-sea and / or the rarity of the specimens of the family Bythocytheridae in the deep-sea.

First Molecular Study on Deep-Sea Ostracoda (Crustacea)

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DNA-based genetic and phylogenetic studies of Ostracoda have so far mainly focused on non-marine taxa (Schoen et al. 1998, 2000, 2003), with some exceptions. Here, deep-sea specimens of the family Macrocyprididae Mueller, 1908 from Antarctica are analyzed with molecular techniques. This study aims to link genetic structures of deep-sea ostracod populations with water depths and geographic regions in the Antarctica (Weddell and Scotia Seas). In the pilot phase, DNA from 24 specimens collected in 5 different stations was extracted (*Macromckenziea glacierae* Maddocks, 1990; *Macrosarisa* sp. nov. 102; *Macroscapha inaequata* Maddocks, 1990; *Macroscapha opaca* Maddocks, 1990; *Macroscapha turbida* (Müller, 1908); *Macroscapha* sp. nov. 72). Universal primers for 7 markers (COI, COII, Cyt B, ND4, 16S, 18S, ITS, hsp82) were used for PCR and the following regions were successfully amplified: COI, ITS, 16S, 18S. The PCR products of COI, ITS, 16S and 18S were sequenced automatically and directly. The 70 obtained sequences are between 120 to 1500 bp long. After their confirmation by BLAST search, the edited sequences were aligned with ClustalX and genetic variability (Kimura-2 parameters) was estimated for different taxonomic levels and sample stations. Sequences of ITS, COI and 16S have sufficient genetic variability to be used in population studies. The distances are: 1) ITS - intraspecific: 0,000% to 2,254%, interspecific: 9,266% to 10,977%, between genera: 20,096 to 31,741%; 2) COI - intraspecific: 0% to 14,397%, interspecific: 3,133% to 14,440%, between genera: 7,930% to 23,833%; 3) 16S - intraspecific: 0% to 0,436%, interspecific: 8,752% to 8,981, between genera: 11,652% to 16,300%. These distances are comparable to those from previous studies on freshwater and coastal ostracods.

Deep-Sea benthic respiration: bacterial contribution to sediment community oxygen consumption assessed with allometry

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The structure and function of microbial food webs in deep-sea benthic communities influence the magnitude of carbon remineralization and recycling that occurs at the sediment-water interface. Bacteria have been implicated as the primary recyclers of the deep-sea sediment-water interface based upon their biomass dominance. The direct measurement of bacterial metabolism in deep-sea sediment is difficult, however. For several years we have been collecting samples from bathyal and abyssal benthos off central California to characterize the trophic structure and rates of carbon flow within the sediment community. Measurements of sediment community oxygen consumption and infaunal community structure among several size classes have been made at several deep-sea (>3000m) sites. Respiration rate measurements were based on a benthic chamber (n=3) system equipped with oxygen optodes and a chamber flushing pump enabling repeated measurements (~36 hrs per incubation) during a single month-long deployment. Counts of bacteria, soft bodied protists, foraminifera, metazoan meiofauna and macrofauna are based on ATP and/or microscopic determinations. Allometry has been used to calculate metabolic parameters such as growth, ingestion and respiration, based on the individual carbon content of the infaunal organisms. Using an allometric model for respiration and appropriate biovolume to carbon conversions we have calculated the total respiration attributable to the sediment community. The carbon attributable to bacteria comprises approximately 95% of the total (0.4 gC m^{-2}) sediment community biomass and accounts for 97.7% of the calculated respiration. Reconciling the disparity between estimated and measured respiration rates (~10 mgC day^{-1} m^{-2}) is problematic.

Horizontal distribution patterns in arctic deep-sea macrobenthic communities

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Horizontal distribution patterns of macrobenthos were studied based on material collected at the deep-sea long-term observatory HAUSGARTEN off West Spitsbergen (79°N) during the RV "Polarstern" expedition ARK XIX/3c in July-August 2003. Macofauna was obtained at water depths between 2500 and 2600 m. Samples were arranged using a hierarchical approach to analyze benthic fauna distribution at different scales. Three stations were performed along the 26 km transect. Three giant box-corers (0.25 m²) were taken at each station. Five subcores were extracted from each box corer. Total macrofauna biomasses varied from 2.31 g ww m^{-2} to 6.41 g ww m^{-2}, and densities ranged from 1976 ind. m^{-2} to 3254 ind. m^{-2}. Both qualitative and quantitative methods of statistical analysis confirmed that all samples belong to one benthic community with the dominant species complex Tetractinomorpha gen.sp. – *Diastylis polaris* – *Myriochele heeri* – *Galathowenia fragilis*. The inner heterogeneity in species relative abundance and composition was found at a "sub-community" level. Multivariate analysis showed the division of all samples into two clear groups on the subcore and corer levels. The set of species at the lowest examined level (i.e. in a subcore) allowed the identification of two types of benthic "sub-communities". The size of these sub-communities appeared to be not less than several km across. The hierarchical organization of benthic communities on the continental slope off Spitsbergen includes at least two levels: "communities", which replace each other along the depth gradient (Wlodarska-Kowalczuk et al. 2004), and "sub-communities" which make up the orthogonal inner mosaics in each vertical zone. Wlodarska-Kowalczuk, M., M.A. Kendall, J.-M. Weslawski, M. Klages, T. Soltwedel. 2004. Depth gradients of benthic standing stock and diversity on the continental margin at a high latitude ice-free site (off West Spitsbergen, 79°N). Deep-Sea Research I, 51: 1903-1914.

Meiofauna and Harpacticoid Associations on Seine- and Sedlo- Seamount

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Seine- and Sedlo Seamount were sampled during the OASIS cruise in 2003. Multicorer and Giant-Boxcorer samples were taken. The Meiofauna of the summits and of the surrounding deep-sea is compared on higher taxonomic levels. The 3588 harpacticoid specimen from 9 stations will be compared on species level. Between summit-associations similarities and differences in composition are already found on family level. New species of selected families will be described.

The Tonga and Kermadec Trenches as biogeographical barriers in the South Pacific Ocean: evidence from mtDNA evolution in galatheids from the French Polynesia and the South West Pacific

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We report the preliminary results from a phylogenetic study of galatheids from the French Polynesia and the South West Pacific. These two regions are separated by the Tonga and Kermadec Trenches, which may represent a phylogeographic break. A fragment of the 16sRNA gene was sequenced from numerous species with the aim of testing the hypothesis. A clear phylogenetic break was found across the trench for two of three species that are distributed on both sides. Divergence between the French Polynesian and South West Pacific clades varied from 3-5%. However, the third species showed negligible genetic differentiation, which could be the result of a current gene flow or a recent vicariant event. Preliminary results suggested different origins for the specimens studied of the genera *Munida* and *Raymunida*. These phylogenetic relationships show that different historical processes may have shaped phylogenetic patterns in these two areas. Further analyses (e.g. morphology, developmental biology etc) are underway to complete our understanding of the evolutionary processes responsible for the high taxonomic diversity of this group and its distribution.

Quest for High Resolution Mapping in Deep-Sea Environments

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Marine scientists and decision makers often lack data concerning the distribution of bottom organisms. This information is crucial for understanding the environment and for taking decisions about its sustainable use. It is difficult to collect this information, especially in extreme environments as found at deep-sea hydrothermal vents. Practical, efficient and reliable solutions for the acquisition and analysis of these environments may also be useful for other areas of the marine realm. The obvious limitations imposed by currently available vision systems can, in principle, be overcome by complementing optical data with acoustic data obtained with sounding devices. However, the technology required for their routine application is still immature. As a contribution towards the development of efficient methods for marine habitat mapping, a set of experiments was performed to assess the potential of using echosounder data for this purpose. In the experiments, carried out in a tank, slabs of a hard material were completely or partially covered with different animal patches (shrimps and mussels). A thin acoustic beam produced by a Tritech profiling sonar was aimed at the slabs, at different angles of incidence, and the backscattered energy was recorded. Collected echoes were studied using various feature-extraction methods. This communication includes the results of this preliminary study, it evaluates the potential of the technique developed, and discusses issues that warrant further research.

The response of deep-water decapod communities to depth and seasonal changes in food availability in Le Danois bank (NE Atlantic)

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The community structure and trophic relationships of decapod crustaceans inhabiting Le Danois bank (Atlantic Ocean, NE of Spain) were studied in the framework of the multidisciplinary project ECOMARG (CICYT, REN2002-00916/MAR, Spain) in two cruises performed on October 2003, and April 2004. At depths ranging between 455-1048 m, we found two decapod assemblages distributed on the bank summit and deeper on the head of Lastres canyon with a main faunal change discontinuity appearing at around 600 m. Eleven species of decapods were analyzed to characterize diets (323 specimens; MDS analyses). This allowed the classification of the species in 3 functional guilds: 1) plankton feeders which comprised the shrimps *Acanthephyra pelagica*, *Sergia robusta*, and *Pasiphaea tarda* preying for instance on euphausiids, or calanoids; 2) benthos feeders mainly preying on polychaetes, and comprising the crangonids *Pontophilus norvegicus* and *Pontophilus spinosus*, the crab *Geryon trispinosus* and the shrimp *Aristeus antennatus*; and 3) an intermediate guild comprising the rest of species with a mixed diet which also includes detritus. Among the intermediate guild the Anomurans (*Munida tenuimana*, *Paguris alatus*, and *Parapagurus pilosimanus*) consumed phytoplanktonic detritus in April (as revealed by HPLC analysis), probably linked to peaks of primary production occurring in March-April that can be observed in satellite images of the same area. Both the pigment and isotopic analyses ($\delta^{13}C$/ $\delta^{15}N$ correlations) of the gut contents showed that summit and canyon head species may have different food sources, with the later group having a stronger dependence on marine snow derivates. These results can be explained by a higher proportion of mud and of total organic matter (OM) in the head canyon (82,24% pellites; 6,31% OM at 1028 m) compared to the summit of Le Danois bank (only 13,92% pellites; 2,77% OM at 485 m), the last being a more hydrodynamic zone. Stomach fullness (a mesure of feeding intensity) increased in April both between and within species in most dominant decapods, and both among detritus feeders (*Munida tenuimana*) and benthos feeders (e.g. *Geryon trispinosus*, *Pontophilus norvegicus*), pertaining to a different trophic levels (deduced from $\delta^{15}N$ results: 6.88 ‰ for the hermit crab *Pagurus alatus*, 13.52 ‰ for the crangonid shrimp *Pontophilus norvegicus*). Most species exhibited a parallel increase in their density in April (positive significant correlation between density and stomach fullness). As conclusion, decapod assemblages of Le Danois bank aggregated to feed in most productive periods,

coinciding with a peak of (surface) primary production in March-April. The lowest trophic levels seemed to show a quick response of < 1 month to this peaks in production.

Composition and dynamics of suprabenthos communities around the Balearic Islands (Western Mediterranean)

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The faunal composition and community structure of suprabenthos (Eucarid and Peracarid crustaceans) collected in two areas situated in the NW and SE of Mallorca (Balearic Islands, Western Mediterranean) were studied within the framework of the multidisciplinary project IDEA (CICYT, Spain) at slope depths ranging between 135-780 m. Four stations situated at 150, 350, 650 and 750 m were sampled at bi-monthly intervals during six cruises performed between August 2003, and June 2004, using a Macer-GIROQ suprabenthic sledge, and a WP2 plankton net (both with 0.5 mm mesh size). Based on data from August 2003, 21 eucarid species (17 decapods and 4 euphausiids), 138 peracarids (15 mysids; 76 amphipods – 59 gammarideans, 16 hyperiideans, and 1 caprellidean – 16 isopods; and 31 cumaceans) and 1 Leptostracean were collected. The isopod *Munnopsis beddardi* was a new record for Mediterranean fauna, while at least 10 species (the mysid *Parerythrops lobianco*i, the amphipods *Eusirus leptocarpus*, *Ampelisca* (*dalmatina*), *Haploops niirae*, *Pleusymtes* sp., *Melphidipella macra*, *Amphilochus brunneus*, and *Lysianassa plumosa*, and the cumaceans *Bodotria scorpiodes* and *Diastyloides bacescoi*) were found for the first time at bathyal depths from this region. Suprabenthic assemblages (sampled at daylight) were often separated from the plankton assemblages in MDS analyses, with a low similarity between them (0.5–8%), except for the shallowest station of SE Mallorca at 155 m where similarity increased to 36% because of the simultaneous occurrence of the neritic mysid Leptomysis gracilis in the water column and close to the bottom. This suggest that, excluding the fauna of shelf-slope break (ca. 150 m), suprabenthic species rarely move up into the water column more than 15 m above bottom. Dynamics of peracarid assemblages (performed on the whole sampling series) showed a similar trend for suprabenthic communities both NW and SE of Mallorca. There was a peak of biomass regularly appearing in summer (June 2004, August 2003), with a sharp decrease of biomass, simultaneously occurring at all depths, in autumn (September-November 2003). This pattern in the dynamics of the suprabenthos agrees with that found in previous studies performed at similar latitudes on the slope (e.g. Bay of Biscay) and also in muddy shelf bottoms (off Ebro Delta, and in the Adriatic Sea), and it seems related with the own population dynamics of suprabenthic species. Biomass of suprabenthos (WW) was directly correlated with salinity taken 5m above the bottom, %OM and PPS3months (Chla concentration on surface recorded 3 months before to the sampling time) in Multi-Linear Regression models constructed on 46 data cases. The dynamics of suprabenthos could be related with the temporal dynamics of the levantine intermediate water, LIW, close to the bottom.

Detection of mariner transposons in the genome of hydrothermal organisms: evidence for horizontal transfer in marine invertebrate genomes

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Mariner transposons are small DNA sequences (1300 bp long) able to move in a host genome using a DNA-mediated “cut and paste” mechanisms. Mariner-Like Elements (MLEs) are described as ubiquitous but to date little is known about their occurrence in marine environment. We searched for MLEs in several coastal and hydrothermal invertebrates and found numerous sequences among which 6 displayed a full length open reading frame encoding a putative functional transposase. Phylogenetics analyses revealed that all sequences gather in two MLEs clusters: a hydrothermal one and a coastal one. However, all sequences isolated from marine organisms belong to the same clade, a marine group distinct from the terrestrial MLEs. Our results show that MLEs isolated from very distant species such as the crab, Bythograea thermydron and the amphipoda Ventiella sulfuris displayed 98% nucleic homology. The similarity reached only 70% for B. thermydron MLEs and the coastal crabs, Cancer pagurus and Maia brachydactyla. These results may be explained by horizontal transfer, a process frequently evoked to explain such incongruence. The ability of MLEs to move

within a genome allows their occasional transfer between individuals of different species. The mechanism used to achieve horizontal transfer is believed to involve viruses, bacteria or protozoans as potential vectors. The high level of biomass including viruses and bacteria found in hydrothermal vent environment is convenient with the occurrence of horizontal transfer.

Bioluminescence emission of the deep-water pandalid shrimp *Heterocarpus sibogae* (Decapoda: Caridea: Pandalidae) under laboratory conditions

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The deep-water pandalid shrimp *Heterocarpus sibogae* exhibited bioluminescence by emitting two streams of blue luminous secretions from the mouth when disturbed. The blue luminous materials decayed rapidly and disappeared in seconds. Shrimps were retreated from the luminous region immediately after secretions suggesting the bioluminescence is a defense response. Under laboratory conditions, *H. sibogae* can produce prolonged luminous secretions when continuously stimulated. Maximum emission time was recorded in a female, which reached 634 seconds. Males and non-ovigerous females had similar average maximum emission time of about 30 seconds. Ovigerous females, however, produced significantly longer emission with an average of 110 seconds, suggesting ovigerous females may contain larger amount of the key bioluminescence chemical coelenterazine than males and non-ovigerous females. Longer maximum emission time in ovigerous females may associated with the need for better defense to protect the eggs from being predated, thus maintaining the fitness of the shrimp population. After 43 days of laboratory culture, *H. sibogae* still produced luminous secretions revealing that the shrimps could biosynthesize the coelenterazine for bioluminescence, apart from obtaining it from the diets in the natural environment.

Preliminary results of the ANDEEP III cruise: Distribution of peracarid crustaceans in the deep Weddell Sea, Antarctica

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During the ANDEEP III (Antarctic benthic DEEP-sea biodiversity, colonisation history and recent community patterns) expedition in spring 2005 with R.V. Polarstern samples were taken by means of an epibenthic sledge in depth from 1032 – 4931 m. Preliminary results show that these epibenthic samples are rich in peracarid crustaceans. Among these the Amphipods clearly dominated in abundance. In total 50% of the Peracarida are Amphipods, 33% are Isopods, 11 % belong to the Cumacea, 5% to the Tanaidacea and only 1% are Mysidacea. The high percentage of Amphipods is caused by there enormous abundance at station 133, which was taken on the Powell basin continental slope at a depth of 1584 m. At this station we collected more than 10,700 individuals of peracarid crustaceans, and here the Amphipods are by far the dominant group, with 7,602 individuals. When this station is excluded Isopods are the dominant peracarid taxon with 38%, followed by Amphipods with 33%, Cumacea with 20%, Tanaidacea with 8% and Mysidacea with 1%.

Molecular Particularism and Structural Adaptations of HSP70 (Heat Shock Protein 70 kDa) Genes from Hydrothermal Crabs (Bythograeidae, Eubrachyura)

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The heat shock proteins (HSP) are described in both prokaryotic and eukaryotic organisms and multiple environmental stresses such as exposure to polluting chemical compounds and hypoxia are stimuli for their production. The most studied HSP is HSP70 because it is ubiquitous. It intervenes specifically as a molecular chaperone in the facilitation of the restoration of the function of these denatured proteins and for the transportation of irreversibly damaged proteins to degradative

organelles and proteasomes. It is constituted by the conserved NH2-terminal ATPase region (44 kDa) and the variable COOH-terminal region of 25 kDa, which is divided into a substrate-binding domain (~15 kDa) and a COOH-terminal domain (10 kDa). Since 1977, many deep-sea hydrothermal vents were discovered; described mainly as being between 700 to 3700 m depths. The hydrothermal ecosystem depends on the existence of chemical interactions between the magma source and the surrounding seawater, which is released as superheated water (approximately 300-350°C) with various chemical composition. This environment is considered as "extreme" because high pressure, high levels of potentially toxic compounds and low pH are observed. Bythograeidae is the unique endemic crab family present in hydrothermal environment so it is possible to suggest that it present molecular adaptations to survive in these "hard" life conditions. A phylogenetic analysis, based on 16S information, was built to determine the coastal families closed on Bythograeidae and a HSP70 genes were characterised for different families to establish if a molecular adaptation exist on the Bythograeidae. We characterised the HSP70 genes from the *Bythograea* (B), *Cyanagraea* (C) and *Segonzacia* (S) genera living respectively in Atlantic (S) and Pacific (B, C) oceans and some coastal crabs. The results were discussed on the poster.

Determination of trophic relationships on deep-sea species from the Mid-Atlantic Ridge: a stable isotope approach

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Several macro and megafaunal organisms from the deep-sea environments, collected from hydrothermal vent and non-vent sites, around the Azores and from the Mid-Atlantic Ridge (north and south of the Azores) were studied in order to evaluate their trophic position. A stable isotope analysis approach was used. Stable carbon and nitrogen values overlap and cover a large range within feeding types, indicating a strong overlap in food sources and a high degree of competition for food. Suspension feeders have a broad trophic spectrum through feeding on resuspended material as well as capturing pelagic prey; Benthic deposit feeders use a variety of feeding strategies as the stable isotope indicates. The highly mobile benthopelagic predators/scavengers, are at the top trophic position with the higher nitrogen values, and represent a major link with the benthopelagic food web through their feeding on pelagic prey. The species that leave close to the vents present the lower carbon isotopic values, indicating that at some degree they depend on the chemossynthetic food web.

Trends in body size across an environmental gradient: a differential response in scavenging and non-scavenging demersal deep-sea fish

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Body size trends across environmental gradients are widely reported but poorly understood. Here we investigate contrasting relationships between size (body mass) and depth in the scavenging and predatory demersal ichthyofauna (800-4800 m) of the NE Atlantic. The mean size of scavenging fish, identified as those regularly attracted to baited cameras, increased significantly with depth, whilst in non-scavengers there was a significant decline in size. The increase in scavenger size is a consequence of both intra and inter-specific effects. The observation of opposing relationships, in different functional groups, across the same environmental gradient indicates ecological rather than physiological causes. Simple energetic models indicate that the dissimilarity can be explained by different patterns of food distribution. While food availability declines with depth for both groups, the food is likely to be in large, randomly distributed packages for scavengers and as smaller but more evenly distributed items for predators. Larger size in scavengers permits higher swimming speeds, greater endurance as a consequence of larger energy reserves, and lower mass specific metabolic rate, factors that are critical to survival on sporadic food items.

A global census of marine life on seamounts: are they really oases in the ocean?

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Seamounts have been referred to as oases in the ocean, yet our knowledge is such that this notion can neither be refuted nor accepted. We know that seamounts can support high levels of biodiversity and endemism, that they can play an important role in patterns of marine biogeography, and that they can be highly productive ecosystems acting as feeding grounds for fishes, marine mammals and seabirds. However, our current state of knowledge is such that these observations cannot be taken as generalisations. Under the umbrella of the Census of Marine Life the project CenSeam is conducting a global census of marine life on seamounts, and working towards quantifying what is known, unknown, and will never be known. Seamounts are found in every ocean of the world but of the estimated 100 000, less than 400 have been sampled, and of these, less than 100 in sufficient biological detail. Furthermore, the global sampling effort has been geographically biased - high latitude as well as equatorial seamounts are currently under sampled and the majority of sampled seamounts have summit depths of less than 500m, sampling being limited by practical and financial capabilities. Through uniting the active seamount research community CenSeam aims to establish, at a global scale, the roles that seamounts play in the biogeography, biodiversity, productivity and evolution of marine organisms in order to determine the effect and contribution of seamounts to the global oceanic ecosystem. Recognising that it is not feasible to sample all the world's seamounts, future sampling efforts must be standardised and strategically guided, through assessing the current state of knowledge, to fill critical knowledge gaps and target understudied regions and types of seamounts. This paper will synthesise the current state of seamount knowledge and critically evaluate the global sampling effort stimulating discussion about the future of seamount research and associated methodology and data analysis.

Reproductive patterns of crustaceans in chemosynthetic environments beneath contrasting regimes of surface productivity: a test of Crisp's Rule

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Abundant aseasonal sources of chemosynthetic nutrition at vents and seeps provide natural laboratories in which to examine Crisp's Rule, the axiom that seasonal reproduction in the deep sea is governed by variation in food available to larvae rather than adult organisms. Crisp's Rule predicts seasonal reproduction should not occur in vent and seeps species unless they have planktotrophic larvae and inhabit sites beneath areas of seasonally-varying surface productivity. We tested these predictions by examining the reproductive patterns of four crustacean species: the shrimp *Alvinocaris stactophila* and squat lobster *Munidopsis* sp. at a Louisiana Slope cold seep and two shrimp at Mid-Atlantic vents, *Rimicaris exoculata* from TAG (26^{o} N) and *Mirocaris fortunata* from Lucky Strike (37^{o} N). Reproduction in *A. stactophila* is seasonally synchronous and the release of planktotrophic larvae coincides with a seasonal peak in surface productivity identified from satellite images. In contrast, the putatively directly-developing *Munidopsis* sp. does not exhibit seasonal reproduction. Comparison of summer and autumn samples of *R. exoculata* reveal asynchronous reproduction at TAG, which lies beneath an oligotrophic gyre. Reproduction in *M. fortunata* does not appear to be seasonal, despite planktotrophic larvae, seasonal surface productivity and seasonal reproduction in other species at Lucky Strike. The reproductive patterns described therefore fit the predictions of Crisp's Rule, but seasonality is not inevitable in species with planktotrophic larvae beneath areas of seasonal surface productivity. With seasonal reproduction now known in several vent and seep species, this study adds to the growing evidence of interactions between surface productivity and the ecological dynamics of deep-sea chemosynthetic environments.

Site-specific metal signature in the shells of the deep-sea hydrothermal vent mussel *Bathymodiolus azoricus*

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The bivalve *Bathymodiolus azoricus* is endemic and biomass dominant at the two geochemically distinct hydrothermal vents, Menez Gwen (MG) and Lucky Strike (LS) at the Mid Atlantic Ridge (MAR). It is suggested to be physiologically adapted to the extreme vent environment characterized by high levels of metals, including Fe, Cu and Zn. In this study we report the concentration of essential metals (Fe, Zn and Cu) in whole shells and in different shell-compartments of *B. azoricus* from MG and LS, and levels are compared to those in non-hydrothermal mussels from polluted sites reported in the literature. Inter-site difference of metal concentrations in the shell reflected undiluted fluid composition. Fe concentration from L. Strike exceeded over 25x, and Cu approximately 4x those found in M. Gwen. This study supports the hypothesis that metal bioaccumulation takes place in the shells and thus may prevent toxicity by sequestration of bivalent metals within the shell microcrystals. It is alleged that such sequestration may by an adaptation strategy under the hostile conditions typical at deep-sea hydrothermal vents. It is also concluded that bivalve shells may be considered as good indicators of changes in environmental levels of these metals over the mussel's lifetime.

Distribution patterns and community structure of demersal and benthopelagic fishes on the slope of eastern Brazilian coast

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Demersal and benthopelagic teleost fishes from eastern Brazilian coast (11-22^{o}S) were sampled between 200-2200 m, aboard the R/V Thalassa (IFREMER) from May to July, 2000. Samples were taken using an otter trawl (47.2 x 26.8 m) adapted with 0.65 m diameter rubber bobbins (rockhoppers). A total of 45,368 teleosts, distributed in 208 species, 61 families and 15 orders were caught in 58 trawls. Families with highest diversity of species were: Macrouridae (22), Alepocephalidae (17), Ophidiidae (17), Synaphobranchidae (9), Ipnopidae (8). Diversity was higher on the upper-slope (117 spp.), followed by 95 species on the mid-slope and 85 in the lower-slope. New records for southwestern Atlantic comprised 39% of the identified taxa and included 2 orders, 3 families and 82 species. Numerical abundance was standartized catch in numbers per hour trawling and the data processed by cluster analisys and non-metrical classification of samples, using the quantitative Bray-Curtis dissimilarity index. On the upper-slope it was observed two assemblages: the first (246-565 m) includes the most abundant species collected during the cruise, such as *Thyrsitops lepodopoides*, *Steindachneria argentea* and *Synagrops trispinosus*. The second was exclusively dominated by macrourids, including *Benthodesmus tenuis*, *Ventrifossa macropogon*, *Nezumia suilla* and *Gadella imberbis*. On the mid-slope (922-1374 m), *Conocara macroptera*, *Xyelacyba myersi*, *Aldrovandia affinis*, *Trachonurus sulcatus* and *Synaphobranchus* sp1 were dominant species. On the lower-slope (1545 e 2137 m) one assemblage was distributed all over the area, including *Aldrovandia oleosa*, *Conocara macroptera*, *Narcetes erimellas* and *Bathypterois phenax*. Most species found on the Brazilian slope is widely distributed in the tropical and subtropical western Atlantic, with considerable low levels of endemism. High level of specific similarity was found with the Gulf of Mexico (44%) and Guianas (39%) fish fauna, suggesting that those communities present a long and extense filogeographic conection, following the distribution of the Caribbean fish fauna in the southwestern Atlantic.

The distribution of the small frenulate pogonophores of the NE Atlantic in relation to sediment geochemistry

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The small frenulate pogonophores are typically considered to be inhabitants of muddy sediments on the Continental slope, although some species have been found near hydrothermal vents or at cold seeps. In the NE Atlantic they occur in depths ranging from 30 m to > 4000 m. We present data on the characteristics of the habitats of species from sites on the continental shelf and slope from 48°N to 75°N. The environments inhabited include shallow, organic-rich, fjord sediments, slope sediments and methane seeps. All the species studied obtain nutrition from symbiotic bacteria and most are believed to take up reduced sulphur species or methane through the posterior parts of their tubes that are buried in the anoxic layers of the sediment. However, the majority of the species studied occur in sediments in which dissolved reduced sulphur species and methane are at very low concentrations in the pore water, <100 nM. Evidence is presented that some, at least, of these species are able to undertake some form of 'mining' of particulate sulphides, a mechanism previously demonstrated in the bivalves *Lucinoma borealis* and *Thyasira sarsi*. Other possible explanations for the particular distribution of individual species in the sediment are suggested.

Multi layer biodiversity in the deep Mediterranean Sea: a comparison of spatial patterns of prokaryote, meiofauna and macrofauna diversity

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Continental margins represent hot spot of benthic biodiversity but information dealing with factors controlling diversity at different levels of biological complexity is practically non-existent. This appears of primary importance for a better understanding of the relationships of biodiversity and ecosystem functioning in the deep sea. We investigated the diversity of prokaryote, meiofauna and macrofauna in open slopes characterised by different topographic settings. As such we utilised a multi layer approach in order to investigate whether all these biological components display consistent spatial patterns of biodiversity. Sediment samples were collected in the Strait of Sicily in the framework of the HERMES (Hotspot Ecosystem Research on the Margins of European Seas) project in August 2005. A total of 22 stations located along 5 transects from 183 to 807m depth were selected, including two landslides of the deep Gela Basin and three adjacent open slopes. Prokaryote biodiversity was investigated by means of molecular fingerprinting techniques (i.e. Automated Ribosomal Intergenic Spacer Analysis, ARISA), and meiofaunal diversity was estimated as taxa richness and to the genus/species level for nematodes. Finally macrofaunal was identified to the species level (when possible). Results presented here provide new information on biodiversity patterns and controlling factors at different level of biological organization.

The distribution of cold-water corals on UK banks and seamounts

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We have compiled a cold-water coral database for the NE Atlantic region using over 2500 distribution records for deep-water species (>200 m) dating back to 1868. The database is compiled from a range of sources, including original cruise reports. Although the database holds a great number of records, there are areas and species for which data is sparse. This is particularly true for the solitary corals. During 2005, two photographic seabed surveys were undertaken of banks and seamounts within UK waters. One funded by the Department of Trade and Industry as part of their strategic environmental assessment process; and the other undertaken by the Joint Nature Conservation Committee as part of a routine fisheries monitoring cruise funded and conducted by Fisheries Research Services. Here we describe the known distribution of cold-water coral species on the banks and seamounts of the UK

using both historical and contemporary data sources. The distribution of cold-water corals found in this region are mapped using GIS. Differences between historical and new data are investigated.

Demersal Fishes Communities of the Madeira Archipelago Slope (Eastern-Central Atlantic)

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Located in the Eastern-Central Atlantic, the archipelago of Madeira includes the volcanic islands of Madeira (737 km^2), Porto Santo (41 km^2) and the three Desertas islands (14 km^2). Due to its recent volcanic origin in several eruptive episodes, with source in the Madeira mantle plume, the ocean floor of these islands is characterized by the absence of continental shelf and steep incline of its slope. From 1995 onwards several survey cruises were yearly made (1995, 1996, 1997, 2004 & 2005) to assess the composition, structure and relative abundance of the deep-sea demersal fishes communities inhabiting the Madeira archipelago slope. These cruises were accomplished through the use of the Research vessel "Arquipélago" of the Oceanography and Fisheries Department of the Azores University (DOP). In each survey cruise, fishing sets were made, with a bottom long-line, along randomly selected transepts crossing the bathymetry. Herein the data hitherto collected in the cruises is analysed regarding the species composition, relative abundance and dynamics of the deep-sea demersal fishes communities living along the Madeira archipelago bathyal slope from 200 to 1,200 m deep.

New Data on the Microelements' Composition of the Vent Bottom Fauna

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The distribution of As, Ag, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, and Zn, was studied in different individual tissues of four vent bottom communities dominated by bivalves (*Bathimodiolus azoricus*, *B. thermophilus*, *Calyptogena magnifica*), shrimps (*Rimicaris exoculata*), and Vestimentifera (*Riftia pachyptila*), sampled using the Russian submersibles "Mir-1" and "Mir-2" at Mid Atlantic Ridge (Menez Gwen and Snake Pit) and East Pacific Rise (9o N) hydrothermal fields. Total amount of the analyzed samples being about 90. Positive relationship was found between microelements content in the animals tissues and ambient fluids. Content of all the microelements studied in the bivalves, with the exception of Pb and Cr, was much higher (up to 1-2 orders of magnitude) in soft tissues compared with the shells at most sites. Among soft tissues, the highest concentrations were typical for those organs: gills and digestive tracts of clamps and obturaculum, trophosome and opistosome of Vestimentifera. The anomalously high microelements' contents were detected in gills of vent mussel *Bathymodiolus puteoserpentis*, collected at Snake Pit: Fe -3,749% dry w., Zn - 2500, Cu -975, As –145,8, Mn- 102,5, Pb –94,3, Cd- 63,93, Ag –54,43, Cr- 7,74, Ni –4,5, Co- 2,35, Hg-0,06 ppm dry weight. This is obviously caused by high content of endosymbiotrophic sulfide-oxidizing bacteria inhabiting gills. The lowest metals' levels were determined in the shells of bivalves at all sites. Our preliminary results shows that within the above species sizes and concentrations of microelements in their organs there is no evident relationship, that is probably caused by the unique physiology of animals adapted to extreme chemical environments. The work is partially supported by RFBR, No 05-04-49413.

Phylogeny of Hexactinellida

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Hexactinellida are an important component of the sessile benthos and provide a major fraction of the biomass, especially in deeper waters. They are known from the late Precambrian and are therefore amongst the oldest known metazoans. It is nowadays commonly hypothesized that Hexactinellida are the sister-group to Demospongiae sensu stricto, which is primarily supported by the shared intracellular formation of siliceous spicules along a protein filament, rDNA sequence data as well as the shared possession of demospongic acids, a siliceous sponge-specific biomarker. A strict

phylogenetic system of Hexactinellida has only been proposed once (by one of us, D.J., based on spicule morphology) and remains problematic due to homoplastic or uninformative characters. Further cladistic analyses of morphological character data as well as molecular studies to resolve internal relationships of Hexactinellida had not been conducted so far. Here, we present the first estimate of a hexactinellid phylogeny based on Bayesian analysis of full-length 18S rDNA sequences, taking into account rDNA secondary structure models for evolutionary model selection. Our results so far support some of the classically recognized higher hexactinellid subtaxa as monophyletic, but challenge the monophyly of many others. Further sequencing efforts with respect to taxonomic sampling and inclusion of additional, independent phylogenetic markers as well as morphological character analysis and incorporation of data from the fossil record will allow for a much better understanding of the evolution of hexactinellid sponges through the Earth's history. Financial support: JA 1063/11-1, Wo896/5-1: The phylogeny of Hexactinellida.

Taxonomic Revision of Deep-Sea Pennatulacea

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A review of the morphological taxonomy of Pennatulacea (Anthozoa: Octocorallia) is presented, together with a guide to identification of six deep-sea species of the genus *Umbellula* from the NE Atlantic. Morphological characteristics of true taxonomic value in this group are limited. A combination of the following features is considered valid: presence/absence of sclerites; sclerite shape and size; shape of axis in cross-section; arrangement of autozooids along the rachis (e.g. tassel-like versus pompom; distinct bilateral symmetrical budding along the rachis versus seemingly random disposal). A proposal to re-instate *Umbellula aciculifera* as a species, rather than a synonym of *Umbellula thomsoni* is presented. Classification based on morphological features is compared with phylogenetic relationships suggested by molecular data.

Comparative analysis of the mesopelagic fish community in the northern Mid-Atlantic

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Based on the data collected in the Russian research cruises 2003-2005 in the Irminger Sea and the area westwards of British Islands, the composition and structure of the mesopelagic fish community are considered. The species composition of the catches and its dynamics are considered. The relative abundance and biomass of all fish species and its proportions are provided. The main attention will be paid to reveal the peculiarities in the fish community over the Mid-Atlantic ridge and in the area westwards and eastwards.

Cirratulidae (Polychaeta) from the continental slope Weddell Sea, Antarctica, with description of two new species

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The bitentaculate cirratulid polychaetes are an important faunal element of deep-sea benthic infaunal communities, but are poorly known. Undescribed species are often erroneously identified with names more commonly applied to shallow-water taxa. Eight species of bitentaculate cirratulid polychaetes have been collected from the continental slope and abyssal basins of the Weddell Sea, Antarctica. Seven of these species are new to science. In the present study, two of these new species belonging to the genus *Chaetozone* are described. These species were collected during the ANT XXII/3 (ANDEEP III) cruise in 2005 aboard the German research ship 'FS Polarstern'. Sediment was collected using box cores and multicores from depths of 2000-3000m. Descriptions, original illustrations, and a discussion of the relationship of these new species with related species from other ocean basins are provided. Coding of several new character states, such as peristomial annulations,

location of nuchal organs, location of tentacles and branchiae relative to one another, and methyl green staining patterns are included. This study is part of a larger investigation of the systematics and interrelationships of the bitentaculate Cirratulidae on a global scale. [This study was supported by the National Science Foundation under Grant No. OPP-0086665 and Grant No. DEB-0118693 (PEET) to James A. Blake, University of Massachusetts, Boston.]

Reponses of a Deep-Ocean Bacterial Community to Organic Nutrient

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Near-seabed water samples taken at a site in the North East Atlantic (3170m; 53°29'N, 16°15'W) were incubated for 5 weeks at 4°C under in situ or surface pressure and in the absence or presence of peptone/yeast extract (5:1 ratio: PYE) at final concentrations of 6 and 30mg/l. Total bacterial numbers were determined before and after incubation. Pressurised and unpressurised incubations showed a similar increase in numbers (32-fold) in the absence of added nutrients. Supplementation with 6mg/l PYE produced a 203-fold increase in unpressurised and a 163-fold increase in pressurised incubations. In the presence of 30mg/l PYE the increase in unpressurised incubations (2275-fold) was approximately an order of magnitude larger than that in pressurised incubations (241-fold). Changes in bacterial community structure were studied by means of Denaturing Gradient Gel Electrophoresis with excision and sequencing of the more prominent bands. Gamma proteobacteria (most closely grouped with *Colwellia*, *Moritella* and *Oceanospirilla* spp.) came to dominance in samples incubated with 30mg/l PYE under in situ conditions. Supplementation of pressurised incubations with 6mg/l PYE resulted in groups most closely related to *Cytophaga* and *Flexibacter* spp. predominating. Incubations carried out at atmospheric pressure yielded banding profiles most closely related to the delta and gamma sub-divisions of proteobacteria, irrespective of the nutrient levels used. We conclude that at surface pressures a copiotrophic fraction (possibly allochtonous) of the original bacterial population was stimulated by nutrient addition. Under in situ conditions, the response to added nutrients was less marked, possibly due to the combined effects of low temperature and high pressure. The appearance of different groups in response to differing levels of organic loading, suggests that these groups may be oligotrophic and able to function within a fairly restricted range of nutrient concentrations.

Recovery of novel mobile integron/gene cassette metagenomes from deep-sea environment

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The vast majority of bacteria in the deep-sea environment have yet to be cultured. Hence, it is clear that the majority of their genetic diversity is unknown. This unknown diversity is in the form of undiscovered gene families. Isolation of these genes is limited by lack of sequence information. Here, we outline a strategy for recovering mobile integron/gene cassette metagenomes from different deep-sea environments without laboratory cultivation of the host organism. Integron is gene acquisition and expression system used by bacteria as a way for adaptation to surrounding environmental conditions. We checked the existence of integron in deep-sea free living and symbiotic bacteria. New primers were designed to study the diversity of integrase-encoding genes in deep-sea samples. Also, PCR assays were described to target the 59-base element family of recombination sites that flank gene cassettes, associated with integrons. The integrase gene showed high diversity in hydrothermal vent plume samples. Each symbiont DNA showed the existence of one sequence of integrase gene. Diverse gene cassettes could be amplified from the deep-sea DNA samples tested. These gene cassettes contained novel complete open reading frames homologies to heat-chaperone protein, degradation of proteins, peptides and glycopeptides, metabolic functional proteins etc… The amplified gene cassettes from deep-sea symbionts contained open reading frames that encode interesting functional proteins and enzymes expect to help in the fixation of the life of symbionts within the deep-sea host animals. Accumulation analysis of the gene cassettes amplified from deep-sea hydrothermal vent plume samples showed no signs of saturation and each sample demonstrated different amplification profiles. The success of this approach indicates that integrons are widespread in deep-sea environment and are likely to contribute significantly to functional bacterial diversity. Also, this study demonstrates the viability of direct sampling of mobile metagenome as a route for the discovery

of novel proteins that play an important role in the establishment of bacterial life in deep-sea environment.

Variability in space and time in the abyssal macrofaunal community of the Gulf of Mexico

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We hereby present the results obtained from the analysis of macrofaunal samples collected in the abyssal Gulf of Mexico (depths 3000 to 4000 m) during 8 cruises carried out onboard UNAM's R/V Justo Sierra (Sigsbee 1 to 7) and TAMU's R/V Gyre (DGoMB) from 1997 to 2004. Samples were collected in soft bottoms using US-NEL and MUC corers and sieved with 250 and 300 mesh size sieves. Density average values decreased with depth. Significant differences were recorded with time (ANOVA F (5,18)=8.6994, p=.00025) in the time series station with average values varying from 3819.71 ind.m-2 to 677.33 ind.m2 in the seven years analyzed. Differences were recorded as well between stations located in the northern and southern sectors with values being almost twice as large in the former sector in comparison. The average density between East (carbonate region) and West (terrigenous region) displayed similar differences with values being twice as large in the East. The density values were more than 10 times larger in stations located in the mouth of canyons. The presence of diapers has an important effect with the local distribution of the macrofaunal density and biomass. Our study concludes that food availability and quality define the variability of the macrofaunal community in the abyssal Gulf of Mexico.

Spatial and temporal changes in the diet and feeding of the pandalid shrimp Plesionika martia off the Balearic Islands (Western mediterranean) by stomach contents and stable-isotope analyses

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Spatial and temporal changes in the diet of *Plesionika martia* off the Balearic basin (Island of Mallorca) were investigated. Samples were taken with a bottom trawl from depths between 583 and 752 m at two sites situated in the NW (Soller), and SE off Mallorca island, near the Cabrera Archipielago, from August 2003 to June 2004. A total of 794 *P. martia* were studied to analyze the influence of season, depth, prey availability and reproductive pattern on feeding habits. Simultaneously to shrimps collection benthopelagic macrofauna (suprabenthos) and zooplankton were sampled by means of a Macer-GIROQ suprabenthic sledge and WP2, at the same stations and depths. *P. martia* It preyed mostly on mesopelagic decapods, euphausiids, hyperiids, pelagic mollusks, salps and mesopelagic fish. (more than 90 taxa identified in stomach contents). Diet showed a seasonal pattern with a dominance of salps in August and September, decapods in February, euphausiids in April and hyperiids in August. Multivariate analysis showed two seasonal diets, corresponding to August-September and November-June periods, which coincided with changes in zooplankton communities. Fullness was significantly correlated with maturity state, latitude and month. A coupling between available resources and stomach contents was found, depending not only of the abundance but of the size of some prey (e.g. euphausiids). Stable isotopes values also showed some temporal changes both in trophic levels δ15N, between 7.57‰ to 7.89‰) and in the source of carbon δ13C, between -19.23‰ and -20.27‰.), with δ15N being for intance maximal in June2004. These changes will be compared with changes in the isotopic composition of main prey.

Occurrence and distribution of Black hakes *Merluccius senegalensis* Cadenat 1950 and *Merluccius polli* Cadenat 1950 off Mauritania

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There are two species of hakes distributed in waters off Mauritania, that are commonly known as black hakes, *Merluccius senegalensis* Cadenat, 1950 and *Merluccius polli* Cadenat, 1950. Both species overlaps their bathymetric distribution on the continental shelf and slope where they are fished by Spanish trawling and bottom longliner fleets, which implies mixed fishing statistics. During 2003 and 2004 there were conducted several scientific watching campaigns onboard of trawler ships as well as two experimental campaigns onboard in a longliner ship. Based on obtained data, in the present work there are analyzed general aspects of time-space variation of both species population. It is stated a dependence distribution on depth. *M. senegalensis* was found in poor quantities deeper than 500 m. The overlapping between both species took place from 150 to 500 m, and *M. polli* were caught by trawling in deepest waters, more than 900 m. *M. polli* was the predominant specie of the trawling fleet catches (88 % in weight) that fishing on deep waters, whereas *M. senegalensis* was the most abundant specie into the longliners fishing area, reaching 67 % of the catches. The specimens of both species increase in size with depth, being the average lengths of *M. senegalensis* larger than *M. polli*. It was found significant difference between the length frequency distributions of both species in all the strata of depth.

Some biological parameters of black hakes *Merluccius senegalensis* and *Merluccius polli* in Mauritanian waters

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The black hakes *Merluccius senegalensis* Cadenat 1950 and *Merluccius polli* Cadenat 1950 are demersal species whose geographical distribution overlaps off Mauritanian waters. Spanish trawling and longliner fleets catch both species. During 2003 and 2004, 8101 and 2691 specimens of *M. polli* and M*. senegalensis* respectively were sampled biologically in several scientific watching campaigns onboard of commercial trawling ships and two longline experimental campaigns. From the information stored, it has been calculated the total length (cm) vs. total weight (g) and total length vs. total gutted weight relationships by sexes and species, as well as the conversion factor from gutted to total weight. By means of macrocospic analysis of the gonadic stages and the evolution of the gonadosomatic indexes (GSI) of both species it has been located the spawning season and zones. The spawning season extends mainly from November to February with a peak in December-January for both species, but with quite early in *M. senegalensis*. The males reaches the sexual maturity at lower lengths than females in both hake species (**34, 3 ♂ - 39,2 cm** ♀ in *M. polli* and 33,0 **- 39,2 cm** ♂; in *M. senegalensis*) and females of both species reaches at the same length the first maturity. For the combined sexes, *M. senegalensis* reach the firsts maturity at slightly lower length (35,4 cm) than *M. polli* (37,0 cm). Females dominate the sex ratio in the populations of both species. The largest specimen caught (79,6 cm) corresponded to a female of *M. senegalensis*, as well as two males of great size for the same specie of (65,7 and 67,5 cm total length).

A Descriptive Examination of the Effects of Drilling Activity on the Epibenthic Megafauna of North Western Australia

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Disturbance events and perturbations to natural communities are commonplace, causing temporal and spatial heterogeneity on a range of scales that depend directly on the scale of the community itself. In oil and gas fields, community change is allogenic and is driven by exogenous factors. Species response and adaptation to these factors are fundamental to our understanding of recovery in the disturbed community. Using high resolution ROV (remotely operated vehicle) video transects, this study investigated the effect of offshore drilling for oil on the megabenthic community of the Exmouth

Basin (North West Australia), in terms of altered sediment characteristics, patterns of drill spoil and community response. Oil exploration activities in the northwestern Australian deep waters have created distinct zones of disturbance radiating from the production centre, each with characteristic species assemblages and sedimentary qualities. The zone of heaviest disturbance around oil wells is dominated by a scavenging anemone crab (*Parapagurus pilosimanus* aff.). Low disturbance zones were more species-rich than heavy zones. Motile deposit-feeding and scavenging species were the dominant functional groups. Different disturbance effects were noted between oil production wells and water injector wells, primarily attributed to the drilling regime. ROV technology is the best available tool for the scientific and ecological study in otherwise inaccessible areas where exclusions apply.

Patterns of nematode diversity at hydrothermal vents on the East Pacific Rise

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The megafauna of deep-sea hydrothermal vents exhibit high endemism, high abundance and low species richness compared to non-vent habitats. It is not known, however, to what extent these ecological features apply to meiofauna. Previous meiofaunal studies at vents have largely been confined to observation of species encountered in qualitative mega- and macrofaunal samples. This study describes the taxonomic composition and abundance of nematodes and major meiofauna taxa in quantitative samples from *Bathymodiolus* mussel beds on the East Pacific Rise (EPR). Three vent sites were sampled on the northern EPR and four on the southern. Nematodes, copepods and polychaetes appear to dominate the meiofauna of these samples. The taxonomic endemicity of nematodes appears to be lower that of macro- and megafauna, with genera were present that are not restricted to vents. Among the nematodes, the family Monhysteridae are most abundant with species identified from two genera. Samples from the SEPR show greater diversity with species from 5 additional families: Draconematidae, Cythalaimidae, Leptolaimidae, Microlaimidae, and Desmodoridae. Species dominance appears to change with latitude, suggesting possible biogeographic patterns in meiofauna. To date, meiofauna have seldom been included in ecological studies at vents and it is therefore not clear to whether patterns of faunal zonation and biogeography similar to those known in megafauna are also present in this size class. In a wider context, meiofaunal work at hydrothermal vents provide a natural “control” for testing positive latitudinal gradients in nematode species richness with organic flux in the deep sea.

Not all deep-sea whips are created equal: Genetic analysis of bamboo corals (Octocorallia, Isididae)

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Bamboo corals (family Isididae) are among the most easily recognized deep-water octocorals due to their articulated skeleton comprised of non-spicular calcareous internodes alternating with proteinaceous nodes. Most commonly encountered in the deep sea are species in the subfamily Keratoisidinae, including the genera *Acanella* Gray, 1870, *Isidella* Gray, 1857, *Keratoisis* Wright, 1869, and *Lepidisis* Verrill, 1883. Of particular interest for this study is the branching growth form of the colonies, which most observers use to distinguish *Lepidisis* from *Keratoisis*. In practice, most deep-sea biologists label as *Lepidisis* unbranched, whip-like bamboo corals that often spiral as they get taller; colonies that branch from the internodes are classified as *Keratoisis*. Systematists have debated whether *Lepidisis* and *Keratoisis* should be defined on the basis of “colony branching.” Although recent taxonomic keys use “colonies unbranched” to distinguish *Lepidisis*, the original description of the genus included both branched and unbranched morphologies, with both forms also classified in *Keratoisis*. I analyzed mitochondrial DNA sequence variation from isidids collected between 500–2250 meters depth to address the following question: are unbranched, whip-like bamboo corals in the subfamily Keratoisidinae monophyletic? I sequenced 1426 nucleotides of the mitochondrial *msh1* gene from 28 isidids to construct a phylogeny. Coding of gaps provided additional informative characters for taxon discrimination. The results show five well-supported clades, all grouping both branched and unbranched colony morphologies; there was no single monophyletic clade of

unbranched Keratoisidinae. The *msh1* phylogeny suggests that the distinction between the genera *Lepidisis* and *Keratoisis* should not be based on whether or not colonies branch, and further indicates the need for a taxonomic revision of the subfamily Keratoisidinae.

Distribution and abundance of black corals (Antipatharia) in relation to depth and topography on the New England Seamounts (Northwest Atlantic)

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In May of 2004, the 'Mountains in the Sea' team deployed the ROVs *Hercules* and *Argus*, equipped with high-definition still and video cameras, on ten dives (> 110 hours of bottom time) to document deep-sea coral communities on five of the New England Seamounts (northwest Atlantic) between depths of 1329–2420 meters (and 3841–3879 m on Retriever Seamount). Voucher specimens were collected for at least 27 octocoral and 8 black coral species (species identification is ongoing). In this study we report on the distribution and abundance of antipatharians (black corals) observed in the video transects. Antipatharians have variable growth forms, sizes, and colors, and identification of some species on video is difficult, particularly from higher altitudes (observations were made from altitudes of < 5 meters above the substrate). We classified the taxa into 7 types based on comparison to voucher collections: *Bathypathes*, *Leiopathes*, *Parantipathes*, *Stauropathes*, *Stichopathes*, Schizopathidae n. gen., and "other black coral" (which includes unidentified/uncollected specimens and poorly-seen specimens that may be one of the other types). Smaller and thinly branched antipatharians, such as bottlebrush-like *Parantipathes*, blended into the landscape and may have been missed when the ROV flew at higher altitudes. Thus our density and distribution data are minimum estimates. Our preliminary data show the distribution of antipatharians is patchy both within and between seamounts. Black corals in the family Schizopathidae dominate the fauna, and species of *Parantipathe*s and *Bathypathes* were most abundant, while Schizopathidae n. gen., typically the largest colonies, were rarest. *Stichopathes* were particularly patchy, with all 41 observations in 2004 coming from a single dive on Manning Seamount, although additional specimens were seen in 2005 on Rehoboth Seamount.

New Records of Aphyonidae fishes (Ophidioidei) from southwestern Atlantic

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The family Aphyonidae includes 6 genera and 22 species distributed in all oceans at lower latitudes, occurring on or near the bottom at depths between 230 and 5600 m. *Barathronus bicolor* Goode & Bean, 1886 is the only Aphyonidae species reported in the southwestern Atlantic (Serét & Andreata, 1992). Nevertheless, the single known specimen collected is presumably lost. In February and August 2003, the R/V "Astro Garoupa" (a tug boat adapted for oceanographic research) made two cruises on the continental slope off Rio de Janeiro (1100-1600 m depth) as part of the Campos Basin Deepsea Environmental Project coordinated by CENPES/PETROBRAS. Three specimens of *Aphyonus gelatinosus* Günther, 1878 and one specimen of B. bicolor were collected. The material was obtained using a small otter-trawl semi-balloon net (5.5 x 1.0 m). Counts and measurements follow Hubbs & Lagler (1974) except for the upper jaw length, which was taken from the upper jaw symphysis to the posteriormost point of the maxillary (Nielsen, 1969). Vertebral counts were taken from radiographs.

UV Photosensitivity in a Deep-sea Benthic Crab

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During an NOAA Ocean Exploration funded research cruise in the Gulf of Mexico (Operation Deep-Scope 2005), new techniques were used which proved to be very successful at collecting deep-sea benthic crustaceans with intact photoreceptors. Collections were made from Harbor Branch Oceanographic Institution's Johnson-Sea-Link (JSL) submersible under red and orange illumination,

so that collections could be made without blinding the animals. Two collection techniques were used. Baited traps were deployed, together with a decoy bait bag placed some distance away. The decoy was needed to lure away the larger crabs, which would otherwise guard the traps and prevent the smaller crabs from entering them. The traps were recovered on a subsequent dive and deposited into specially constructed black BioBoxes, which are thermally insulating and light tight when closed at depth. In addition, the suction sampler on the arm of the JSL was modified so that crabs could be picked up and deposited directly into a BioBox, which was then sealed for the trip back to the surface. Even though over half the cruise was lost due to Hurricane Katrina, 7 species of crustaceans were collected from bottom depths of 525 to 550 m. These included anomuran crabs *Gastroptychus* sp, *Eumunida picta*, *Munidopsis tridentata* and two unidentified genera, the brachyuran crab *Bathynectes longispina*, and 1 unidentified caridean shrimp. A surprising discovery, revealed by electrophysiological recordings, was that *Gastroptychus* has an ultraviolet photoreceptor, in addition to the usual blue receptor. The role of ultraviolet photoreception in such a deep-living crab remains a mystery, but preliminary data from the caridean shrimp suggest that it too possesses UV sensitivity, while *E. picta*, *M. tridentata* and *B. longispina* do not.

Deep-sea Chondrichthyes caught between 1000 and 2500m off Madeira (NE Atlantic Ocean

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A collection of deep-sea Chondrichthyes from the waters of the archipelago of Madeira was studied. The specimens were caught between 1000 m and 2500 m during two research cruises in 2004 and 2005, using bottom longlines and baited fish traps set off the islands of Madeira and Porto Santo and at Unicorn (34º 35'N, 14º 28'W) and Seine seamounts (33º 45'N, 14º 22'W). Fourteen species of Chondrichthyes were identified, belonging to 6 families: Mitsukurinidae, Scyliorhindae, Centrophoridae, Etmopteridae, Somniosidae and Chimaeridae. For some of the species caught and due to its rarity, data regarding depth of occurrence, sexual matury and morphometry are given. This research was co-funded by the EU in the framework of the Initiative INTERREG III-B (Madeira, Azores, Canaries), projects PESCPROF-1 (MAC/4.2/M12) and PESCPROF-2 (03/MAC/4.2/M8), and Câmara Municipal do Funchal.

Baseline study of benthic communities and of their habitats in deep-sea polymetallic nodule fields in the North-East Pacific: the NODINAUT cruise

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The main objective of the NODINAUT cruise was to conduct a baseline study of the benthic communities and of their habitats on two French mining claims in the Clarion Clipperton Fracture Zone (N-E Pacific), before a potential exploitation of polymetallic nodules. The structure of the benthic communities was assessed in terms of diversity, abundance and distribution together with the description of environmental parameters (geological, physical and chemical characteristics), in order to test for influence of habitat features on spatial variability of the communities. This study was mainly conducted at two spatial scales, the regional scale (two areas 1200 miles distant), and the local scale (different nodule facies, mile scale). All the size classes of fauna (megafauna, macrofauna, meiofauna and microbiota) have been sampled either by USNEL boxcorer and multicorer (operated by wire), or using the submersible Nautile and its associated tools. Submersible dives allowed to work on targeted areas, in particular to distinguish the different nodule facies. The results suggest that the presence/absence of nodules on the seabed influence differently the different size classes of fauna in terms of abundance and diversity. Moreover, the long term effects of physical disturbance made by a dredge 26 years ago were investigated in order to evaluate the recovery of the sediment and benthic community. Sediment, water and fauna were collected in a dredge track still visible on the bottom. Oxygen and nutrient fluxes at the water-sediment interface were measured using a respirometer, exactly positioned in the track by the submersible Nautile. Imprint of the disturbance was still evident on most of chemical profiles but biological activity and nutrient flows at the interface seemed restored. Results in terms of community structure are still being processed. The NODINAUT cruise provided informations to two international programmes aiming at evaluating biodiversity in the deep sea,

Census of Marine Life/CeDAMar and the "Biodiversity, species ranges and gene flow in the abyssal Pacific nodule province" programme.

Lost Village in the suburb of the Lost City: new evidences about bottom fauna at off-axis hydrothermal vents

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The Lost City hydrothermal field is located at 30N on the Atlantis massif more then 15 km away from the spreading axis at a water depth of 750 to 900m. This field is most distinctly different from all other known hydrothermal fields in that it is underlied by ultramafic rocks and is dominated by spectacular steep-sided carbonate chimneys. In August 2005 the Lost City was revisited on the 50th cruise of the RV "Akademik Mstislav Keldysh". During the dives with submersibles "Mir" samples of bottom fauna were recovered including obligate hydrothermal species inhabiting porous interiors of the carbonate edifices. Active chimneys, inactive tower flanges and the complex base were explored. Initial analysis revealed the presence at least 55 species. Our observations reveal qualitative differences in species abundance and composition with substrate type. A dense aggregation of mytilid valves presumably belonging to *Bathymodiolus azoricus* (about 80-100 m from the north on the south and from 25 up to 40-50 m from the west on the east) was revealed at the southern slope of Atlantis massif (depth 1016-1072m). The abundance and disposition of shells force to think, that they lived in this area, instead of have been drifted from smaller depths. This found extinct community existed in historically foreseeable time what the condition of valves testifies. On shape and structure this community was similar to modern upper-bathial Atlantic communities Menez Gwen and Lucky Strike with the dominance of *Bathymodiolus azoricus.*

Phylogenetic relationships of two distinct groups of molluscs from deep-sea chemosynthetic ecosystems

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Deep-sea chemosynthetic communities at hydrothermal vents, hydrocarbon seeps and sunken dead whales and wood were first discovered three decades ago. Since then, many new species of different taxonomic groups were been described. Gastropods and bivalves are important elements of chemosynthetic ecosystems, however the phylogenetic relationship between mollusc species at deep-sea chemosynthetic sites and their shallow-water relatives is still poorly understood. Although certain physiological adaptations occur in chemosynthesis based organisms, some morphological characteristics show high similarity with those of the phylogenetic group to which these organisms belong, rather than being affected by their particular environmental conditions. The present study involves phylogenetic analyses of two distinct groups of molluscs: families Skeneidae (Gastropoda) and Mytilidae (Bivalvia). These have several representatives in deep-sea chemosynthetic ecosystems but their phylogenies are far from being resolved. Shell microstructure and DNA sequence data will be combined to better understand the relationships amongst the members of these taxa. Preliminary results based on Scanning Electron Microscopy (SEM) of shell microstructure of 17 species from 13 genera and DNA sequences are presented here.

New Ancorabolidae (Copepoda: Harpacticoida) of the Atlantic ocean. The taxon *Ceratonotus* Sars, 1909

George K.H.

Ancorabolidae Sars, 1909 are "typically", but not exclusively found in deep-sea samples. With a long and slender body, laterally projecting swimming legs, and often with strongly developed dorsal, dorsolateral, and lateral cuticular processes, they present a very peculiar and bizarre body shape. Up to date, 58 species are allocated into the family, which is split into the subfamilies Ancorabolinae Sars, 1909 (27 species in 13 genera), and Laophontodinae Lang, 1944 (29 species in 7 genera). Although in

the past years the scientific interest in the systematics of Ancorabolidae has increased remarkably in comparison with the preceding decades, an overall phylogeny of the taxon is far from being established. This is partly due to the rarity of ancorabolid representatives in meiofaunal samples and the resulting lack of phylogenetic information. The taxon *Ceratonotus* Sars, 1909 is represented by four species so far. However, deep-sea material sampled by German RVs “Polarstern” and “Meteor” in the Atlantic ocean provided three new species, *Ceratonotus steiningeri* sp. nov. (Arctic Laptec Sea), *C. tauroides* sp. nov., and *C. vareschii* sp. nov. (both Angola Basin, South Atlantic). The new species present several characteristics which are of great importance for detailed phylogenetic studies, particularly concerning the relationship to the genus *Dendropsyllus* Conroy-Dalton, 2003.

Fish and Crustacea Associated with Lophelia Reefs in the Agassiz Coral Hills (Blake Plateau) in the 'OSPAR' region of Northeast Atlantic

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Habitat destruction by bottom trawling over deep-sea coral beds and commercial fishing (*Orange roughy*, *alfonsino*, and *Coryphaenoides* spp.) over summits of seamounts are now known as two fundamental threats. Recent evidence of “pirate fishing” (IUU – Illegal, Unregulated and Unreported commercial trawl-fishing or long-line fishing) calls for immediate ban by UN in the highseas. This poster tabulates estimated unknown number of species from seamounts of all marine metazoan groups. Several figures and tables illustrate or list fish species and crustaceans, both isopods and decapods, in the Blake Plateau (Agassiz Coral Hills off North Carolina coast) on Northwestern Atlantic and OSPAR region in the Northeast Atlantic Ocean. This poster also reports on benthopelagic munnopsidid asellote isopod species (adapted for swimming), associated with *Lophelia* coral reefs at bathyal depths (200 – 800 m). Four new species of munnopsidid isopods are now known (George 2006, In Press) to be associated with the *Lophelia* reefs off Cape Lookout, North Carolina: *Acanthocope ahlfeldi* n.sp., *Munnopsis reedi* n. sp., *Torbenocope hulti* n.gen., n.sp. and *Ilyarachna thistlei* n.sp. *Munnopsis reedi* n. sp. is similar in morphology with the type species *Munnopsis typica*, originally described by Michael Sars (father of the reputed Norwegian carcinologist, G. O. Sars).

Polychaetous annelids from North Atlantic seamounts: Ampere, Galice, Gorringe, Josephine and Seine: a biogeographical approach

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A study of the polychaetous annelids living on North Atlantic seamounts was undertaken to give data on biogeography of seamounts. The data from the Ampere, Galice, Gorringe, Josephine and Seine banks came from the SEAMOUNT 1 Expedition on board the Noroît in 1987. Eighty three sites from 54 m to 2,100 m depth were sampled: 15 samples on Ampere (7 with polychaetes), 12 samples on Galice (6 with polychaetes), 26 samples on Gorringe (15 with polychaetes), 15 samples on Josephine (15 with polychaetes), and 15 samples on Seine (15 with polychaetes). In all 2081 polychaetes from seamounts were collected: 359 individuals on Ampere, 488 individuals on Galice, 567 individuals on Gorringe, 452 individuals on Josephine, and 215 individuals on Seine. The dominating families were Syllidae, Amphinomidae, Onuphidae and Eunicidae. The species richness is 83 species for the five seamounts: 24 species on Ampere, 28 species on Galice, 37 species on Gorringe, 39 species on Josephine, and 25 species on Seine. The most abundant species were *Hyalinoecia tubicola* (223 individuals), *Eunice vittata* (116 ind.), *Nereis rava* (109 ind.), *Pareurythoe borealis* (105 ind.) and *Haplosyllis spongicola* (83 ind.). Four species are shared on the five seamounts: *Ehlersia cornuta* (17 ind.) *Euphrosine armadillo* (21 ind.), *Haplosyllis spongicola* (83 ind.) and *Nereis rava* (109 ind.). Results of the biogeographical distribution of the polychaetes collected on these five seamounts will be compared with the results of SEAMOUNT 2 Expedition (Gillet & Dauvin, 2000 ; Gillet & Dauvin, 2003) and with those from other seamounts.

Bivalves molluscs of the genus *Policordia* of the Atlantic Ocean

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The genus *Policordia* (Bivalvia, Lyonsiellidae) comprises specialized carnivorous bivalves. It is a rare but consistent component of deep-sea fauna. We've studied bivalves of this genus obtained during 4 research cruises to different regions of the Atlantic Ocean (Cruise 4 of Akademik Mstislav Keldysh, Cruises 11 and 43 of Akademik Kurchatov, and Cruise MAR-ECO of G.O. Sars). Samples from 11 stations taken at depths from 966 m to 6150 m have been examined. The collection includes 8 species, out of them 6 are tentatively new. Details of anatomy showed that morphological diversity in this genus is higher than anticipated before and this diversity does not fit into currently recognised subgenera. The subgeneric level in this taxon requires revision. For the first time *Policordia* has been found in the Caribbean Sea and the Orkney Trench. The depth limit of distribution has been extended from 3917 m to 6150.

The biodiversity and biogeography of komokiacean foraminifera in ANDEEP III samples from the abyssal Southern Ocean

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The superfamily Komokiacea was established by Tendal & Hessler (1977) based on samples from the central N. Pacific with additional data from the Atlantic, Pacific and Indian Oceans. Several species were subsequently described from the Atlantic. The Russian literature includes reports of komokiaceans at sites in the Southern Ocean but there are no species-level studies of this important deep-sea taxon in Antarctic waters. This gap in our knowledge was remedied during the ANDEEP III campaign when we recognized 42 komokiacean morphospecies (excluding *Rhizammina* spp.) at 12 stations south of 60º S with an additional 7 species confined to the adjacent Cape and Anguillas Basins. The family Komokiidae is represented by 25 species, the Baculellidae by 11 species, and chain-like taxa by 13 species. At least 34 species are undescribed. Komokiaceans were most abundant and diverse in the central Weddell Sea (4800-4950 m) where 25-27 species (total 33) occurred at each of three stations. They were fairly diverse at another abyssal station (4700 m) on the 0º Meridian (11 species) and in the Powell Basin (3400 m; 8 species) but poorly represented or absent at bathyal sites (<3000 m) near the Antarctic continent. Some species had wide distributions; *Normanina conferta* (12 stations), *Reticulum* sp. A (7 stations) and *Septuma ocotilla* (6 stations). Six other species occurred at 5 stations. However, 18 species, all undescribed, were confined to single sites. More than half (22) of the 42 species are known from the N Atlantic suggesting that a considerable degree of faunal continuity exists between these two areas. Seven species are also known from the Pacific. Thus, a core group of common komokiacean species, belonging to genera such as Baculella, Edgertonia, Ipoa, Komokia and Septuma, are widely distributed at abyssal depths. At particular sites, they are supplemented by additional rarer species. This pattern of species occurrences seems to be common in many deep-sea taxa.

The Eastern Mediterranean is a Deep-Sea Desert

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The Levantine Sea at the easternmost Mediterranean is isolated from the deep Atlantic and western Mediterranean waters by the shallow Gibraltar Straits and the Siculo-tunisian sill. The Levantine deep waters are ultra-oligotrophic and distinguished by temperature values that are higher than in the rest of the sea. A series of cruises conducted off the northern coast of Israel as part of pollution monitoring surveys at depths between 1000-1500m, afforded us an opportunity to examine the deep Levantine ichthyofauna. Though extremely sparse, the number of deep-water fish species known from the Levant increased to 38, as compared to the number of deep-water fish species known from the entire Mediterranean (58). The species richness in the Levantine Sea is comparable to other Mediterranean basins of a similar size. Contrary to the widely perceived notion of Mediterranean eastward progressive faunistic decline, our findings suggest that the ichthyofaunal richness is correlated with the

level of research. *Bathypterois mediterraneus* and *Nezumia sclerorhynchus* were the prevalent species; the Macrouridae, Ipnopidae and Nettastomatidae were the most common families, with respectively 35%, 25% and 12% of the specimens.

The deep-sea fauna associated with mussel beds and alvinellid polychaete colonies at 9°N EPR, the composition and structure

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Repeated samples of mussels and alvinellid polychaete populations and their associated fauna were collected during 49th cruise of Russian RV «Akademik Mstislav Keldysh» at 9°N EPR. 13 samples from 4 active hydrothermal vent sites were analysed. Six of them were collected from alvinellid polychaete populations, six of them from mussel beds and one of them from vestimentiferan tubeworms cluster. Mussels (*Bathymodiolus thermophilus*) occupied low-temperature zones (<10°C) associated with cracks in lobate basalt lavas. Vestimentiferan *Riftia pachyptila* clusters often settle among mussels, but they prefer cracks with the more strong flow. Alvinellid polychaete assemblages live in the hottest part of the hydrothermal environment (<40°C) at the surface of sulphide chimneys. The species composition of mussel beds differs from the species composition of alvinellid settlements. There are some taxes in each assemblage, which were not found in other settlement. It was found 67 morphospecies. The species richness was almost twice higher for mussels populations. The pair-wise comparisons (Gakkar's index) showed the greater similarity between alvinellid samples, than between mussels samples. Polychaetes are the most diverse group, gastropods are on the second place in both assemblages. Mussels samples were numerically dominated by limpets (Lepetodrilidae – 31%), amphipods Lysianassidae (*Ventiella sulfuris*) (27%), copepods (13%), polychaetes Ampharetidae (*Amphysamytha galapagensis*) (11%). Alvinellid polychaete samples were numerically dominated by copepods (77%). The percentage of species, which have the same rank order, always is lower for alvinellids, than for mussels (except the first rank order). Grazers and bacteriovores are the most numerous trophic groups at mussel beds and alvinellid polychaete colonies. Thus, mussel and alvinellid polychaete settlements distinguish by species composition and ecological characteristics.

Hunting the Wild Symbiont: Free-living tubeworm symbionts at deep-sea hydrothermal vents

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Unlike most major ecosystems on earth, deep sea hydrothermal vent communities have at their base chemosynthesis, rather than photosynthesis. Symbioses between metazoans and chemoautotrophic bacteria account for some of the major trophic relationships there. One such relationship at vent sites along the East Pacific Rise, involves the vestimentiferan tubeworms *Riftia pachyptila*, *Tevnia jerichonana*, and *Oasisia alvinae*, mouthless and gutless organisms that rely entirely on their endosymbiotic chemoautotrophic bacteria to prove them with organic carbon. In spite of the obligate nature of this symbiosis, the symbionts are transmitted environmentally. Here, we describe a systematic search for a free-living counterpart to the tubeworm symbiont. Recruitment devices containing pieces of autoclaved Columbia River basalt and glass microscope slides were deployed and recovered on the East Pacific Rise at 9ºN at deployment times ranging from less than a month to one year. Natural environmental samples were also collected. Recovered basalt pieces and water samples were screened via PCR for the presence of the tubeworm symbiont phylotype using symbiont-specific primers as well as host specific genes to rule contamination of samples. The tubeworm 16S rRNA phylotype has been recovered from many of these samples. In addition, fluorescence in situ hybridization performed on glass slides using probes specific to the tubeworm symbiont phylotype. Both techniques indicate that the tubeworm symbiont or an identical phylotype is present both in the water and on surfaces at these vent sites. Elucidating the distribution and abundance of both host and symbiont, and is important in understanding the free-living microbial diversity at deep-sea hydrothermal vents.

New technologies for the study of ecosystem consequences of seabed disturbance: The development of an „Integrated Sediment Disturber“ (ISD)

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New, innovative technologies developed and integrated within the EU-project COBO (Coastal Ocean Benthic Observatory) will be used to study benthic responses to natural and anthropogenic factors. The primary objective of COBO is to integrate emerging and innovative technologies from different disciplines (physics, chemistry, biology, and imagery) to provide in situ experimentation and monitoring of sediment ecosystems. The Alfred Wegener Institute for Polar and Marine Research (AWI) leads a workpackage within the COBO-project developing an “Integrated Sediment Disturber” (ISD), in order to understand the complex interactions between the biota (their functioning and diversity) and environmental pertubations. The ISD frame carries three rotating fork-like disturber units, which will repeatedly rework surface sediments simulating physical disturbances. Disturber arms are 50 cm in length generating a circular reworked area of about 0.75 m². Three disturbed zones and an undisturbed control area will be monitored continuously using a digital camera and a microprofiler with oxygen microelectrodes. To study disturbance effects on the benthic community sediment sampling will be carried out using coring devices handled either by divers or a remotely controlled vehicle (ROV). This will allow the investigation of biodiversity shifts in response to pertubation and the changing chemical condition of the sediment. The ISD frame can be lowered to the seafloor on a wire (shallow-water version), however, there are attachment points for floats allowing to convert the ISD frame into a free-falling device (bottom-lander version). Integrated observations of the natural environment at high spatial and temporal resolution will enable a quantitative description of the fundamental processes governing the interaction between the biota and its chemical environment in the sediment. The ISD will be developed in close cooperation with CEFAS (Centre for Environment, Fisheries & Aquaculture Science, UK) and CEA (Commissariat á l´Energie Atomique, France).

Bathyal and Abyssal Fish Tracking

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In the present study we compare the swimming behaviour of three deep demersal fishes tracked in the NE Atlantic Ocean, in a tropical upwelling region off West Africa (ca. 17°N) and at temperate latitudes in the Porcupine Seabight (ca. 49°N). Swimming data for *Coryphaenoides armatus* were obtained at both stations while *Antimora rostrata* was only tracked at Porcupine Seabight and the first swimming data for the ophidiid *Barathrites iris* were obtained off West Africa. The swimming performance of these scavenging deep-sea fishes is described with regard to depth range, latitudinal distribution and seasonal variation. There is an observed trend of slower swimming speeds with increasing depth across the three species: *C. armatus*, 0.4040m.s^{-1}; *A. rostrata*, 0.5306m.s^{-1}; *B. iris*, 0.2135m.s^{-1}.

Reproductive biology of pogonophorans from cold seeps in the European margin: Species from mud volcanoes in the Gulf of Cadiz

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Pogonophorans (Polychaeta: Siboglinidae) are ecologically important members of deep-sea chemosynthetic communities, including cold seeps on the European margin. In the last two decades the cold seep environment has received considerably attention by researchers of all areas of marine sciences. The 6th framework Integrated Project HERMES, has recognised the cold seeps from the Gulf of Cadiz, eastern Mediterranean, and Norwegian margin as important study sites. The reproductive pattern of an organism plays a major role in the dynamics of the population and the biogeography and continuity of the species; its knowledge is fundamental to fully understand the functioning of an ecosystem. Embedded in the HERMES programme, this work represents the first steps towards the understanding of the reproductive pattern of pogonophorans from the above sites. We used histological techniques to study the anatomy of the reproductive system, and to compare the

fecundity and the reproductive condition of different species from the genera *Siboglinum*, *Polybrachia* and *Oligobrachia*, collected in the TTR-14 and TTR-15 cruises, from mud volcanoes in the Gulf of Cadiz.

Review of Lophiidae (Order Lophiiformes) of Taiwan, With Description of Two New Species

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The anglerfishes in family Lophiidae are reviewed base on all known specimens. Of them, eight species in three genera are recognized. Two species are described herein as new in *Lophius* and *Lophiodes*, respectively. The new species are different from their congeners in the escal morphology and other combined characters. Three additional species, *Lophiodes naresi*, *L. insidiator* and *L. miacanthus*, are new recorded from Taiwanese waters. *Lohpius litulon* is re-collected form northeast Taiwan which is southernmost locality of its distribution. Diagnosis and distribution for each species are provided.

Britain's Deep-Sea Landscapes

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Britain's deep-sea territory covers an area almost twice the size of the UK's land surface. The DC-UK project, funded by the Esmée Fairbairn Foundation, has been designed specifically to help conserve and raise awareness of the marine natural heritage of this amazingly diverse environment. It is a largely unknown environment to all but a few specialist scientists, yet it is an environment that is under threat; with both the oil and gas industry and the fishing industry extending their operations into deeper and deeper water. Britain's deep-sea landscape is very rich in habitats and biodiversity, perhaps more so than many other deep-sea areas worldwide. It is time there was a greater awareness of this extraordinary environment at all levels – from public, to NGO, through to UK Government. The DC-UK project will provide practical information on threats to offshore biodiversity, valuable new information to help future conservation management and will disseminate this information to a wider public. One of the key elements of the DC-UK programme is the development of an image library containing photographs and video collected during scientific surveys. The Deepseas Group at the National Oceanography Centre, Southampton has a vast archive of material, which is being sorted and catalogued ready for publication online. Included are images of coral thickets formed primarily by the deep-water coral Lophelia pertusa which were discovered on small sediment mounds – the Darwin Mounds – at a depth of ~1000m. This discovery, made by scientists of the SOC in 1998, prompted the designation of the UK's first Special Area of Conservation in offshore waters. Images representing many of the UK's deep-sea habitats will be represented in the image bank; from the iceberg-ploughmark zone to barchan sand dunes and mud diapers. The publication of these valuable images will provide a unique opportunity to visualise this hitherto unseen environment.

Sustainable management of deep-water fisheries and their impact on marine biodiversity

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Deep-water species currently comprise approximately 3% of the global marine catch and it is estimated that 40% of the world's trawling grounds are now in waters deeper than the continental shelves. In the north-east Atlantic deep-sea fisheries have already had a devastating impact on the fish populations, such that, in their 2004 report ICES recommended an immediate reduction in established deep-sea fisheries unless they can be shown to be sustainable. For some species like roundnose grenadier a 50% reduction in effort was specified. For deep-water sharks ICES recently recommended a zero catch, stressing that fisheries taking deep-water sharks as bycatch must be reduced if means to avoid their bycatch cannot be found. Deep-water fish stock decline is in part a result of poor management of the stock. Deep-sea species/stocks have been depleted before

appropriate management measures have been implemented. Only in the last 2 years have total allowable catch limits (TACs) been introduced by the European Union for some deep-water species including black scabbardfish, blue ling, orange roughy, and roundnose grenadier. There are currently no such regulations regarding deep-water sharks. This project will use both historical and current data from deep-water trawl surveys in the Rockall Trough region to inform the development of an ecosystem based approach to management of the deep-water fisheries through the use of mass balanced trophic models (Ecopath with Ecosim). The impact of the removal of deep-water fish species on the deep-water ecosystem and the impact of changes in management regime (gear restrictions, closed areas) will be modelled. In addition, historical pre-fishing data on the fish populations of the continental slope will be compared with the most recent data to elucidate changes in the fish communities.

SERPENT Project: Linking deep-sea science to the oil and gas industry

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The SERPENT Project (www.serpentproject.com) (Scientific & Environmental ROV Partnership using Existing INdustrial Technology) is a collaborative programme between scientific institutions and companies associated with the oil and gas industry. SERPENT is hosted at the National Oceanography Centre, Southampton (NOCS), one of the world's largest research and teaching organisations specializing in deep-sea science and oceanography. SERPENT encompasses a scientific network of academic partners across the world linked to a network of major oil and gas operators and contractors. The project centers around the opportunistic and ad-hoc use of ROVs (Remotely Operated Vehicle) in operational settings during periods of non essential use (Stand-by time) and the utilization of data collected as part of routine offshore work and previous environmental assessment. The presentation will discuss the dynamics of how the project works and the research be carried out in collaboration with industry on a range of deep-sea research projects, and also how the project has developed an active educational outreach project.

Living off yesterday's news? A new record of vestimentiferans (*Lamellibrachia* sp.) from a deep shipwreck in the eastern Mediterranean

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Specimens of the vestimentiferan tubeworm *Lamellibrachia* sp. were collected from the wreck of the S.S. 'Persia' at 2800 m depth southeast of Crete, in association with masses of compressed newspaper in the ship's mailroom. Anaerobic breakdown of cellulose by bacterial consortia including sulphate-reducers is proposed as the source of sulphide required by *Lamellibrachia's* chemoautotrophic symbionts. Timing of wreck colonization by vestimentiferans is unknown but observed tube dimensions suggest growth rates at least equal to those measured at Gulf of Mexico hydrocarbon seeps. The organic substrate supporting vestimentiferan growth in the 'Persia' is unusual in consisting of highly refractory, human-modified terrestrial plant material. This record therefore expands the range of energy sources known to support chemosynthetic biota at the deep-sea floor.

Factors controlling the bathymetric distribution of crustaceans on the continental slope and Abyssal plain in the Porcupine Seabight

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The aim of this study was to examine the bathymetric distribution of benthic decapods and relate this to physical and biological parameters. Decapod samples from the Discovery Collection were collected between 1976 and 1999 at depths between 200 and 4850 m in the Porcupine Seabight, southwest of Ireland (centred on 51° N 13° W). Specimens were identified and counted, only Reptantia and

benthos-related Natantia were considered in the analysis Decapod distributions change with depth has been shown in other areas but horizontally change within a depth range and temporally variation should also be considered. The lateral distribution of the species could not be investigated, but the study of a single species, *Dorhynchus thomsoni* revealed a high degree of aggregation. No seasonal changes on the species distribution were detected, even though this has been suggested to be an important factor. Our results showed that samples, species and species clusters were segregated along the depth gradient in the Porcupine Seabight. Regarding their species composition, the stations can be divided into upper, mid and lower slope groups, and a distinctive abyssal plain group. The species clusters found in the area are not likely to correspond to close-knit communities but rather to a continuous gradient. However, the limits of those clusters show depths of rapid species overturn. The number of decapod species, abundance and biomass decrease from upper slope to the abyssal plain. The rate of decline varies between decapod groups. Depth in itself does not cause zonation, but there are a range of physical and chemical factors that vary with depth, such as pressures, feeding gradients and sediment composition and transport. Interaction within or between species will also be important in controlling species ranges. In the Porcupine Seabight, the main controlling factors identified for species aggregation were pressure, temperature, food gradient and biological interactions.

Biodiversity of Meiofauna on Margins of European Seas

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Cutting the continental shelf or slope, submarine canyons form large corridors from shallow water to the deep-sea. They contain very complex ecosystems and show a large variability. However, canyon systems remain poorly studied, largely due to difficulties exploring their complex terrain. With recent developments in technology, it seems that the knowledge of canyon ecosystems will thrive in the nearby future. Submarine canyons are considered 1) hotspots for high faunal biomass and biodiversity, 2) pathways for transport and burial of organic carbon, 3) channels for material transport from land to sea and 4) potential barriers or traps for carbon and organisms. The flux of organic matter has proven to be an important factor regulating benthic standing stocks. Not only will the degradation of the sedimentating organic matter play an important role in deep waters, also spatial and temporal differences in primary production rates influence benthic production and diversity. Other research has shown that hydrodynamic disturbance – an important factor in canyons – plays a key role in the formation of structural biodiversity. The diversity of canyons on variable spatial scales and to what extent environmental variables are responsible for this diversity however, remains to be studied, especially on meiofauna level. During the HERMES project, various canyon systems will be sampled for meiofauna study. By identifying structural (community structure) and functional (feeding types, stable isotopes) diversity of meiofauna (nematodes) in canyons from various biogeochemical provinces along the European continental margin and linking them to environmental variables, we can get an idea on how biodiversity in these canyon ecosystems is driven and maintained.

Distribution of Nematode and Harpacticoid Fauna in the Central Indian Ocean

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Free-living nematode and harpacticoid fauna of the deep-sea sediments associated with abyssal hills and seamounts of the Central Indian Ocean has been studied for its spatial and vertical distribution. A total of 49 sediment samples were collected using a USNEL type box core (50x50x50 cm size). The sampling stations were located in the depth range of 5000-6000m, hiving high (avg.07 kg.m-2) nodule abundance. The study site has flat topography with presence of ≥200 seamounts or abyssal hills that either occurs as isolated edifices or in sub-parallel chains. Sediment was mainly comprised of siliceous and calcareous ooze with moderate to low content of organic carbon. Nematodes were the main constituents of the benthic meiofauna comprising over 65% of the population density. Vertically, they occurred down to a sediment depth of 35 cm, whereas the harpacticoid copepods, which formed the second dominant group, were found only in top 10 cm sediment layer. A total of 27 nematode and 14 harpacticoid copepod genera were identified. Geographically, higher numbers of nematode genera were recorded around 10 degree S latitude. Since the study area falls under the high nodule

abundance zone, possible relation between nodule concentration and faunal diversity is discussed along with the potential impact of future nodule mining on the associated benthic communities.

Studies on the mega-epibenthic community at the deep-sea long-term observatory HAUSGARTEN

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In 1999 the deep-sea long-term observatory HAUSGARTEN was established by the German Alfred Wegener Institute for Polar and Marine Research to detect and track the impact of large-scale environmental changes in the transition zone between the northern North Atlantic and the central Arctic Ocean. One of a great variety of approaches covered the characterization of the megabenthic community, where megabenthos is defined as benthic organisms large enough to be recognized and characterised by means of optical seafloor imaging. The employment of the towed underwater camera system OFOS (Ocean Floor Observation System) yielded colour slides from 1300 to 3900 m water depth which were analysed in respect of general megafaunal composition, community changes along the depth gradient and additional aspects such as the presence of hard substrate and crawling traces. The identification of organisms was supported by analysis of reference material obtained during the same expedition by means of an Aggsssiz trawl. Image analysis revealed representatives of eight taxa with a distinct faunal zonation along the depth transect and a pronounced transition zone in community composition at about 3370 m depth. This depth seems to be the lower boundary for some species, for example the pyconogonid *Colossendeis proboscidea*, the holothurian *Irpa abyssicola* and the crinoid *Bathycrinus* sp. A high degree of habitat diversity in terms of hard substrate, crawling traces and occasionally food-falls was also observed which is known to affect the colonization by megafauna and also smaller sediment-inhabiting organisms. Further observations in the same region will help to trace shifts in megabenthic community composition and probably link them to environmental changes.

Opportunities for Deep Sea Biology in the KM3NeT Neutrino Telescope Project

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The KM3NeT consortium is a pan-European consortium of leading Universities and Research laboratories funded by the European Commission to design a neutrino telescope to be built at one of three possible sites in the Mediterranean Sea. The telescope array will be of the order of one cubic kilometre in size, in water over 2000m deep comprising of photomultiplier tubes capable of detecting photons resulting from interaction of neutrinos with water molecules. KM3NeT will be possibly the largest man-made underwater infrastructure ever assembled and from the point of view of deep-sea biology there are three opportunities for new science. 1. Site surveys: The design study for KM3NeT will require environmental surveys of the proposed sites and this will include studies of the fauna likely to interact with the array. 2. Studies on Bioluminescence: The array itself will detect light produced by fauna in the water column and the site will be chosen in order to minimise this effect. A thorough understanding of bioluminescent activity in the area before the array is built and during its operation will be an important part of the KM3NeT project. 3. Associated Sciences permanent observatory node: KM3NeT will establish and underwater infrastructure for collecting data over several decades. An associated sciences observatory is proposed for parallel long term monitoring of the deep-sea environment.

Influence of an Oxygen Minimum Zone on Food Quality and Trophic Strategies of Benthic Fauna: as revealed by lipid biomarkers

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The aim of this study was to delineate benthic processes occurring on the Pakistan Margin, Arabian Sea using molecular techniques. The Pakistan Margin is characterised by an intense oxygen minimum zone (OMZ), which impinges on the continental shelf and is subject to intense seasonal biogenic fluxes that deliver high quantities of organic matter to the seafloor (total organic carbon values of surficial sediments of 8 - 35 mg/g-1). Using lipid biomarkers, a food quality index was derived in order to assess the phytodetritus as a food source at five sites across the Pakistan Margin. A high degree of patchiness was observed across the Margin, a result of benthic reworking and inputs of phytodetritus. The greatest degree of patchiness was observed at the deeper sites (CV > 100 %), where large deposit feeding megafauna such as holothurians are present. In addition stable isotope data suggested seasonal differences in feeding strategies, with certain animals (e.g. decapods) becoming depleted in 13C during the late monsoon. Lipid profiles of tissue samples confirm changes in feeding strategies between monsoon phases. Changes in lipid profiles were also apparent in the polychaete *Linopherus* sp., at the lower OMZ boundary. Individuals at 800 m had significantly lower quantities of polyunsaturated fatty acids than those at 900 and 940 m. Implications for the assessment of feeding behaviour and carbon cycling will be discussed.

Ecological controls on diversity and density of polar megabenthos

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The megabenthic ecology of comparable bathyal Arctic (E Greenland) and Antarctic (NE Weddell Sea) areas were investigated using NOC WASP (Wide Angle Seabed Photography) towed camera platform and the Autosub Autonomous Underwater Vehicle (AUV). A series of photo transects were undertaken at each location at a range of depths from 200 to 700m. Photographic transects allowed quantitative data to be obtained on benthic megafaunal abundance and diversity, allowing valid comparisons to be made between these polar areas. Megafaunal abundance was comparable between the Arctic and Antarctic stations although in both areas abundance decreased with increased depth. Diversity was higher in the Antarctic stations but in both areas there were changes in species richness and evenness with depth. The shallower stations in both areas were characterised by regular disturbance from icebergs, this was visible in seabed photographs and concurrent geophysical observations. Iceberg disturbance was found to be very important in structuring megabenthic communities particularly in the Antarctic. The results of this study are used to assess the utility of towed camera sleds as a method for obtaining ecological information in remote environments; comparisons are made with some of the first AUV seabed pictures from Autosub.

Knowledge Transfer between deep-sea science and industry: Case Studies from the DIEPS Project

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The transfer of knowledge from science to industry, regulators and the public is not always easy, and it has been recognised that more efforts are needed to encourage dialogue and for cutting edge blue skies research to be used to drive policy, legislation and best practice. As part of the SERPENT Project, a series of research projects examining the effects of offshore exploration in a variety of deep-sea localities including the Faroe-Shetland Channel, Mauritania and Norway has shown how new methods of ROV survey and in situ experimentation are helping to understand the controls and recovery as a result of seafloor disturbance and ecosystem impact. DIEPS sets out to transfer this knowledge through the SERPENT Project to industry partners and goverment departments for them to better understand our impacts on the deep sea.

Evidence for benthic body size miniaturisation in the deep sea

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The body size miniaturisation hypothesis (Thiel, 1975) states that 'associations governed by constantly limited food availability are composed of smaller individuals on average'. Using appropriate sample sets, this study tests this hypothesis by contrasting the benthic communities of the Fladen Ground (North Sea, 150 m) and the Faroe-Shetland Channel (1600 m). Samples were collected for large (500 µm) and small (250 µm) macrofauna, meiofauna (45 µm) as well as an intermediate sized 'mesofauna' (180 µm) to ensure comprehensive coverage of the full meio- and macro-faunal body size range. The body size structure of the benthos was compared by using two methods. The more widely used average individual biomass method involves dividing the total sample biomass by sample abundance. Additionally, body size accumulation curves were constructed by assigning all specimens into a logarithmic size class and then plotting the cumulative percentage of individuals present in each size class. The results seem to support the hypothesis that the deep-sea environment is a small organism habitat. Although these findings only represent two locations, the overall body size accumulation curves clearly display a statistically significant shift towards smaller body sizes at the deeper site. The magnitude of the effect is appreciable with median metazoan body size reducing from 14.3 µg wet weight in the Fladen Ground to 3.8 µg wet weight in the Faroe-Shetland Channel. The average individual biomass measurements are shown to be of limited value and can lead to potentially misleading conclusions if the underlying size structure is not analysed in detail.

Size-based modelling of benthic communities in the Faroe-Sheltand Channel

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A body size-based model was tested against observed biomass distributions within a deep-sea benthic community. Empirical data collected for meio-, meso- and macro-benthos (45-500 µm) from the NE Atlantic site (1600 m) showed biomass to increase with body size. The simulation model consisted of classifying organisms into 16 size classes that all fed from the same food source (detritus pool). The biomass transfer between the size class compartments and the detritus pool was expressed as a function of four processes: ingestion, respiration, defecation and mortality. The parameterisation of these processes was based on published literature values relating each function to individual body size. The degree to which these processes are body size-dependent was investigated using a range of parameter sensitivity tests. The standard run of the model was defined as a case where all parameter values were set constant across the size classes. This resulted in an equal biomass distribution across the size range when the model was run to equilibrium. The subsequent sensitivity analysis involved setting a size-based gradient to one of the parameters at a time with everything else kept constant. The second approach involved applying gradients to all the processes simultaneously and then setting one parameter constant with gradients remaining in all other processes. The size-based modelling approach was shown to be capable of reproducing the increasing biomass trend observed in the empirical data. This implied that a size-based modelling approach is appropriate for modelling benthic biomass distributions. The sensitivity analyses revealed that size-dependency in ingestion rates was unlikely and that a gradient in respiration parameter values alone had a negligible effect on the resulting size distribution. Conversely, size-based defecation and mortality rates were supported by the model results.

Investigating the body size structure of benthic communities

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Benthic communities were investigated in terms of their body size distributions across three environmentally contrasting study sites: (i) a shallow-water location on the Fladen Ground, North Sea (150 m), (ii) a deep-water location in the Faroe-Shetland Channel (1600 m) and (iii) and a mid-slope oxygen minimum zone location on the Oman Margin, Arabian Sea (500 m). The construction of body

size spectra formed a central component of this analysis and it served as a foundation for further investigations into the functioning and dynamics of these communities. The shape of the biomass size spectra at all three locations could be best described by total biomass increasing as a function of body size. In contrast to earlier studies, the biomass distribution patterns did not display statistically significant bimodality, implying that biomass size spectra do not distinguish meio- and macro-fauna as two functionally distinct groups of benthic organisms. The body size spectra were found to vary in different environmental conditions. Comparisons of the two NE Atlantic locations revealed that the deeper Faroe-Shetland Channel site was dominated by smaller individuals than the shallower Fladen Ground site hence conforming to the deep-sea size miniaturisation hypothesis as suggested by Thiel (1975). The size distribution patterns at the Arabian Sea site also differed significantly from the other two locations. Two taxonomic units (nematodes and polychaetes) overwhelmingly dominated the fauna and this was reflected in the shape of the size spectra. Regression analyses revealed that the scaling exponents for biomass and abundance distributions generally approximated the theoretically predicted values of 1/4 and -3/4, respectively. The slopes for the biomass distributions varied from 0.19 for the Fladen Ground site, 0.26 for the Oman Margin site to 0.32 for the Faroe-Shetland Channel location. The respective slopes for the abundance relations were recorded as -0.81, -0.73 and -0.67.

Desmosomatidae versus Nannoniscidae (Isopoda, Crustacea). Systematics and problematics

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The relationship of Desmosomatidae Sars, 1897 and Nannoniscidae Hansen, 1916 is one of the most discussed questions in the literature about both families, especially the affiliation of *Pseudomesus* Hansen, 1916 is discussed more than once by several authors (e.g. Hansen, 1916, Gurjanova, 1933, Svavarsson, 1984, Wägele, 1989). There is no doubt about the close relationship between Nannoniscidae and Desmosomatidae (Siebenhaller & Hessler, 1977, 1981; Wägele, 1989), together they build a monophylum. The question about the systematic position of *Pseudomesus* is representative for these difficulties. The history of the genus may best be described as “systematic odyssey“, a title that reflects the ambiguity of the characters resulting in this genus “falling between two stools”, namely, the families Nannoniscidae and Desmosomatidae. In this presentation a close analysis of desmosomatid and nannoniscid characters is presented and both families are discussed based on methods of phylogenetic cladistics. Discussing the systematic background, the authors come to the conclusion that the two families are one. The valid family name is Desmosomatidae. This leads to new results concerning the relationships within this family.

Deep evolution and cold ecology at multiple scales: Southern Ocean isopods show how complex the deep sea can be

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Samples of isopod crustaceans are revealing the Atlantic sector of the Southern Ocean, one of the most dynamic and important regions influencing the global deep-sea environment, to be highly complex. Life on the seabed of the deep sea there has proved very rich, abundant and highly endemic. Despite thoughts to the contrary less than a decade ago, new data reveals our model taxa to be all of these, being abundant from shelf to deep sea. Until now over 370 isopod species from the Antarctic shelf, with about 90 % endemism, have been described. High biodiversity of isopods in the deep Southern Ocean has been detected during the ANDEEP cruises (ANtarctic benthic DEEP-sea biodiversity, colonisation history and recent community patterns), and as with shelf levels, a high degree of endemism. The ANDEEP III cruise probed richness and abundance of peracarid crustaceans as a model across selected Southern Ocean sites. We sampled at multiple spatial scales to include sites tens, hundreds and thousands of km apart. Our sites stretched from the Southern Cape Basin to continental Antarctica, including depth from about 750 to nearly 5000 m. We show patterns within the peracarids of order, family and species richness across scales and geographic areas and we compare this evolutionary success with the ecological dominance by investigating individual abundances in space. The level of patchiness in both richness and abundance is striking, and underlines these depths are anything but the fabled monotonous and impoverished deep-sea environment. At local and regional scale there was a huge variability in absolute abundance of specific

groups and across taxonomic levels. Across the deep Weddell Sea are patches, which were from rich to poor, abundant to impoverished, in any to all groups and in any to all taxonomic levels. This study presents an opportunity to learn more about the Southern Ocean deep sea with its rich fauna of peracarids and its impact on the Antarctic shelf communities.

Komokiaceans (Foraminifera, Komokioidea) from the hadal trenches of the West Pacific

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Komokiacean foraminifera were sampled at hadal depths in the Western Pacific during the 57th cruise of the R/V #8220; Vityaz #8221. In total, 43 samples were taken from depths of more than 6000 m in the Ryukyu (Nancei), Philippine, Palau, Yap, Mariana, Volcano and Izu-Bonin trenches. Komokiaceans occurred in 35 of these samples. A total of 26 species from the families Komokiidae, Rhizamminidae and Baculellidae was recognised. The most widespread were *Edgertonia tolerans*, which occurred in the Volcano (6330-6320 m), Palau (7000-7170 m), Philippine (7610-8580 m) and Izu-Bonin (8690-8550 m) trenches and *Normanina tylota* found in the Philippine (6290-6330 m), Volcano (6330-6320 m), Izu-Bonin (6850-6740 m) and Mariana (10220-10275 m) trenches. Other species occurrences were as follows: *Baculella globofera* in the Mariana and Volcano trenches (6320-6650 m); *Komokia multiramosa* in the Volcano (6330-6320 m) and Mariana (10700-10730 m) trenches; *Septuma ocotillo* in the Mariana (7360-6580), Volcano (8780 m) and Philippine (7950-9340 m) trenches; and *Septuma brachyramosa*, a species previously known only from the Atlantic Ocean, in the Ryukyu (Nancei) trench (7030-7310 m). Species diversity of Komokioidea decreased with increasing of depth from 10-15 species in the upper hadal zone (6000-7000 m) to a few species in the deepest parts of the trenches. The komokiacean fauna of the hadal zone was close to abyssal Pacific assemblages and shared many species with abyssal fauna of the Atlantic Ocean.

Tides and currents in the deep sea: time signals and the potential for selective tidal transport

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Like almost every region of the world's oceans, the bathyal and abyssal depths of the deep sea experience the regular currents generated by the ebb and flood of the tide. This physical signal constitutes the clearest dial zeitgeber in the deep-sea environment. Regular changes in hydrostatic pressure and in the resuspension of bottom sediment caused by the rising and falling tides may serve to entrain physiological or behavioural aspects of the lifecycles of deep-sea fauna. The friction of the seabed on the flow of water over it has an effect proportional to the velocity of the overlying current (and inversely proportional to the Coriolis parameter), and means that the velocity and direction of water flow is not uniform throughout the water column. Is there potential then for deep-sea fish to select their position in the water column to utilise tidal transport currents as intertidal fish are known to do? For the purpose of describing the current regime in the Porcupine Seabight and Porcupine Abyssal Plain of the NE Atlantic, hourly ADCP data were collected from successive 3 m depth cells above the sea floor over a period of 13 months. Spectral analysis of the current flow regime showed a distinct semi-diurnal tidal oscillation with a period of 12.4 h and approximate change in current speed of 5.2 cm s^{-1} over one tidal cycle. There was also indication of a longer 14-day cycle. Tidal oscillations were generally orientated north-south. Mean residual current flow was southwest in autumn 2001 (across slope), shifting erratically over the winter months, and reverting to a south-westerly flow again in spring and summer of 2002. This south-westerly flow closely parallels the local bathymetry of the deployment site. The potential for deep-sea fish to use these currents for selective tidal transport is discussed.

Community structure and distributional pattern of meiofauna in the deep-sea bottom of the Clarion-Clipperton Fracture Zone of the Northeastern Pacific

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This study was conducted to investigate the community structure and distributional pattern of meiofauna in the deep-sea bottom of the Clarion-Clipperton Fracture Zone of the northeastern Pacific in July 2001, July 2003 and August 2004. Meiobenthic samples were collected using the multiple corer at 33 stations (13 stations along the transects from 5°N to 17°N, 8 stations in the nodule area and 11 stations along the parallel line of 10°N between 128° to 135°W). A total of 10 meiofaunal groups were found in the study area. The most abundant meiobenthos was nematodes and followed by benthic foraminiferans, harpacticoid copepods. The maximum density of meiobenthos was 306 inds./10cm^2; at station located in 11°N (water depth 4833m), and the minimum density was 6 inds./10cm^2 at station located in 14°N (water depth 5037m). The latitudinal distribution pattern of meiobenthos in the study area seemed to be related with the primary productivity of the surface water that is also connected to the water circulation pattern of the Pacific Ocean near the Equator, diverging at latitude of 8°N and conversing at 5°N. Horizontal distribution of meiobenthic animal in the study area showed high densities of meiobenthos at the stations within 135~136°W. Distribution of meiobenthic animal within CCFZ showed high densities of meiobenthos at the stations had few manganese nodules on their sediment surface in the site of low latitude. Vertical distribution of meiobenthic animals showed the highest individual numbers in the surface sediment layers of 0~1cm depth and showed more steep decreasing trend as sediment gets deeper on the stations of high latitude located in 16~17°N. For size distribution analyses showed that animals, which fit into the sieve mesh size of 0.063mm were abundant.

Deep-sea scavenging demersal fauna of the Nazaré Canyon system, Iberian coast

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The Nazaré Canyon is a high sided, steep sloped canyon on the Portuguese continental margin with high terrigenous organic input, causing episodic turbidity currents that are responsible for high invertebrate biomass and low biodiversity. The RObust BIOdiversity (ROBIO) lander was deployed in the Nazaré Canyon (6 deployments; 39°N; 909 – 4361 m) during summer 2005 to investigate the demersal scavenging fauna. Amongst the fishes at shallow sites (909 & 918 m) within the canyon *Synaphobranchus kaupii* were numerically dominant at bait with intermittent visitation by *Mora moro* (common *Mora*), *Phycis* sp. (*forkbeard*), *Trachyrincus* sp. and 3 species of shark. At deeper sites (> 3453 m) the abyssal grenadier, *Coryphaenoides* (*Nematonurus*) *armatus* and the deepwater arrow tooth eel, *Histiobranchus bathybius* were the only fish species observed. *C*. (*N*.) *armatus* was the most frequently observed vertebrate scavenger with an estimated abundance of 188 fish.km^{-2}. At the shallowest depths (909 & 918 m) invertebrates attending bait were present throughout deployments in significant numbers, and exhibited species succession with asteroidea attending first, followed by gastropoda (*Colus* sp.), and finally by Paguridae. During deeper deployments (3453 – 4361 mm) invertebrates were less frequently observed. However during one deployment at 3476 m ophiuroidea were constantly within the field of view intermittently burying and re-exposing themselves. We thank Phil Weaver, principal scientist, and the shipboard party, officers and crew, HERMES canyon cruise, *RRS Discovery*, and acknowledge support from the UK Natural Environment Research Council.

Roles of Benthic Foraqminifera in Carbon Cycling at Marginal Oceans with Active Tectonic Forcing: In situ Experiment and Observations

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Forearc region along arc-trench system is an active area of sedimentation. Slope basins with thick piles of hemipelagic sediments are typically distributed in the region. Sagami Bay is one of the forearc basins. High rates of sedimentation at the basin are sustained by the lateral input of organic and

inorganic particles from land or coastal areas. Benthic organisms may play big roles to mineralize organic carbon at the sediment-water interface. The aims to evaluate benthic activities in carbon budget atslope basins, we have long been observing material cycles around sediment-water interface at a permanent station in the central Sagami Bay, Japan. Our basic strategy for the research is to conduct both observations and experiments directly at deep-sea floor. For this purpose, we have introduced and developed both in situ feeding devices and planer optode systems. Mineralization potentials are measured through in situ feeding experiment with carbon-13 labeled food materials. Two-dimensional images of both oxygen and pH are visualized through planer optode system. Respiration signals both by O_2 and CO_2 are excellent proxies for mineralization of organic carbon. In the presentation, we try to review our monitoring systems and show some results obtained from the systems.

Community Structure and Seasonal to Interannual Variation in Benthic Faunal Communities, Monterey Bay, California

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In this 15-year time series, we investigated patterns of abundance, distribution, and species diversity for benthic megafaunal invertebrates and demersal fishes on the continental shelf and slope to 1,000 m depth in Monterey Bay (Smooth Ridge), California. To document changes in biological communities, high-resolution video was recorded along seafloor transects using MBARI's ROV *Ventana*. Transects ~2 km long were sampled at depths of 200, 400, 600, 800, and 1000 m five to eleven times from 1991-2005. Seasonal to interannual variability in the abundance and distribution of species as well as species- specific habitat associations were determined from analyses of video transects. The structure of the slope community is both spatially and temporally variable, with considerable horizontal patchiness, depth-related patterns associated with the OMZ, and interannual variation, particularly at shallower depths.

Occurrances of deep-water cumaceans (Crustacea, Cumacea) in the North Atlantic – relationship to water masses?

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One of the main characteristics of the northernmost part of the North Atlantic is the diverse composition of water masses. At least five major types of water masses have been reported, differing much in temperatures. Furthermore, the submarine ridge that extends from Greenland to Iceland and the Faeroe Islands (GIF Ridge) separates the basins of the Arctic Ocean from the basins of the North Atlantic. The Ridge's saddle depth is around 830-860 m and the Ridge separates basins that are more than 4000 m deep. This scenario makes the area very interesting for evaluation of distribution of different species in relation to water masses. Cumaceans (Crustacea, Peracarida) were studied at more than 100 stations in the North Atlantic as part of the BIOICE project (Benthic Invertebrates of Icelandic Waters). The samples were collected in 19 cruises in the years 1991 to 2004 with a Rothlisberg-Pearcy epibenthic sled. The samples are from both the north and the south side of the GIF Ridge, from locations with -0.9°C to sites with 9.6°C and at the depth range of 18 to 3003 m. The distributional pattern of selected cumacean species is presented. Many species are restricted to a certain water mass, such as Atlantic Water (AW), dominating the area south of Iceland. Several species occur in various cold water masses, mainly found to the north of the Ridge. It is evident that the Ridge and the associated water masses do have extensive effects on the distribution of the deep-water cumaceans.

Macrofauna community structure at Campos Basin continental slope, Southeast Brazil

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Whilst the benthic macrofauna from the Brazilian shallow coastal zone is well known, there are rare benthic deep-sea studies from the continental margin and below. This study is part of the 'Campos Basin Deep Sea Environmental Project/PETROBRAS'. Its main objectives have been: 1) to characterize the benthic macrofauna regarding its abundance, diversity including species richness at depths from 1000 to 2000m; and 2) also detect significant spatial and temporal variations in community structure at Campos Basin continental slope, southeast Brazil. During November 2002 and June 2003, spring and autumn respectively, 4 replicate samples were collected from the northern and 4 from the southern areas of Campos Basin at each of the following depths: 1050, 1350, 1650 and 1950m. Around 400 marine invertebrate taxa have been identified so far, being the polychaetes, isopods, amphipods and molluscs the most diverse groups. The deep-sea benthic macrofauna composition at Campos Basin has shown common characteristics to other studied deep-sea regions in the world, such as the dominance of polychates (mainly from the Spionidae and Amphinomidae families), peracarid crustaceans (tanaidaceans and isopods), and bivalves (family Nuculidae). A considerable rare species percentage represented by only one individual was found (around 30%). Data from this study revealed a significant temporal variation not only in terms of the main groups density, but also in terms of community composition and diversity. This could be related to pulses of organic matter input to the deep-sea throughout the year. The upwelling occurrence at the region of Cabo Frio near Campos Basin during spring summer each year may cause seasonal pelagic originated organic matter inputs to the benthic system. This may reflect in the population increase of certain benthic groups during the subsequent period, as a response to the highest particulate organic matter sedimentation rates. In general, the total macrofauna density found varied from 16.5 to 92.3 ind.0.09m^{-2}. This value is lower than that found in other regions at similar depths between 1000 and 2000m. Comparisons in relation to abundance between several deep-sea studies are limited because of methodological differences regarding mesh size and depths of sampled sediment layers. Nonetheless, the data shown here reflect the oligotrophy of the Campos Basin region strengthened by the evaluation of other communities sampled during the same period in the water column, such as the phytoplankton that was dominated by nanoplankton. A bathymetric gradient was found, being the macrofauna richness and abundance of the main groups found at 1050 and 1350m distinct from that found at 1650 and 1950m. This variation could be associated to differences in sediment particle-size distribution, concentration of organic matter, presence of carbonates, and influence from different water masses, factors which are dissimilar comparing the 1050-1350m to the 1650-1950m depth ranges.

Origin of the Komokiacea – molecular insight

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The Komokiacea are common deep-sea organisms, which in many abyssal areas dominate the macrofaunal size fraction. They consist of a complex system of fine branching tubules, sometimes giving rise to bead- or droplet-like chambers and lacking any recognizable apertures. In some species, the spaces between the tubules are filled with mud to create a mudball structure. The tubules are very fragile and unequivocal fossil examples are unknown. Because of their variable morphology, which sometimes resembles a lump of mud or piece of detritus, the "komoki" are widely overlooked and often discarded from the collected samples. Based on features of their test morphology, wall structure and cytological observations they have been classified among foraminifera, but the specific foraminiferan granuloreticulopodia have never been observed. To investigate the phylogenetic relationships between "komoki" and foraminifera, we have analysed the SSU rDNA sequences obtained from several genera of Komokiacea collected during ANDEEP II and ANDEEP III expeditions to the Weddell Sea. Preliminary results of these analyses will be reported.

Evidence of phylogenetic molecular proximity between hydrothermal (Alvinocarididae, Mirocaridiae) and deep-sea (Nematocarcinidae, Oplophoridae) shrimp families

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During the 1970's, the hydrothermal environment was discovered. Alvinocarididae and Mirocarididae are two permanent families for this environment but some families have been observed as passing through the hydrothermal vent fields such as Oplophoridae and Nematocarcinidae. A phylogenetic analysis based on rDNA information was carried out to determine if hydrothermal vent species have evolved from other deep-sea lineages of shrimp, as would seem to be the case for other vent groups. The 16S and 18S fragments of some shrimp families living at distinct depths were compared, including epipelagic (0 until 100 m depth), mesopelagic (100-1000 m), bathypelagic (1000 - 3000 m) and hydrothermal (sites mainly between 700-3700 m) zones. Analysis based on Maximum Parsimony and Neighbour-Joining realised using PAUP* and Maximum Likelihood investigated using PHYLIP, reveal two clades: one of them includes the deep-sea (Nematocarcinidae, Oplophoridae) and hydrothermal vent (Alvinocarididae, Mirocarididae) shrimp families and the other comprised of the epipelagic families (Alpheidae, Atyidae, Palaemonidae, Processidae). The phylogenetic relationships of these groups and their distinct environmental adaptations are discussed.

Biometrical study of the deep-water crab *Chaceon affinis* (Milne-Edwards and Bouvier, 1894) off the Azores

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For the last couple of years, several biological data regarding *Chaceon affinis* was gathered based on surveys conducted in the Azorean archipelago. The main purpose of this study was to bring together all the biometrical information from 1994 to 2005 of different geographic areas within the Azorean archipelago, allowing an integrated analysis of the allometric relationships, which may bear secondary sexual characteristics. The deep-sea crabs were caught by bottom traps. A total of 5507 crabs (3882 males and 1587 females) were caught at depths ranging from 400 to 1100 m on rock and/or muddy bottoms. Size range from 12 to 188 mm carapace length (CL), being males larger than females. A wide spread of values was found in the collected data regarding biometrical information, making relationships possible. Length and width of both chelae, carapace width and fifth abdominal segment width, were plotted against CL values from both males and females to investigate possible changes associated to the pubertal moult. Therefore, the size at first maturity of *C. affinis* was tentitatively estimated by biometry. This first approach on estimating the size at sexual maturity in the region may be useful in what assessment procedures are concerned, as they form the basis for developing both short-and long-term management strategies.

Molecular Phylogenetics of Stomiiformes (Pisces) inferred from mitochondria Cy b gene sequence

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Stomiiforms are mesopelagic or bathypelagic deep-sea fishes. They vary in body shapes and they are ecologically important. There are 391 species of 53 genera in 5 families by now. Several systematic problems still need to be resolved within Stomiiformes. For example, the order could be divided into Gonostoatoidei and Phosichthyoidei, but they could be categorized into 4, 5, or 9 families by different points of view. In addition, there is also some incongruence between and within the familial relationships in this order. Besides, relationships between both genera *Diplophos* and *Triplophos* to other stomiiforms are still uncertain. We used mitochondria Cyt b gene as a molecular marker to find out the interrelationships of this group of fishes. Preliminary results indicate that phylogenetic

relationships are incongruent between morphological or molecular characters. Stomiiforms can be divided into two major clades. The clade that consists of all Stomiidae species as a monophyletic group has a low bootstrap value. Our results conflict with the hypothesis that Diplophos is basal to other stomiiforms. Triplophos is clustered together with gonostomatid fishes rather than with phosichthyids.

Hydrothermal vent mussels as recorders of the environmental change

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Bivalve shells can provide high resolution seasonal records of shell growth and environmental conditions from different wide geographical spread oceans and natural settings stretching from estuaries to coastal and deep waters and from mid to high latitudes. Utility of bivalve shells would tell us about environmental settings in more novel environments. Deep sea hydrothermal vent mussels live in continuous darkness, close to vents that discharge hot ≤10-350°C) fluid enriched in various metals, methane and sulphide. The mussels are thought to live in waters between 5°C - 15°C and can experience rapid fluctuations on the timescale of seconds to days. This temporal variability in the environment has the potential to be recorded in the geochemical composition of the shell. While any changes in growth rate that may be affected by the environmental conditions would be recorded in the internal growth bands of the shell. In this study we examine banding and geochemistry δ13C and Mg/Ca) of the shells of *Bathymodiolus azoricus* which dominate the vent fauna at MAR to provide high resolution records of changes in their growth and environmental setting.

Asphalt volcanism and chemosynthetic communities in the Southern Gulf of Mexico: preliminary results from RV METEOR cruise 67/2

MacDonald I.R. & RV METEOR 67/2 Scientific Party

The Gulf of Mexico region offshore Campeche, Mexico contains unusual hydrocarbon seep features that were dubbed “asphalt volcanoes” during an expedition with RV SONNE in 2003. The region was revisited with RV METEOR during a 34 day expedition in March and April 2006. The scientific party on board METEOR completed swath bathymetric mapping within a 40,000 km^2 study area. The results showed an array of ridges and knolls, many of featured craters, slump zones, and oil slicks on the sea surface. Acoustic profiles showed bubble trains rising from the seafloor to the upper water column. Seismic profiles indicated gas wipe-outs and intense sub-bottom reflectors. Exploration of the Chapopote asphalt volcano site was carried out with ROV QUEST and a video-platform. Collections of asphalt and sediment were made using push cores from the ROV and gravity cores from the surface. Preliminary finding are summarized as follows:

1. Asphalt can contain copious thermogenic gas and gas hydrate.
2. Asphalt floes completely cover 1000’s of m^2 of the seafloor.
3. Asphalt is present in a wide range of apparent ages, from fresh, soft material to eroded and broken pieces, with numerous intermediate stages.
4. Fresh asphalt is frequently colonized by white mats that comprise a complex assemblage of sulphur bacteria and amorphous spicules.
5. Bubble gas seeps and outcropping gas hydrate were observed at a location on the periphery of the asphalt field.
6. Chemosynthetic tube worms and mussels as well as abundant heterotrophic fauna occupy a diverse range of habitats in this active seep site. The biological assemblages vary from a) simple bacterial mats, b) aggregations of tubeworms to c) complex assemblages of mussel beds, gastropods, sponge and coral associations and dense tubeworm aggregates.
7. The asphalt may function as a seafloor storehouse of volatile hydrocarbons, thereby spreading chemosynthetic substrata over a wider area has been observed at other seeps.

Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico

MacDonald I.R. & the CHEMO-III Project Team

The Continental Slope of the northern Gulf of Mexico hosts diverse chemosynthetic communities at oil and gas seeps. Previous investigations have concentrated on seeps at depths less than 1000 m. A new, multi-disciplinary investigation of sites in the 1000 to 2800 m range has been sponsored by the U.S. Minerals Management Service and NOAA Ocean Exploration Program under the management of TDI Brooks International, Inc. This poster presents preliminary results from two recently completed cruises in this program. Potential sites where chemosynthetic community might occur were selected on the basis geophysical, geochemical, and satellite remote-sensing indicators. A list of twenty high-priority targets was compiled from this review. Nineteen of these locations were surveyed during a reconnaissance cruise conducted on R/V GYRE from 11 to 25 March 2006. At each site, the seafloor was imaged using a drift camera system comprising a digital camera, CTD, and USBL navigation pinger. Several previously unknown communities were discovered by this process and were targeted for follow-up sampling with submarine ALVIN. The ALVIN cruise was completed on RV ATLANTIS during 6 May through 3 June 2006. Extensive biological collections were made at sites discovered during the reconnaissance cruise and at site known from previous investigations. This program will extend knowledge of the Gulf of Mexico chemosynthetic ecosystem in the zones anticipated to receive energy exploration and production activities over the coming decades. Models developed from these investigations are essential for effective management of this ecosystem and for understanding the zoogeography of chemosynthetic species in the Gulf of Mexico and Western Atlantic Ocean.

Distribution of species of the genera *Munidopsis* and *Galacantha* (Crustacea, Decapoda, Galatheidae) in the SW Indian and SW Pacific Oceans

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Sixty-six species of the genus *Munidopsis* and nine species of the genus *Galacantha* have been studied using specimens collected during numerous expeditions carried out in the last decades in the deep-waters of the SW Indian and SW Pacific Oceans, between 140 and 4400 m. The number of species collected by station is very low (mostly one species), probably related to their low densities. However, in some samples, as many as five species have been found. The highest number of species have been observed in the Banda Sea (Indonesia) and Solomon Islands. The new records of some species greatly extend the previously known distribution range of the species. The most abundant species collected in this study are sexually dimorphic, with males smaller than females. The high number of undescribed species (twenty-five in *Munidopsis* and three in *Galacantha*) indicates the existence of a rich deep-sea galatheid fauna in these areas and emphasizes the necessity of further studies to describe the communities in the deep-sea benthos.

First results and perspectives of trophodynamics for bathyal suprabenthos from the Catalano-Balearic Basin: stable isotopy, secondary production, and biomarkers

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This study focuses on the main suprabenthos groups (i.e. amphipods, cumaceans, isopods, mysids and euphausiids) sampled in the Western Mediterranean (NW Balearic Islands, Catalano-Balearic Basin), at depths between 350 and 780 m. Samples were collected every two months using a Macer-GIROQ suprabenthic sledge during six cruises between August 2003 and June 2004. Stable isotope ($_{13}C/_{12}C$ and $_{15}N/_{14}N$) analyses were performed on 22 species of suprabenthic fauna (12 amphipods, 2 cumaceans, 2 isopods, 5 mysids and 1 euphausiid). At least three trophic levels of the food web were covered by the 25 species δ 13C ranged from -24.2‰ to -19.42‰ and $\delta_{15}N$ from 2.7‰ to 13.0‰). The amphipod *Rhachotropis caeca* showed the highest (most enriched) $\delta\ _{13}C$ and $\delta\ _{15}N$ values, while

Hemilamprops normani (cumacean) and *Lepechinella manco* (amphipod) showed the lowest (most depleted) values of $\delta_{13}C$ and $\delta_{15}N$ respectively. Secondary production (P) and P/B ratios will be estimated using the method of Hynes based on size frequencies for these same dominant species. Some preliminary estimations were obtained from animals of the neighbouring area of the Catalan coast. 852 specimens were measured and the size-weight relationships were obtained for two amphipods (*Rhachotropis grimaldii* and *Rhachotropis rostrata*). The cumacean Leucon longirostris had a P= 0.428 mgWW/m2/yr and a P/B = 1.31, *R. grimaldii* a P=3.428 mgWW/m2/yr and P/B =9.77 and *R. rostrata* a P=2.017 mgWW/m2/yr and P/B=7.26. The results obtained for *Rhachotropis* species were close to those obtained for other co-generic species in the same area. Pigment analyses (HPLC) and fatty acids (GC-MS) will be performed on selected dominant species to identify the origin of food sources consumed by these species, and to explore possible explanatory variables of P/B.

Brychiopontius galeronae sp. n. (Copepoda, Siphonostomatoida, Brychiopontidae) from the North Pacific Nodule Province

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Brychiopontius galeronae sp. n. is described based on specimens collected from the province nodule area (Pacific Ocean) using multicorer at 4,978 m depth. The new species is assigned to the genus Brychiopontius Humes, 1974. The monotypic family contained a single species viz. *Brychiopontius falcatus* Humes, 1974, collected from washings of deep-sea holothurians in the North Atlantic. The family Brychiopontiidae is defined by following characters: body cyclopiform, urosome 5-segmented in the female, caudal ramus with 6 setae, aesthetasc on the 4th most distal segment. *Brychiopontius galeronae* sp. n. differs from *Brychiopontius falcatus* in having 21-segmented antennulae, different shape of terminal elements in antenna, 4 setae in second segment of antenna, the presence of a mandibular palp, more than 1 seta in maxillary endopod, 3 setae on the first endopodal segment of the maxilliped (2 setae in *B. falcatus*), 2 setae on sixth leg (1 in *B. falcatus*), 2 outer spines on third exopodal segment of leg 1 (3 in *Brychiopontius falcatus*). This is the second species of the family and the first record from the Pacific Ocean.

Meiofauna Communities of the Pacific Nodule Province

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Samples were taken using a Multiple Corer during the French NODINAUT Cruise on board RV L´Atalante, May – June 2004, in the East Zone of the France mining claim in the North Pacific Nodule Province, N 14 2.5157 – N 14 3.9807 and W 130 4.7287 – W 130 8. 5499 at about 5,000 m depth. The purpose of this study is to find out whether the Meiofauna communities in the nodule area are similar or not to the communities of an nearby area without nodules which regards abundances and diversity. We analysed 8 corers taken replicatively at each area. Nematoda and Harpacticoid copepods were the most abundant taxa. In the area with nodules 17 taxa were found, while 16 taxa were present in the area without nodules. However the density of Meiofauna organisms was about 50% higher in the area without nodules. An MDS plot using Bray-Curtis Dissimilarity shows a good separation of the replicates of the two areas. This difference was significant using the ANOSIM test (R = 0,71). It means that the similarity within areas is higher than between sites and the H0 hypothesis that the observed difference may happened by chance could be rejected. In the present contribution we will present some possible explanation for the observed patterns.

FISHing for Bacteria: Biodiversity in Deep-Sea Sediment

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The bacterial population density and species diversity of deep-sea sediment was analysed using molecular methods at two sites of contrasting productivity. Sampling locations in the southern Indian Ocean were within close proximity to the sub-Antarctic Crozet Archipelago. To the north of the islands, seasonal blooms generate enhanced productivity levels contradictory to the oligotrophic, high nutrient, low chlorophyll (HNLC) conditions that characterise much of the Southern Ocean. Determination of microbial abundance, composition and community structure in sediment cores beneath eutrophic and oligotrophic sites was achieved by 4',6'- Diamidino-2-Phenylindole (DAPI) staining, Fluorescent In Situ Hybridization (FISH), construction of clone libraries and denaturing gradient gel electrophoresis (DGGE). The presence of active cells was investigated by 5-Cyano-2,3-Ditolyl Tetrazolium Chloride (CTC) analysis. Significant differences in total cell count observed between sites were particularly evident in surface sediment. Novel FISH data incorporating seventeen species-specific oligonucleotide probes, revealed inter-species trends both within the depth profile of a single site and between contrasting sites. Variability in predominance and relative abundance of *Gamma-proteobacteria* and *Cytophaga- Flavobacteria* species was indicated according to site productivity. These results provide a comprehensive insight into the deep-sea bacterial populations present in this southerly region of the Indian Ocean. Findings suggest that global changes affecting surface water productivity may impact upon deep-sea microbial communities and potentially their involvement in benthic biogeochemical processes.

Munnopsidae Lilljeborg, 1864 (Crustacea, Isopoda) from the South Atlantic and Southern Ocean, current state

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Family Munnopsidae is the largest family of the deep-sea janiroidean Asellota. This cosmopolitic natatory family includes 9 subfamilies, about 40 genera and the about 500 species. Wilson (1989) erected a new subfamily Lipomerinae for a problematic group of genera of "the ilyarachnid-like eurycopids" and drew attention to the systematic problems of the family Munnopsidae sensu lato. After this extensive publication Munnopsidae have been the subject just of several papers with descriptions of new species of the world fauna and a monograph on Munnopsidae of the northern hemisphere (Kussakin, 2003). New collections of Russian and recently German deep-sea expeditions to the South Atlantic and the Southern Ocean showed that Munnopsidae were the most abundant and diverse group of Isopoda in the samples (around 50% of all specimens). In the beginning of our research there were approximately 40 munnopsids species known from that region, most of them were poorly described. Now we may say that the munnopsid fauna in this area consists of more than 120 species of 29 genera, approximately two thirds of them are new species. The taxonomic work on the group is still ongoing. During the last years, 21 new species and 5 new genera have been described, the subfamilies Storthyngurinae Kussakin, 2003, Acanthocopinae Wolff, 1962, and Eurycopinae Hansen, 1916 were revised, reevaluated and defined, and the distribution data of many species and some genera were extended and discussed.

Preliminary Results on Suprabenthic Peracarids Collected in Near-bottom Sediment Traps Deployed in the Nazaré Submarine Canyon

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In the context of the EUROSTRATAFORM Project, two sequential sediment traps (Technicap PPS3/3) were deployed at 20 meters above the bottom, in moorings located at 1600 and 3200 m depth, in the axis of the Nazaré submarine canyon (West Iberian margin). The mooring lines included also current meters at 17 meters above the bottom. We present results from the macrofauna colected in four consecutive sediment trap deployments between October 2002 and October 2004. Temporal series of organic carbon, carbonates, biogenic silica and lithogenic contents of settling particles, along with current data, will also be presented to support the interpretation of the faunistic results. A total of 36 taxa of crustaceans, mainly peracarid crustaceans (6 mysids, 23 amphipods, 1 isopod, 2 cumaceans) were identified. Among Peracarids (283 specimens identified), Gammaridean amphipods were the

most diversified taxa (22 species). The isopod *Munnerycope murrayi* was the dominant species, while Lysianassidae (6 species), Eusiridae (4), and Oedicerotidae (2 species), were dominant families in terms of abundance and species richness among amphipods. After a preliminary revision of material, 2 Eusiridae (one *Eusirus* sp.) and 1 mysid (*Dactylerythrops* sp) are probably new species. Results will be presented comparing fauna in the two depths sampled and by season (winter and spring). A preliminary analysis (non-parametric Spearman correlation) between Peracarid abundance and environmental variables showed higher concentration of crustaceans depending on %CaCO3, %N, and current speed. The Nazaré submarine canyon is a very active site in terms of current and sediment dynamics. Tides are intensified close to the bottom along the canyon axis, and sediment gravity flows triggered by winter storms sweep periodically the canyon axis to depths > 3200 m. These dynamics probably influence the abundance of Peracarids in our traps.

Physiological condition of mussel *Bathymodiolus azoricus* from Eiffel Tower hydrothermal vent field: filament bacteria approach

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Lucky Strike is one of the largest known active fields in the modern ocean. The hydrothermal fluid, with a temperature ranging between 170 and 324ºC, has fluid characteristics (temperature, chlorinity and gas concentration) varying from site within the field (Charlou et al. 2000). Well-defined active chimneys such as Eiffel Tower, Y3 or Elizabeth, belching out very hot fluids, and zones where hydrothermal activity is more diffuse can be found at Lucky Strike. Except for the flaky anhydrite and barite-clad steep slopes, which are inhabited by more or less extensive populations of *Mirocaris fortunata*, the edifice walls of Eiffel Tower are covered by *Bathymodiolus azoricus* (Desbruyères et al. 2001). It is often seen in Eiffel Tower patches of *B. azoricus* cover by filament bacteria mats. How this bacteria influence the mussel physiological condition and the uptake of heavy metals is the main goal of this study. During EXOMAR cruise *B. azoricus* were collected in an area partially cover with filament bacteria. Mussels with and without filament bacteria were sampled. Several physiological biomarkers (proteins, lipids, carbohydrate and dry weight condition factor) have been measure in both groups of mussels. Preliminary results will be presented at the Symposium.

Preliminary results on community structure of gastropods from mussel beds at deep-sea hydrothermal vents along the South East Pacific Rise (SEPR)

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Hydrothermal vents represent peculiar ecosystems exhibiting extreme and highly variable physico-chemical conditions (e.g. high temperature, high sulphide concentrations, low pH) and, a patchy and ephemeral distribution. The South East Pacific Rise (SEPR), that has been poorly explored until today in comparison with other ridge systems, is an ultrafast spreading ridge associated with either effusive volcanism or tectonism that govern the lifetime of vent emissions and the level of extinction/recolonisations of benthic communities. During the BIOSPEEDO cruise that was carried out in April-May 2004, 11 mussels beds from 8 discrete vent fields were sampled along SEPR between 7°25'S and 21°33'S. From these samples, species composition and distribution patterns of biodiversity was assessed on the example of gastropods which are one of the main components of hydrothermal fauna. A total of 26 species was identified and local species richness ranged between 2 and 13. Most of the species found within the SEPR mussel beds belong to species previously described from the well known vent sites on the North East Pacific Rise, suggesting that there is one single large biogeographic province extending along the East Pacific Rise (EPR). However, a progressive mixing of the classical EPR fauna with species closely related to the western Pacific back-arc basin such as Eosipho auzendi is reported south of 18°S. At least one new species from 21°S is currently described (A. Warén, pers. com.). Processes controlling biodiversity distribution (e.g. species richness, species diversity, species abundance) at different spatial scales are discussed in relation to: (i) biogeographic factors such as transform fault governing dispersal at large scale (> 1000 km), (ii) geodynamic environment governing habitat turn-over and colonization processes at intermediate scale (10-100 km), (iii) successional dynamics of communities at local scale (< 1 km).

The observation of deep- water octocorals on the equatorial seamounts, Mariana, W Pacific

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Seamounts are known to have unique and high biodiversity of animas in the middle of ocean. It is also reported that the seamounts in the area of Mariana, West- Pacific Ocean are a larvae source area of Japanese eel (*Anguilla japonica*). Therefore, these isolated seamounts may have important role as home for the pelagic animals as well as habitat for the benthic animals. It becomes to be known that deep- sea corals are essential habitat- forming organisms in deep- and cold- waters. However, there has not been described the information on deep- water corals on these equatorial West- Pacific seamounts. Using the image records of ROV JAGO (Max- Planck Institute: surveys in 1998), Deep-tow camera system (Japan Agency for Marine-Earth Science and Technology: surveys in 2001) on the seamounts in the area of Mariana ranging 14 - 17°N/142 - 143°E latitude/longitude to the depth of ca.2000m and the octocoral collections in UOG (University of Guam), the diversity and occurrences of deep-water octocorals were examined and compiled. In this poster, we describe the distribution of several deep-water octocoral species on the seamounts based on the image and specimen data. It is first time to document the observation of deep-water corals down to 2000 m depth of the area in W Pacific.

Brazilian Deep Sea Octocorals: an Evaluation of the State of Art

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Brazilian Octocorallia were poorly known until the 1980´s. The knowledge on the group was based on little information, produced by expeditions that included Brazil as part of their trajectory. In the last 25 years, there was an increase in the number of works on Brazilian marine systems carried out by specialists from national institutions. Still, this production treated mainly of shallow waters species. Difficulties related to sampling procedures prevented the investigation of deep-sea species (>50 m deep). The project “Assessment of the Sustainable Yield of the Living Resources in the Exclusive Economic Zone”, funded by the federal government, performed an extensive survey along the Brazilian coastline, from 1995 to 2002, enabling the collection of marine species up to 2000 m deep. Two other projects reinforced this deep sea prospecting, both sponsored by the Research and Development Center of the Brazilian Energy Company-PETROBRAS. The “Campos Basin Deep-Sea Environmental Project” and “Campos Basin Deep-Sea Coral Assessment Project” allowed species sampling and ROV images generation at depths from 700 to 1100 m. The huge number of species obtained from these sampling efforts enabled the evaluation of the state of the art of the knowledge of Octocorallia in Brazil. For this, all data available for the group in Brazil was compiled, from ancient works to the present. A total number of 97 species or morphotypes were surveyed in 240 sample sites. The completeness was tested with Jacckniffe, Chao 2, and ICE estimators, as well as the number of uniques and duplicates. The results showed that the number of species for the studied area may be, in average, 13% greater than it is known today. It indicates that, despite the recent evolution, there is much to be done in the research of Brazilian octocorals, including the continuity of the sampling programs and the identification of collected material that are still stored in scientific collection.

Geographic and bathymetric distribution of Alepocephalidae fish species in the NW African deep waters

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Fourteen fish species that belongs to Alepocephalidae family were recorder during Spain–Moroccan scientific deep (500 – 2000 m) surveys in NW Africa (2004 – 2005). The Alepocephalidae species represented 6% of the total weight of fish catches during the deep surveys and at the same time 35 %

of the target or potentially target fish species. Geographic and bathymetric distribution by species and length frequency of three main Alepocephalidae species by weight were analyzed. Specimens of *Alepocephalus bairdii*, *Alepocephalus rostratus* and *Rouleina attrita* were examined. There was a clear bathymetric segregation by species, from shallowest to deepest: *A. rostratus* (750 to 1750 m, main peak at 1300 m), *A. bairdii* (850 to 1900 m, main peak at 1700 m) and *R. attrita* (1300 to more than 2000 m, main peak 1900 m). There was also bathymetric segregation by length in the three species, younger specimens in upper strata and older ones in deeper strata. The length interval of *A. rostratus* was 10 – 65 cm, with two main modes (15 – 20 and 30 – 35 cm) between 800 to 1500 m and a third mode (50 – 55 cm) deeper than 1500 m. *A. bairdii* showed one main mode (15-25 cm) between 800 to 1500 m and a second one (55 – 60 cm) between 1500 to 2000 m. *R. attrita* showed one mode (25 – 30 cm) between 1300 to 1500 m and a second one (40 – 45 cm) deeper than 1500 m. Additionally, for *A. bairdii* we present the length – weight relationships. Also it was determined that females of *A. bairdii* are larger than males. Taking in account the geographic distribution, for three species the largest yields (kg/h) occurred in and vicinity of mouth submarine canyons. This finding support the idea that the submarine canyons play an important role as a mechanic feature to connect and transport material form the high productivity surface area (due to upwelling) and deep sea.

Bathymetric distribution limits and biological parameters of some Gadiform fish species in deep waters off NW Africa

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Gadiform fish species for because of their contributions in weight to the total catch as demersal target species. *Trachyrincus scabrus* was the most important specie in weight (8%: 814.1 kg), followed by *Mora moro* (3%: 360.2 kg), *Merluccius merluccius* (1%: 112.5 kg), *Micromesistius poutassou* (0.6%: 66.2 kg) and *Phycis blennoides* (0.2 %: 24.8 kg). There was a clear bathymetric segregation by species, between 500 m (peak) to 950 m (limit) *M. merluccius* and *M. poutassou* were dominant, followed by *P. blennoides* and *T. scabrus* (650 – 1000 m, 800 – 900 m peaks) and finally *M. moro* (700 – 1450 m, 100 m peak). It is presented and discussed the geographic abundance distribution of species that shares the same depth strata as well as the basic biological parameters (length frequency distributions grouped and by sexes, length – weight relationships, sex ratio and maturity stages) of these species.

Multiscale spatial distribution of a sedimentary macrobenthic community on the Angolan margin

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Organisms are often not randomly distributed in space. They are rather more abundant in some areas than in others, displaying spatial discontinuities in patches, gradients or other spatial structures. These structures are primarily a response to environmental changes and/or biotic interactions, which may be occurring at different spatial scales. Understanding variation in the spatial distribution and abundances of organisms is an important component of ecological theories and more pragmatically it is an essential part in the development of sampling strategies. This study aimed at assessing the multiscale variability of a macrobenthic community inhabiting fine sediments on the Angolan margin. Data were obtained from sampling cruises carried out during the Biozaïre program, a partnership between Ifremer and the French oil-company Total. Samples were collected in 2000, 2001, and 2003 at depths ranging between 1300 and 1400 m. Multiscale variability of the macrobenthic fauna was analyzed using a new statistical approach, Principal Coordinates of Neighbor Matrices (PCNM), which allows the detection and quantification of spatial variability over a wide range of spatial scales detectable by the sampling grain. The macrobenthic community displayed spatial structures according to the size classes of the taxa studied. Small mollusks and crustaceans (mesh sizes: 250 µm and 300 µm) displayed spatial structures at the fine (0.25 m2), meso (200 m2), and very broad spatial scales (6700 km2), explaining 53.1 % of the total variability of the small taxa. Large mollusks and crustaceans (mesh sizes: 500 µm and 1 mm) showed less spatial variability, displaying structures at the meso and very broad spatial scales and explaining 38.1 % of the large taxa variability. Further analyses are

being done to identify association of size-related taxa. The results will be address in the context of the spatial variability of size-related biological interactions in the deep-sea benthos.

Influence of nodules on macro-infaunal communities in the abyssal Pacific

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Nodule fields in the Clarion-Clipperton Fracture Zone (Tropical North Pacific) are scattered in space. Areas with nodules of different shapes, different chemical compositions and thus different economical values alternate with areas without nodules on short spatial scales. In order to test a structuring effect of nodule coverage on macro-infaunal assemblages, box core samples were collected in adjacent areas with and without nodules during the Nodinaut cruise. All dominant macrofaunal taxa had higher densities in areas with than without nodules, although differences were not statistically significant. Among the Polychaeta, the family Spionidae had significantly higher densities within the nodule field. Identification of 11 morphotypes within the family Spionidae showed that richness did not differ but dominance and composition do differ between areas with and without nodules. Four morphotypes of Spionidae abundant in sediments covered with nodules were not sampled in areas without nodules. The results of the Nodinaut project highlight that nodule fields likely constitute a distinct habitat for infaunal communities, which may enhance biodiversity of the abyssal benthos at the regional scale. These results also have consequences on biodiversity conservation in the prospect of nodule mining.

Systematics of the *Mesocletodes abyssicola*- group (Argestidae, Harpacticoida, Copepoda)

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Belonging to the Argestidae Por, 1986, the genus *Mesocletodes* Sars, 1909 is known as a typical, but not exclusive deep-sea taxon. Within this genus, species belonging to the *Mesocletodes abyssicola*-group have dorsal cuticular processes at the cephalothorax and/or the last abdominal somite and extremely elongated furcal rami. Up to date, 9 species of this group are described. During the expedition Diva 1 of RV #8220; Meteor #8221; in August 2000 to the Angola Basin, 20 specimens of the *Mesocletodes abyssicola*- group were sampled. Distributed to 11 species, all 20 specimens are new to science. The aim of this project was to elucidate the phylogenetic status of the *Mesocletodes abyssicola*-group. Altogether 14 species (included 5 new described species from the Angola Basin) of the *Mesocletodes abyssicola*- group were used for a phylogenetic analysis based on morphological characters.

Epibiotic sea anemones on marine gastropods: diversity, dynamics and role of bathyal associations

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Hormathiid sea anemones live as epibionts on numerous species of gastropods at depths of 950-1400 m along the continental rise of Eastern Canada, whereas they are not present on the same gastropods at shallower depths. The proportion of bathyal gastropods hosting 1-7 sea anemones, which cover up to 82% their shell, can reach 98%. Although the sea anemones are occasionally found on other substrata (i.e. empty shells, pebbles), laboratory trials confirmed that they preferentially associate with living gastropods. They use their tentacles to locate gastropods, eliciting a reaction in the host, which favours the pairing. Juvenile sea anemones (1-2 mm in diameter) readily move from the mud or other inert substrata onto burrowed bathyal gastropods. Conversely, juveniles and adults do not associate with shallow-water gastropods when given the opportunity. Trials exposing predatory sea stars (*Leptasterias polaris*) from shallow and bathyal depths to bathyal gastropods (*Buccinum undatum*) with epibionts, and to "naked" bathyal and shallow-water *B. undatum* revealed adaptive and evolutive behaviours in both prey and predator. Shallow-water gastropods, devoid of epibionts, react defensively to *L. polaris*, whereas deep-sea gastropods rely mostly on their epibionts to protect them, thus falling prey to *L. polaris* when the epibionts are removed. In turn, *L. polaris* from depths >500 m

typically ignore symbiotic gastropods, whereas they consistently prey on "naked" ones, while *L. polaris* from shallow areas initially attempt to prey on all gastropods, but soon learn to stay away from those harbouring sea anemones. The coevolutionary nature of the association between hormathiid sea anemones and bathyal gastropods from the North-Western Atlantic is further evidenced by studies of shell biofilms and host-symbiont selection.

New data on distribution and taxonomy of Benthimermithidae (Nematoda), parasites of deep-sea invertebrates

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Nematodes of family Benthimermithidae are known as very rarely found parasites of predominantly deep-sea benthic invertebrates: the polychaetes, priapulids, various crustaceans, holothuroids, and even free-living nematodes. The juvenile stages of the benthimermithids parasitize the host's body cavities and internal organs. Adult or late juvenile worms leave the host to the environment for a non-parasitic phase where they do not feed but reproduce. New findings of benthimermithids were made during the treatment of deep-sea meiobenthic samples from two cruises: "Nodinaut" RC (the northeastern Pacific, 2004) and "Diva II" RC (the southeastern Atlantic, 2005). About 5,700 nematodes were examined from "Nodinaut" RC, and 7 specimens of benthimermithids were found (0.12% of examined nematodes); 4 specimens were only found among about 15,000 examined nematodes from "Diva II" RC (0.03%). It was found 4 new species of genus *Trophomera* and *Cuspimermis nodinauti* gen. *et* sp. n. among pacific benthimermithids, and 1 new species of genus *Trophomera* among atlantic benthimermithids. Up to now, among about 40 known species of benthimermithids, there were known only 8 species from the Pacific, 9 species from the Indian ocean, and 27 species form the Atlantic. Several species were found in two oceans, and one species was described from three oceans. It is obvious that benthimermithids are widespread in the World ocean. They are known from the North, Central and South Atlantic, from the Indian Ocean, and from the North and Central Pacific. Evidently, the natural habitat of benthimermithids will be extended, as new deep-sea parts of the world ocean will be studied. The majority of benthimermithids are denizens of the deep sea at depths from 100 m to 6,000 m. As a rule, they are very rare worms, and their ratio in samples is at most 1 percent. The work was supported by CeDAMAr and CoML.

Habitat associations in gastropod species at East Pacific Rise hydrothermal vents (9°50'N)

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Hydrothermal vents on the East Pacific Rise (EPR) exhibit marked macrofaunal zonation patterns associated with temperature and water chemistry. Little is known, however, of the habitat associations of smaller macrofauna, such as gastropods and polychaetes. Gastropods are found in large numbers throughout the vent environment and undoubtedly play an important role in the vent ecology, as grazers and potential prey items. They are all mobile and thus their distribution is more likely to reflect current conditions than that of sessile organisms. Using settlement surfaces and field collections, we have attempted to define approximate habitat limits for common gastropod species at 9°50'N, EPR with respect to associations with areas dominated by other macro- and megafaunal species (e.g. alvinellid polychaetes, vestimentiferan tubeworms, bivalves, and other suspension feeders) and with temperature. We found that the nine most numerous species fell into three groups, using nonmetric multidimensional scaling. One group (*Cyathermia naticoides*, *Lepetodrilus cristatus*, *L. elevatus* and *L. pustulosus*, "warm zone species") was found to be significantly more abundant in the areas dominated by vestimentiferans than in cooler areas characterized by suspension-feeders. The second group (*Clypeosectus delectus*, *Eulepetopsis vitrea*, *Gorgoleptis spiralis* and *L. ovalis*, "cold zone species") was most commonly associated with suspension feeders, although this pattern was significant only for *C. delectus*. The ninth species, *Bathymargarites symplector*, was most common in the bivalve zone. *Neomphalus fretterae* and *Rhynchopelta concentrica* appear to associate with vestimentiferans but only at higher temperatures and *Peltospira* spp. and *Nodopelta* spp. associate with alvinellids. We have defined approximate temperature ranges for these species based on their distributions, and compare these ranges to those inferred from isotopic analyses. We suggest that

physiological tolerances restrict gastropod species ranges in the hottest habitat, nutritional requirements limit them in the coolest habitat, and species interactions (predation and competition) are most important in areas with intermediate temperatures.

Effect of associated fauna to the corallum growth of black corals

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Antipatharians or black corals are colonial anthozoans with chitinous skeletal axis covered to varying degrees with small spines. The features used for taxonomy of antipatharians are the size and structure of polyps as well as skeleton morphology, including mode of branching and/or pinnulation and also spine morphology. As many other sessile suspentional-feeders black corals often host to abundant associated fauna. In the course of the study it was found that the growth form and morphology of chitinous skeleton of antipatharians can be hardly influenced by associated polychaetes or other symbiotic organisms. The degree of influences and the value of taxonomic features in the presence of symbiotic organisms are discussed. Work supported by RFFI grant 06-04-48764.

Octocoral size-distributions and their implications for recruitment dynamics on the New England Seamounts

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Seamounts in many regions are known to host diverse communities of deep-water corals including octocorals, antipatharians and scleractinians. We know little about the life histories of these species, but suspect that many are long-lived (decades to centuries) and recruit only rarely. Our objective is to test this hypothesis by investigating colonization dynamics of the whip bamboo coral Keratoisis sp. on the New England Seamounts (N. Atlantic). An experiment designed to measure directly recruitment rates using basalt settlement blocks resulted in collection of only a single octocoral recruit (not Keratoisis) after 2 years, and no recruits after 10 months. This sparse recruitment is consistent with the idea that deep octocorals recruit only rarely, but it doesn't help quantify the time scales of recruitment. An alternative, indirect approach is to measure colony size-distributions to look for evidence of recruitment pulses or missing size classes. To do this, we measured sizes of colonies visible in seafloor images taken during ROV transects over four seamounts. Preliminary measurements using individual images of colonies indicated that Keratoisis colonies ranged from 0.14 to 4.03 m in length, but the technique was too time-consuming for measuring large numbers of colonies. Expansion of the technique required development of a stereo-pair image analysis procedure that used the digital 'Pixel-Fly' still images taken on all transects. The stereo-pair images greatly increase the number of colonies available for measurement, and provide an opportunity to analyze size distributions within discrete habitats and depth zones. As a complement to the size measurements, ^{210}Pb dating studies of coral skeletons are being attempted, in order to ascertain ages for existing colonies.

Benthic megafauna responses to strong oxygen gradients on the Pakistan Margin in the Arabian Sea

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The Arabian Sea oxygen minimum zone (OMZ) is the thickest layer of permanently low oxygen concentrations (<0.5ml/l) in the world. The sediments underneath the OMZ are characterised by strong gradients of oxygen and organic matter input. Investigations of the megafauna present within and beneath the Pakistan Margin OMZ were carried out from photographs and trawled samples collected during September 2003. A series of eight sites from different depths (140, 300, 400, 700, 900, 1100, 1200 & 1850m) on the continental slope were investigated for megafaunal abundance, taxonomic composition, diversity and lifestyles. The relationships between the megafauna parameters

with three environmental variables (depth, oxygen concentration and % total organic carbon) were subsequently tested. The permanent OMZ was comprised of two parts; an intensely dysoxic region ([O2]<0.2ml/l) and a deeper, less intense, region (0.2<[O2]<0.5ml/l). Although foraminifera and polychaetes were present in the intensely dysoxic region (300-900m), megabenthos and nekton were rare to completely absent. Megabenthos and nekton abundances were greatest at 1100 and 1200m depths, which coincided with the lower boundary of the OMZ. The fauna at the lower OMZ boundary were characterised by a high-density assemblage of sessile, suspension feeding pennatulids, hydroids and actiniarians, which dominated the megafaunal community. Species richness ($ES^{(20)}$) and diversity ($H'(\log^{e})$) were greater, and species evenness (J') lower, within the less intense part of the OMZ than in the more oxygenated waters beneath. Megafaunal abundance and community composition within the Pakistan Margin OMZ appear to vary in response to the gradients in both oxygen concentration and organic-matter input. Once a physiological oxygen threshold was exceeded (which occurred somewhere between 0.16 and 0.2 ml l-1) the high organic matter content of the OMZ sediments may have enabled the megafauna to achieve high densities.

Influence of environmental factors in the abundance and length distribution of the deep-water red shimps, *Aristaeomorpha foliacea* (Risso, 1827) and *Aristeus antennatus* (Risso, 1816) in the Eastern Ionian Sea

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The giant red shrimp, *Aristaeomorpha foliacea*, and the blue-red shrimp, *Aristeus antennatus*, are the most commercially important deep-sea demersal resources in the Mediterranean Sea. Both species are caught at more than 300 m depths. The distribution pattern of the two species is still in question for scientists. In the present work, an attempt to understand this pattern is undertaken by studying the relationship of the red shrimps abundance and length distribution with various environmental and biological parameters (depth, latitude, longitude, temperature, sex, maturity). Data were collected during various bottom-trawl and oceanographic surveys carried out between 300 and 1200 m depth, off the coasts of the Eastern Ionian Sea (Greece). For the analysis of data various methods (GLM ANOVA, multiple regression) were applied. Differences in the abundance distribution pattern of the two species were examined.

Deep-Sea Education and Outreach ideas for Europe

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The European Census of Marine Life (EuroCoML) project office began last year with the head office based at the Scottish Association for Marine Science. One of the aims of EuroCoML is to promote science to the general public. As a result, EuroCoML funded a workshop for the four European led deep-sea Census of Marine Life (CoML) funded projects – CeDAMar, ChEss, CoMargE and MAR-ECO. The main aim was to formalise collaboration between the groups with regards to Education and Outreach activities. As a result, the DEep-Seas Education and Outreach (DESEO) group has now been established with numerous ideas for promoting the deep-sea within Europe. Ideas range from travelling exhibitions, which will incorporate photographs, paintings etc. with an associated deep-sea guidebook providing more images and further information regarding the biology and ecology of the deep-sea environment. Other ideas include promoting the deep-sea within schools throughout Europe as well as a series of comic books exploring the different regions of the deep-sea that are currently being investigated through CoML.

Macrofauna inhabiting the Seamounts and Banks of the Northeast Atlantic

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To date very little macrofaunal sampling has been undertaken on the seamounts and banks to the west of the UK. In August 2005 as part of the Department of Trade and Industry's Strategic Environmental Assessment Area 7 survey, macrofaunal samples along with photographic images were collected from the seamounts and banks of interest. A total of 34 stations were sampled using a Megacore, Boxcore and a Day grab depending on water depth and sediment type. Polychaetes dominated the macrofaunal community (67%) followed by the molluscs and echinoderms each accounting for 12% of the total community. Of the polychaetes, the following families were the most dominant; Sabellidae, Spionidae, Amphinomidae, Gylceridae and Ampharetidae making up more than 50% of the individuals present.

Using worldwide ReefCheck monitoring data to develop Coral Reef Index of Biological Integrity

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The Coral Reef Index of Biological Integrity (CR-IBI) were constituted based on ReefCheck monitoring data and bioindicators' ecological functions on reefs. 76 "reference" and 72 "degraded" sites in shallow water and 39 "reference" and 37 "degraded" sites in deep water were classified based on the criteria: more than 35% of hard coral frequency of occurrence, the ratio of (Fleshy algae +Dead coral)/(Fleshy algae + Dead coral + Hard coral) <35%, and Hard coral/(Fleshy algae + Dead coral) >= 2 for reference site; and inversely: less than 30% of hard coral frequency of occurrences, (Fleshy algae +Dead coral)/(Fleshy algae + Dead coral + Hard coral) >50%, and Hard coral/(Fleshy algae + Dead coral) <= 1 for degraded site. Eight and four metrics from 53 potential candidate metrics compiled from global ReefCheck bioindicators' ecological attributes were selected to combine into final indices of shallow and deep waters respectively. The index scores were calculated by scoring each selected metric as 5, 3 and 1 depending on metric value threshold criteria. Overall site classification efficiencies were low 65.97% in shallow water and 66.13% in deep water. However, the strongly negative correlation between index with "dynamite fishing" (-0.286**) and "number of yacht within 1 km" (-0.185*) in shallow water and with "poison fishing" (-0.279*) and "coral damaged by other factors" (-0.283*) in deep water indicated that coral reef indices were significant responses to stressors and promised reliable applicability as the coral reef biological monitoring tool.

'Live' benthic foraminifera from the abyssal equatorial Pacific nodule province

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Replicate samples from 3 stations in the Kaplan East area of the abyssal eastern Equatorial Pacific (~15° N, 119° W; ~4100 m water depth) yielded 12,513 small, rose Bengal stained benthic foraminifera dominated by agglutinated taxa, most of them morphologically simple monothalamous types or komokiaceans. Almost two thirds (65%) of specimens were either obvious fragments, mainly of komokiaceans and tubular foraminifera, or single chambers or small groups of chambers believed to be fragments of very fragile komokiaceans. The remaining 4438 specimens (35%) were complete individuals, most of them indeterminate agglutinated spheres ('psammosphaerids') that constituted 27.6% of all specimens (complete plus fragments). Complete individuals assignable to either described or undescribed species accounted for 983 specimens (22% of complete tests = 7.6% of all specimens); only 26 specimens (0.59% of complete individuals) were calcareous. Some groups exhibited considerable spatial heterogeneity; 45% of the 3455 indeterminate psammosphaerids and 45% of the 3087 komokiacean-like chambers occurred in single subcores. A total of 252 morphospecies was recognised; 168 were represented by complete individuals and 84 by fragments. Preliminary study of samples from the Kaplan Central site (14°N, 130°W, 5042 m) revealed a similar spectrum of foraminiferal types; tiny psammosphaerids and fragments were frequent and some important species were common to the two sites. Clear differences exist between these Pacific assemblages and those from other oceans; in particular, psammosphaerids and isolated komokiacean chambers are much more prevalent in the Pacific than in the Atlantic Ocean. Some morphospecies present in Kaplan samples are known from the Atlantic but many are not. These may either 1) be

ubiquitous but undersampled because they are rare or 2) have geographically patterned distributions. Without further sampling, there is no way to distinguish between these two possibilities.

The Thyasiridae (Bivalvia) in deep-sea settings

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Thyasirid bivalves have been collected from the entire array of deep-sea settings from the oligotrophic abyssal plain, oxygen minimum zones, to vents, seeps, mud volcanoes, hydrothermal springs and anthropogenic sites. They are widely recognised as both chemosymbiotic and heterotrophic and to inhabit intertidal to hadal habitats. Despite their ecological diversity they have not attracted the same attention as *Calyptogena* and *Bathymodiolus*. This is partly because they appear to be less abundant at chemosynthetic sites, are infaunal, are generally not very large and that their taxonomy is confused. They are relatively diverse in Atlantic abyssal oligotrophic settings where they are primarily minute species (5 mm) placed in the genera *Thyasira*, *Parathyasira*, *Axinulus* and *Mendicula*. The interpretation of these genera is imprecise and requires revision. They are rare at vents with only a single species known from the Logatchev site. They are not common at seeps except that in the eastern and northern Pacific the genus *Conchocele* is indicative of such settings. Other than *Conchocele* those species recorded at seeps, vents and oil seeps are morphologically similar, tend to be relatively larger 20-30 mm and allied to the shallow water species *Thyasira sarsi*. *Conchocele* and the other larger taxa are distinctly chemosymbiotic with modified gills harbouring bacteria in dense aggregations of bacteriocytes. At mud volcanoes the species are small (10mm) and appear similar to *Thyasira* and *Parathyasira* from shelf settings. The morphology of these is less modified and the reliance on chemosymbiosis probably less.

Unexpected megafauna community structure in the surroundings of the deep Zaire canyon (East Equatorial Atlantic)

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The megafaunal communities were investigated in three stations in the Zaire canyon area during the BIOZAIRE 3 cruise in order to study the influence of the different sources of energy (cold seeps and Zaire canyon inputs) on their structure. First, ten sites were sampled by trawling at increasing distances from a giant pockmark located at 3150 m depth, 8 km north from the Zaire canyon, to investigate the potential influence of the methane driving ecosystem on the surrounding communities. Megafauna was dominated by echinoderms with high densities of irregular echinids. Another striking feature was the high abundance of protozoans, but no typical cold seep species was sampled even in the close vicinity - 200m - of the pockmark. The community composition did not vary along the transect, but the density seemed to be influenced by the canyon inputs. Except for several fishes whose nutrition is partially based on chemosynthetic production, stable isotopic values d13C and d15N of megafaunal tissues highly contrast with those of the seep species and indicate the absence of nutritional link between both communities. Secondly, two stations located at 4000 depth respectively 15 km and 200 km south of the Zaire canyon were sampled to study the influence of organic matter input driven by the canyon on megafaunal communities. At both stations megafauna composition contrasted surprisingly with the one observed in the surroundings of the giant pockmark. Instead of the classically dominant echinoderms in that environment, large size bivalves belonging to the families Vesicomyidae and Solemyidae, and Siboglinid polychaetes were sampled in high density, particularly at the southern station, far from the canyon. These species with reduced or absent digestive tracks as associated in symbiosis with chemoautotrophic bacteria are indicators of reduced environment with hydrogen sulfide production due to (i) anaerobic oxidation of abundant organic matter or (ii) methane rich fluid emissions and subsequent sulfide production. The isotopic signature of the bivalve tissues (d13C) is consistent with nutrition based on chemosynthetic processes. Different hypotheses can be suggested to explain these megafauna features: (i) fluid emission could occur in relation with fossil buried channels where organic matter have accumulated, (ii) high present day terrestrial organic matter inputs may fuel these communities, (iii) occurrence of such communities and reduced environments may be linked to the deep oxygen and nutrient anomalies evidenced in the water column at 4000 m depth in this area.

Glutathione and superoxide dismutase activity in *Alviniconcha hessleri* and *Bathymodiolus brevior* from Lau and North Fiji Basin hydrothermal vents

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Hydrothermal vent environments are known to have extremely elevated heavy metal concentrations, those in the Lau Basin especially so, but how endemic organisms deal with this burden is not fully understood. Cellular mechanisms to defend against metal-induced oxidative stress include the oxyradical scavenging tripeptide glutathione and the enzyme superoxide dismutase (SOD). These two mechanisms were quantified spectrophotometrically in foot and endosymbiont-bearing gill tissue of the vent gastropod *Alviniconcha hessleri* and the mussel *Bathymodiolus brevior*. Glutathione levels were consistently and significantly higher in gill than in foot tissue of *A. hessleri* but not in *B. brevior*, which had similar levels in the two tissues at each site. Mussels from the more seep-like Hine Hina site showed the highest levels of glutathione of all the sites measured. Differences in glutathione and SOD levels between sites and species are discussed.

Development and uses of a deep-sea nematode morphological and DNA barcode database

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Deep-sea nematodes are widely distributed, abundant and diverse which makes this taxon useful as an indicator of biodiversity and as a monitoring tool. However, deep-sea species are not well described; of the 4,000 marine nematode species identified most are from shallow sublittoral and intertidal zones around northern Europe. Conventional alpha taxonomy of nematodes is time consuming and requires extensive training and expertise. Alternatively, DNA barcoding of nematodes would provide a quick and easy assessment of benthic biodiversity and can be completed successfully with minimal training and experience. This would require the construction of a well-populated nematode library database aligning morphologically identified nematodes with known barcode sequences.

Infaunal macrobenthos communities and sedimentary characteristics of Le Danois Bank (NE Atlantic, N Spain): preliminary studies

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Over the course of 2003 and 2004 a number of multidisciplinary studies were carried out with the objective of examining both the benthic and demersal communities as well as the different environmental variables of Le Danois Bank (Cantabrian Sea, N Spain). All of these studies were conducted under the project ECOMARG (CICYT, REN2002-00916/MAR, Spain). Le Danois Bank, the most relevant of the Cantabrian marginal shelves, is composed of a nearly flat surface located at a depth of 450-600 m. It has a slight slope towards the coast, but is separated from the continental shelf by a deeper internal basin (850 m). The sediments and infaunal communities were sampled using a box corer covering a sampling area of de 0.25 m^2. The sediments at the top of the bank are made up of fine sands (152.05 ± 12.31 µm mean diameter) with a low organic content (3.12 ± 0.35 %), similar to other zones of the adjacent continental shelf, while those found in the internal basin consist of silt (19.49 ± 9.92 µm mean diameter) with a high organic matter content (6.52 ± 0.41 %). The infaunal communities inhabiting the top of the bank are dominated by the polychaetes (67-74 %), particularly the families Paraonidae and Syllidae. The next most abundant group are the crustaceans (10-13 %),

dominated by the isopods, and the molluscs (9-12 %), characterised by the large number of bivalves belonging to the family Limopsidae (*Limopsis aurita*). The surface-deposit feeders and subsurface-deposit feeders comprise the trophic group typical of the zone, although the suspension feeders are also quite prevalent, as they benefit from the high hydrodynamism in the zone. The dominant families of the internal basin, in contrast, are the polychaetes (43-68 %) and the most prevalent group in the infaunal community is the family Onuphidae and bivalves (6-30 %), made up chiefly of species from the family Nuculidae. The prevailing trophic group in this deep zone is made up of the deposit feeders –both surface and subsurface. The abundance and total infaunal biomass in this more shallow and sandy zone is greater than that of the deeper internal basin. Specific richness and diversity are moderate across the entire study area, although higher values were observed on the marginal shelf, but they were very similar to those recorded on the adjacent continental shelf.

The effect of elevated hydrostatic pressure on the spectral absorption of deep-sea fish visual pigments

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Hydrostatic pressure increases by approximately 0.1 MPa for every 10 m depth increase in the open sea. Deep-sea organisms are thus subject to elevated pressures, which they cannot avoid. Many aspects of organismal biochemistry and physiology have been shown to be pressure-sensitive, and several studies have provided evidence suggesting evolutionary adaptations to hyperbaric conditions, which operate at the molecular level. For instance, many enzymatic proteins have been shown to be pressure-sensitive, some having apparently clear adaptive properties. Visual pigments comprise a protein (opsin) and a chromophore which is an aldehyde of vitamin A. Electrostatic interactions, operating at very small distances, between amino acids in the opsin and electrons surrounding the chromophore alter the spectral absorption of the visual pigment. The primary sequence of the protein, and its tertiary structure, both, therefore, affect visual pigment absorption spectra. As protein structure may be altered by elevated pressures visual pigment absorption may be altered by this physical variable. We report the results of experiments to investigate the effect of elevated hydrostatic pressures on the spectral absorption of deep sea fish visual pigments. Experiments were conducted over both physiologically-relevant pressure ranges (e.g. < 50 MPa) and at pressures beyond those encountered by deep sea animals (< 700 MPa).

Community structure of canyon megafauna in relation to energetics and substratum

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The community structure and species composition of the megafauna within submarine canyons is being studied with a view to determining factors that influence variation. Inter- and intra-canyon communities are being compared on the Portuguese margin (Nazaré canyon, Cascais channel and Sétubal canyon), and intra-canyon and canyon and slope communities have been compared on the Pakistan margin. Future cruises will also investigate megafaunal community structure and composition in the Var canyon, Mediterranean. Towed camera sleds (SHRIMP and WASP) are used to obtain high-resolution images that are analysed and used to identify and quantify megafaunal abundance. High densities of soft corals and other suspension feeders are seen in Nazaré canyon at ~2700m, and of deposit-feeding holothurians at ~1000m, from which high SPM concentrations may be inferred. Further results from the Portuguese margin will be presented. Significantly higher megafaunal abundance on the Pakistan margin is seen within the canyon with respect to the adjacent slope. These results will also be discussed further.

Influence of Climatic and Oceanographic Processes on Formation of Coastal underwater Landscapes and Condition of Bottom Communities (Crimea, Black Sea)

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Underwater landscape mapping is one of the principal part of studies aimed monitoring of coastal marine environment and evaluation of state of bottom communities impacted by different abiotic factors. The complex large-scale subwater landscape/ecological investigations have been made in 1993-96 along the coastal zone of SW Crimea (the Black Sea) at 0-40 m depth. In hydrological regime of this area role of breeze effect, more expressed within warm season, is very significant; as a result-wind recharged twice a day. Significant daily alterations in spatial structure of currents induced by winds define the unsteadiness of thermocline structure mostly revealed in early summer period, when the upper boundary of autumn thermocline (11-14^{o}C) surfaced in near-shore zone. Such fluctuations impact on water transparency, concentration of phyto-and zooplankton, oxygen regime of near-bottom water layer, general status of phyto- and zoobenthic communities. To distinguish and differentiate landscape facies, the data on hydrodinamics, seabed microrelief and slope, grain-size structure of soft-bottom substrate as well as quantitative characteristics of phyto- and zoobenthos were used. Peculiarities of spatial pattern of underwater landscapes and changes in bottom communities were represented as a result of hierarchical interrelation between the following principal landscape-forming components: meteorological regimen --> hydrodynamic activity --> grain size structure of sediments --> physico/chemical properties of the upper layer of bottom substrate, including content of pollutants --> quantitative indices, feeding structure and biodiversity of bottom communities. As a result, 7 different bottom landscape facies were distinguished.

Evaluation of the use of ROV images and collected samples on the assessment of Cnidaria associated with deep-sea reefs in the Southwestern Atlantic

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Until the 1960s, most of the investigations on corals of the platform and continental slope in Brazil were from short-term studies made by foreign researchers. In 1995, more intensive studies on the deep- sea corals began as part of the government project “Assessment of the Sustainable Yield of the Living Resources in the Exclusive Economic Zone”. More recently, some oil industry initiatives are contributing to increasing the scientific knowledge of the deep-sea coral fauna from Brazil. The “Campos Basin Deep-Sea Environmental Project” and “Campos Basin Deep-Sea Coral Assessment Project”, coordinated by the Research and Development Center of the Brazilian Energy Company-PETROBRAS, had collected specimens and images between 21-22°S, and 700-1100m depth. The results are based on examination of approximately 48 hours of video images obtained using ROV and of materials collected by trawling and ROV in the same areas. We identified 30 cnidarian species (18 Octocorallia, 7 Scleractinia, 1 Antipatharia, 1 Actiniaria, 2 Zoanthidea and 1 Stylasterina) in the collected material. Analysis of the images, mostly in close-up, enabled 23 morphotypes to be distinguished. Some of these morphotypes may represent species not yet collected. Images from the ROV during movement or static in the water column only allowed the identification of very characteristic morphotypes, like *Narella*, *Anthomastus*, *Anthothela* and *Trachytela* and did not permit differentiation of some rigid and ramified forms like *Solenosmilia* and *Lophelia* or *Enallopsammia* and *Corallium*. When the ROV was stationary, stabilization of the image and closer macro-photography enabled better taxonomic resolution and identification of the images. The results of this study show that the use of quantitative methods using video images is possible with some indicative species in these deep-sea communities, as *Narella alvinae*.

The role of suprabenthic and epibenthic communities in the diet of a deep-sea fish assemblage (Le Danois Bank, Cantabrian Sea, N Spain)

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A total of 602 stomach contents belonging to 9 species of deep fishes (*Alepocephalus rostratus*, *Chlorophthalmus agassizii*, *Coryphaenoides rupestris*, *Deania calcea*, *Etmopterus spinax*, *Galeus melastomus*, *Hoplostethus mediterraneus*, *Nezumia sclerorhynchus* and *Trachyscorpia cristulata*) were analysed. Data come from two surveys carried out in 2003 and 2004 in the Le Danois Bank (Cantabrian Sea, North Atlantic coast of Spain) between 400 and 1000 m. Prey were identified to species level whenever possible, and quantified in number. We described the diet composition of 9 dominant fish and analysed interespecific dietary affinities along the depth interval sampled. The relevance of the epibenthic and suprabenthic communities in the diet of demersal fish species was examined by comparing stomach content data with their abundance in the environment. To evaluate the degree to which the epibenthic and suprabenthic communities were selected in favour of other prey we used the Ivlev index. The main prey taxa found in the diet belonged to the suprabenthic and benthopelagic communities, mostly amphipods, euphausiids and mysids, which made up the 60 % of total diet composition. The mysid *Gnathophausia zoea*, the euphausiid *Meganyctiphanes norvegica* and the amphipods *Syrrhoe affinis*, *Pseudotiron bouvieri* and *Nicippe tumida* were the most abundant species (% number) in the diet. These results were consistent with their abundance in the environment. In addition, epibenthic species such us the polychaete *Hyalinoecia tubicola* and other polychaetes belonging to the family Aphroditidae were important prey for the macrourid *Nezumia sclerorhynchus*. This species showed the highest trophic diversity (H'= 4.9) feeding on a great variety of amphipods and polychaetes. In contrast, the most specialised fish, *Coryphaenoides rupestris* (H' = 2.4), fed almost exclusively on Calanoid copepods and the mysid Gnathophausia zoea. The cluster analysis of prey affinities between fish-depth groups depicted two major blocks, corresponding to two different trophic guilds: one consisting of a macroplankton-suprabenthic feeder group, and a second group of species feeding on ostheichthyes, cephalopods and other nectobenthic prey, this second trophic group consuming, on average, larger prey than the former. These results revealed that feeding ecology of deep fish in the Le Danois Bank was more influenced by prey size than by depth.

Arctic deep-sea scavengers at large food falls: temporal attraction, consumption rate and population structure

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Scavenging amphipods were studied at six locations in the Fram Strait (Arctic Ocean). At each location a tripod lander equipped with a time-lapse camera, acoustic doppler current profiler and baited traps was deployed at water depth between 1500 and 2600 m. All amphipods, both on photographs and captured, belong to the superfamily Lysianassoidea or Stegocephaloidea. Differences between the stations occurred in time and number of amphipod maxima, consumption rates, taxonomic composition, size structure and current direction. Scavenger aggregation dynamics and behaviour on carcasses in the Arctic Ocean differ from other reported deep-sea areas in arrival time at bait, abundance and length distribution of individuals sampled. The giant amphipod *Eurythenes gryllus*, dominated at our bait experiments, exceeded numbers counted by other workers more than 13 fold, and first individuals appeared up to 20 times faster than in other reported experiments. Specimen attraction and abundance seems to be directly linked to the organic input of food falls, in the area. Relations between scavenger aggregations and trophic conditions are discussed with respect to results obtained under different trophic regimes in the Arabian Sea, and the Pacific and Atlantic Oceans.

Spatial heterogeneity of prokaryotic communities in Arctic deep-sea sediments: a question of scale?

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The relationship between deep-sea benthic habitat heterogeneity and nutrient patchiness, and its impact on prokaryotic community dynamics is discussed, focussing on two major mechanisms of particle transport: the input of particulate organic matter from the euphotic zone as main energy source for heterotrophic organisms in deep-sea sediments and the multiple-scale, lateral advection. From large to small scales, these processes mainly connect habitat-structuring patterns with spatial differences in food quality and quantity. In polar regions, the vertical particle flux is governed by highly

variable and intense nutrient pulses reinforced by melting processes at the ice-edge. Significantly contributing to the deep-sea benthic biomass, bacteria and archaea bear the metabolic potential to rapidly react to such relatively short-term changes in environmental conditions. In this context, an attempt is made to compare the spatial patchiness of deep-sea benthic prokaryotic communities at different locations in the deep Greenland Sea and Fram Strait, Arctic Ocean: along a depth transect (1000-5500m) from the Vestnesa Ridge to the Molloy Hole (\'HAUSGARTEN\'), a 200 km-long channel system at the Eastern Greenland continental rise, including examples for small-scale heterogeneity in the microenvironment of biogenic sediment structures. At small scales, biological and physical disturbances are shown to have a marked effect on bacterial abundance and activity. The large-scale distribution, composition and activity of prokaryotic communities reflect a complex scenario of different transport mechanisms, ranging from vertical particle flux associated with ice-edge melting to down-slope sediment transport and lateral advection.

Deep demersal communities of Moroccan waters: First faunistic results of MAROC-0411 Survey

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Deep demersal fauna in northern Morocco (Gibraltar Strait to Agadir) between 500 to 2,000 m is composed by at least 900 species which are shared among fishes (240 sp), crustacean (55 sp), cephalopods (36 sp) and other megabenthic taxa (≈281 sp); 41 fish species belonged to condrichties and the other 199 to teleosts. Taking into account the estimated total catch (269,909 individuals and 73 tons) the 49,7% and 80.1% of numerical abundances and weigth corresponde, respectively, to fishes, and the rest (34.9% and 18.5%) to benthic invertebrates, which are more important than fishes in the north zone. Porifera and Holothuroidea, together *Hoplostetus mediterraneus*, *Alepocephalus bairdii* and the Gadiforms *Bathygadus melanobranchus* and *Gadomus longifilis* are dominant in the global catch; but, while the sponges dominate in the north, *H. mediterraneus* is dominant in the center and holothuroids in the south. In spite of a smooth gradient of both, abundances and specific richnness, as well as some differences in qualitative composition is observed, latitude doesn't seem to be a decisive variable in the distribution of deep demersal communities; mean densities, but the crustacean, increase stronghtly with depth, while numerical abundances and specific richness are also significantly different among the three depth-dependent associations. As the multivariate analysis shows, demersal fauna is structurated in three faunistic communities which segregation seems to be determined by depth having two main boundaries at 830-850 and 1,200-1,300 meters. From 500 to 850 m *H. mediterraneus* constitutes the 27% of total biomass, while at the next strata (850-1,200 m) the demersal shark (*Deania calcea*) represents the 22%; down 1,300 m the fauna is well structurated and dominated (half of total biomass) by Alepocephalidae, big-size and slow-live strategies species; this fact is due probably to the lack of fishing explotation at these zones.

Megabenthos of Morocco deep waters: Preliminary results of MAROC-0411 and MAROC-0511 Surveys

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Fishing effects on deep benthic ecosystems constitute at present, one of the most worrying topics in marine conservation. As consequence, the location of especially vulnerable habitats like cold-water coral reefs or long-lived sponge communities, which can be still protected, recently has turned a priority aim of scientific deep surveys. During November-December of 2004-2005, within the framework of Spanish-Moroccan scientific cooperation, the IEO (Spain) and the INRH (Morocco) carried out two trawling surveys to prospect and evaluate demersal resources and to study the benthic fauna in deep waters of Morocco. On board O/V "Vizconde de Eza" were accomplished 181 stations with a Lofoten trawl gear (one hour trawling real time) between 500 and 2000 meters depth, from the Strait of Gibraltar (36ºN) to cape Boujador (26ºN). Both zones exhibit a different geomorphology, very irregular and characterized by the presence of mud volcanoes, depressions and deep canyons off

Agadir latitud, and at hydrological level by occurrence of upwelling areas. Invertebrate catch was estimated in 177,000 individuals and 17 tons. Biomass dominance corresponded to echinoderms (42 and 47% in the north and south of Agadir), mainly to holothuroids and echinoids belonged to Echinothuriidae family; sponges (46 and 30%) and crustaceans, cnidarians and cephalopods followed them. Estimated species number was similar in both zones ≈280 sp), corresponding the high diversity to cnidarians (100 sp), echinoderms (66 sp) and sponges (43 sp). It is noticeable that mean values of richness, densities and mainly biomass increases with depth. These showed a strong "jump" down 1,500 m. Main densities located in front of capes Ghir and Juby would be related with the highest productivity due to the upwelling and bottom currents, as well as the phythodetritus deposition and material transport through the submarine canyons. These two enrichment ways could maintain, respectively, suspension-feeders and detritivores communities. Lowest densities from 500 to 800 m could be consequence of the intensive fishing exploitation in this bathymetric stratum.

Calcareous sponges from abyssal and bathyal depths in the Weddell Sea, Antarctic

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Seto Marine Biological Laboratory Series 1. p. 1-8. Regarded as a fauna element of a larger geographic region, Antarctic Calcarea shows all the characteristics of need for revision and further collection and investigation. Descriptions and records have been published from scattered locations over a span of more than a hundred years and in several languages, reflecting scientific traditions and philosophy of different times in a number of countries. The basic samples from most expeditions were few, small and often only fragments. It is from a few restricted areas where repeated sampling has been done over a longer period of time that the collections comprising large numbers of specimens and species originate. One example is the material from "Winter Quarters" of the National Antarctic Expedition ('Discovery') 1901-1904 in the Ross Sea, where Jenkin (1908) described 23 species, 20 of them as new to science. Another is "Winterstation" of the Deutsche Südpolar-Expedition ('Gauss') 1901-1903 off Kaiser Wilhelm II-Land, where Brøndsted (1931) listed 29 species from the area, 14 of them described as new. In a survey Brøndsted (l.c.) gave a list comprising 50 nominal species at the time reported from the Antarctic continent. Traditionally Calcareous sponges have been regarded as shallow water organisms, and by far the largest number of records of Antarctic calcareous sponges are from shelf areas between 50 and 400 m depth. They have only been sporadically recorded on the upper slope, and on the lower slope and abyssal depths there are no previous records. Tanita (1959) reported one calcareous sponge from 570 m off Queen Mauds Land (Atlantic sector). Koltun (1976) identified 2 species, from 603 m off Enderby Land and 640 m off Adelie Land, both in the Indian Ocean sector. Tendal found one species at 850 m off Coats Land, in the Weddell Sea (mentioned without depth indication in Barthel et al. 1997). It was therefore a big surprise when the first true deep-sea Calcarea from the Antarctic were collected at depths between 1120 m and 4400 m during the ANDEEP I, II and III expeditions (Janussen et al. 2003, Janussen in press). Alltogether six species have now been found, including four new species and one new for Antarctica. The four new species represent the genera *Ascaltis*, *Clathrina*, *Pericharax* and *Sycettusa*. The species *Amphoriscus gastrorhabdifera* is here reported for the first time since it was originally described from shallow waters outside Tristan da Cunha (Burton 1932). Although calcareous sponges are rare in the Antarctic deep sea they seem to constitute a constant component of the fauna of the Weddell Sea. Litterature cited: Barthel, D., Tendal, O. S., Gatti, S. 1997. The sponge fauna of the Weddell Sea and its integration in benthic processes. - Berichte zur Polarforschung, 249: 44-52. Brøndsted, H. V. 1931. Kalkschwämme der Deutschen Südpolar-Expedition 1901-1903. - Deutsche Südpolar-Exped., XX, Zool: 1-47. Burton, M. 1932. Sponges. - Discovery Reports, VI. pp 237-392. Janussen, D., Rapp, H. T. & Tendal, O. S. 2003: A myth vanished: Calcareous sponges are alive and well at abyssal depths. - Deep-Sea Newsletter, 32: 17-19. Janussen, D. (in press): Preliminary report on the Porifera (sponges) of the ANDEEP III-Expedition.- Berichte zur Polarforschung. Jenkin, C. F. 1908. The Calcarea of the National Antarctic Expedition 1901-1904. - Nat. Hist. Rep. 4:1-52. Koltun, V. M. 1976. Porifera Part I: Antarctic sponges. B.A.N.Z. Antarctic Research Expedition 1929-1931. Reports ser. B. IX(4): 147-198. Tanita, S. 1959. Biological results of the Japanese Antarctic Expedition 1. Sponges.

Population genetics and dynamics of the Antarctic deep-sea shrimp *Nematocarcinus lanceopes* Bate, 1888 (Decapoda: Caridea)

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The presence of Decapoda in the high Antarctic is restricted to the members of the family Lithodidae (stone crabs) and a few species of benthic shrimps. Although low in species number, decapod shrimps represent an important and abundant element of the Antarctic shelf and deep-sea benthos. The benthopelagic deep-sea shrimp *Nematocarcinus lanceopes* Bate, 1888, is the only Antarctic decapod that occurs on the continental slope down to 3000 m depth at various locations between the west Antarctic Weddell Sea and the east Antarctic sector of the Indian Ocean. Large numbers were recorded between 500 and 1200 m depth in the Weddell Sea where *Nematocarcinus lanceopes* is one of the most common shrimp species. Benthic and pelagic Antarctic species with pelagic larval stages are believed to have a circum-Antarctic distribution, for example Porifera, Cnidaria, Euphausiacea, Teleostei and others. However, there are only few studies about the population genetics and phylogeography of such widespread species, and decapod shrimps have been ignored until now. First preliminary results of the analysis of mitochondrial genes of specimens from different stations across the Weddell Sea, Antarctic Peninsula and Ross Sea give evidence for two large clusters of different haplotypes.

The phylogeny of the deep-sea Asellota (Crustacea: Isopoda) inferred from 18S rDNA data

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Isopod crustaceans are an important component of the fauna of soft bottoms in the deep sea. In contrast to shallow-waters, bathyal and abyssal isopod faunas are dominated by the small Asellota. Deep-sea asellotes show a spectacular range in morphologies, including some very bizarre body-forms. Some (e.g. the family Ischnomesidae) have extremely long body segments, while others have very spinose bodies (e.g. the families Dendrotiidae or Mesosignidae). Previous phylogenetic studies based on morphological characters could not resolve details of the phylogeny of the deep-sea Asellota because of the high morphological variability of the species. Here we analyze the complete 18S rRNA gene of more than 100 asellotes to reconstruct their phylogeny. Our analyses support the monophyly of the marine and freshwater Asellota. The monophyly of typical deep-sea families, for example the Haploniscidae, Ischnomesidae, Mesosignidae or Munnopsididae, is well supported by different methods of analysis, while the monophyly of the Janiridae *sensu* Wolff is definetly rejected. In addition to this, most basal relationships among the Munnopsididae, a morphological highly diverse family, are poorly resolved, suggesting the possibility of a hard polytomy due to a rapid and potentially simultaneous radiation early in the history of this taxon. Our molecular data indicate that several lineages of the Asellota have colonized the deep sea independently of one other. One deep-sea lineage is especially rich in species, the so-called “munnopsoid radiation”, including sequenced species of the Munnopsididae, Desmosomatidae, Nannoniscidae, Ischnomesidae, Macrostylidae, Janirellidae, Mesosignidae and *Xostylus*. It gave rise to six families with a total number of 600 species, representing 40% of all known marine Asellota.

New record of the Southern Ocean species of *Cumella emergens* (Cumacea: Nanastacidae) that emerged from the deep

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The species *Cumella emergens* Cobera, 2000, is one of two species of the genus *Cumella* described from the Southern Ocean. *Cumella australis* is a common species from the Antarctic region recorded from shallow waters (46-385 m) of nearly all Antarctic areas, whereas *Cumella emergens* was found in only one location in a depth of 649 m off Livingstone Island (South Shetland Island). The species is

closely related to the Atlantic deep-water species *C. compacta* Johnes, 1984, *C. decipiens* Johnes, 1984, and *C. meridionalis*, Johnes 1984. These species were found in depths from 500–4566 m. New material collected during the 19th Italian Antarctic expedition onboard of RV "Italica"off Victoria-land (Ross Sea) provided 23 specimens from depths between 208-458 m. Most obvious differences from the newly collected material to the type material of *Cumella emergens* are different angles of the pseudorostrum and the shape of the posterior part of the carapax. Whether differences are due to sexual dimorphism, geographical variation, or an indication for a new species has to be proven. Three premature males were collected from the type locality, whereas the new material consists of different stages of females only. Thus a sexual dimorphism cannot be excluded. Until now the species illustrated here has only been sampled on the continental shelf of Antarctica. Nevertheless, this does not mean that it might occur in deeper waters, as the deep Ross Sea is still completely undersampled.

Morphological and Molecular Characterization of *Abyssoanthus nankaiensis*, a New Family, New Genus and New Species of Deep-Sea Zoanthid (Anthozoa: Hexacorallia: Zoantharia) from a Northwest Pacific Methane Cold Seep

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Numerous individuals of an unidentified sediment-encrusting zoanthid-like species (Order Zoantharia=Zoanthiniaria, Zoanthidea) were observed and sampled during Shinkai 6500 deep-sea submersible dive #884 (June 18, 2005) at a methane cold seep (depth=3259m) off Murato at the Nankai Trough, Japan (32°34.945\'N, 134°41.545'E). Unlike previously described deep-sea zoanthids, *Abyssoanthus nankaiensis*, gen. nov. et sp. nov. (Abyssoanthidae fam. nov.) is non-colonial, free-living (non-commensal), and uniquely is found on mudstone in the vicinity of a methane cold-seep. Morphologically, *A. nankaiensis* sp. nov. is characterized by its relatively uniform polyp diameter from oral to aboral end with 19-22 mesenteries. Additionally, obtained novel DNA (mitochondrial 16S ribosomal DNA, mitochondrial cytochrome oxidase c subunit I DNA, and nuclear 5.8-ribosomal DNA) sequences from these samples also unambiguously place this specimen in a previously undescribed and new family within the order Zoantharia. This is the first reported zoanthid species from a methane cold seep or other so-called "limited" environment, and the first molecular characterization of any such deep-sea zoanthid. Potential modes of nutrition of this new species are also discussed.

A Global Analysis of Standing Stock and Body Size in the Deep-Sea Benthos

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We compiled a database on spatial patterns of standing stock from 132 studies that reported estimates from 2702 samples collected between 15 and 8376 m. The data include both biomass and abundance for all major size groups of the benthos: bacteria, metazoan meiofauna, macrofauna and megafauna. We examined bathymetric patterns within and among size categories by using linear regression and the analysis of covariance. The decrease in community standing stock with depth, long known for individual regions and taxa, is a global phenomenon that involves a complex transition in the relative importance of the different size groups. The abundance of larger organisms is significantly lower and decreases more rapidly than for smaller organisms, providing strong confirmation of Thiel's Size Structure Hypothesis (1975. Int. Rev. ges. Hydrobiol. 60:576-606) on very large spatial scales. Similarly, in terms of biomass, smaller size groups replace larger size groups with increasing depth. Broad overlap of biomass among size groups supports Haedrich and Rowe's (1977. Nature 269:141-142) contention that size groups do not correspond to Eltonian trophic levels. For the two largest datasets, metazoan meiofauna and macrofauna, we also looked at horizontal among-basin variation in standing stock associated with differences in nutrient input from overhead production, topographic forcing, lateral advection of sediments and oxygen minimum zones. Predictably, there is a very consistent association between standing stock and food availability. Bathymetric patterns of standing stock have important implications for biodiversity. The bathyal zone affords more opportunity for larger organisms through greater resource availability, and in consequence supports a higher diversity of larger organisms than does the abyss.

Heat Shock Proteins as Indicators of Stress in Marine Organisms: A deep-sea study off the North West Shelf of Australia

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Heat shock proteins (hsp) have been identified as a universal biomarker of abiotic and biotic stress. Thus a fundamental understanding of hsp expression will provide insight as to how organisms are experiencing their environment. This study aimed to determine whether physical disturbances associated with industrial deep-sea drilling along the Northwest shelf of Australia leads to increased expression of hsp70 in deep-sea scavengers. First I determined if benthic macrofauna are deterred by drill spoil. Results of Lebensspuren (animal tracks) analysis from four different well sites indicate little difference in the numbers of isopod tracks in zones of heavy drill spoil (1%) compared with those found in moderate and low spoil zones, indicating that drill spoil does not deter isopods. Although isopod tracks were found in all zones surrounding the drill site, the question that still remains is, do isopods perceive drill spoil as a stressful environment. Isopods and amphipods were collected from within and outside of drill spoil zones. Analysis of tail muscle from isopods and amphipods showed no hsp70 expression indicating no perceived environmental stress by either scavenger. In laboratory studies with the isopod, copper sulfate, a known hsp70 inducer, and drill mud increased hsp70 expression over controls. Isopods were collected from outside of the drill spoil, brought to the surface, and immediately exposed to seawater (control), 5% drill mud or 1µm copper sulphate. Hsp70 expression was measured on four key tissues of deep-sea isopods: tail muscle, maxillary glands and the swimming and respiratory pleopods. Ultimately, isopods can express hsp70 as a result of environmental stress but do not do so in the natural environment as a response to disturbance associated with drilling activity.

Taxonomical composition and distribution of Arctic species of the family Elpidiidae (Echinodermata; Holothuroidea; Elasipodida)

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Species of the family Elpidiidae are the only representatives of elasipodid holothurians in the Arctic. Up to date 4 Arctic species belonging to three genera were recognised: *Elpidia glacialis* Theel, 1876; *E. heckeri* Baranova, 1989; *Irpa abyssicola* Danielssen et Koren, 1878 and *Kolga hyalina* Danielssen et Koren, 1879. *E. glacialis* was regarded as a circumpolar species occurring from continental shelf (in the Kara Sea) to abyssal depth (in the central Arctic Ocean). *K. hyalina*, the single species in the genus, is a cosmopolitan species occurring in a wide depth range. Both *E. heckeri* and *I. abyssicola* were known from single localities. In the present work we analysed the material from most deep-sea Arctic expeditions over the last 100 years as well as the type series of *E. glacialis* and *K. hyalina*. As a result 4 species have been identified: *E. glacialis*, *E. heckeri*, *K. hyalina* and 1 new species of the genus *Elpidia*. *I. abyssicola* has not been found. Diagnoses of all examined species have been revised and ranges of interspecific variability have been clarified. It was shown that all examined species of the genus *Elpidia* differ from each other by details of spicules. Elpidiids from deeper parts of the Arctic Ocean which earlier were determined as *E. glacialis* appeared to be *E. heckeri* or *Elpidia* sp.n. In the genus *Kolga*, the most reliable interspecific character is the morphology and composition of spicules in the tubefeet. *I. abyssicola* is closely related to *K. hyalina* and probably they are congeneric. Distribution patterns and vertical ranges of all examined species were clarified. *E. glacialis* occurs only at 70 – 610 m in the Kara Sea and the Matochkin Shar Strait. *E.* sp.nov has been found at 750 – 2166 m in the central Arctic Ocean and probably at 610 – 1880 m in the Baffin Bay. *E. heckeri* and *K. hyalina* are common Arctic eurybathic species occurring at 1309 – 5500 and 659 – 4100 m respectively. All Arctic species of the genus *Elpidia* are endemic to this region.

Lipid peroxidation and catalase activity in gill and foot tissue of Lau and North Fiji Basin hydrothermal vent mollusks

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Metal exposure can lead to the formation of reactive oxygen species which can cause the peroxidation of cell membrane lipids. Lipid peroxidation has been used as a biomarker of oxidative stress. Reactive oxygen species such as hydrogen peroxide can be converted to water and oxygen by the enzyme catalase. Both lipid peroxidation and catalase activity were measured spectrophotometrically in gill and foot tissues of the hydrothermal vent gastropod *Alviniconcha hessleri* and the mussel *Bathymodiolus brevior* collected from several sites in the Lau and North Fiji Basin. Lipid peroxidation was generally higher in *A. hessleri* than in *B. brevior* with the highest values measured in gill tissue of both species from the White Lady vent site. It is unknown at this time whether these high lipid peroxidation values are coincident with the fungal disease described by Van Dover et al (see talk by Van Dover et al. this conference). The relationship between catalase activity and lipid peroxidation is discussed.

Recolonization in the Deep Sea: Experimental Approaches using Remotely Operated Vehicles (ROVs)

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The objective of my PhD project is to study recolonization and succession processes in benthic communities on the continental slope following deepwater oil drilling. The aim is to collect pre-drilling data in order to assess the impact of anthropogenic perturbations against baseline knowledge of the environment prior to disturbance.
Utilizing commercial Remotely Operated Vehicles (ROVs) will allow us to determine experimentally 1) the rate at which sediment communities on the continental slope recover from physical impacts and 2) the nature of the changes in community structure over time. Collaboration with the oil and gas industry through the SERPENT project provides us with the opportunity to accurately monitor the timing and scope of the disturbance as well as to examine the site directly after the disturbance event. Furthermore, it allows us to revisit the site over a specified period of time to monitor recovery processes and to study the dynamics of recolonization following a major anthropogenic disturbance.
Different locations including the deep-water oil and gas provinces along the continental slope off the West Coast of Shetland, off Norway (Barents Sea) and Angola are proposed to serve as experimental sites. The goal is to examine the factors that control recolonization and succession rates, which are thought to differ between locations resulting in ecosystems that rarely resemble their previous state.
These factors include the topography of the area, the hydrodynamic regime as well as water depth and sediment type. Subsequent comparisons between these areas will enable us to better understand what factors are most important in the recovery of an ecosystem and how these processes depend on and change with the physical and biological properties of each specific locality. This might then allow us to assess the "vulnerability" of an ecosystem to large-scale disturbances caused by smothering effects of drill cutting spoil and to estimate the ability of communities to recover from such impact.

Deep-sea demersal Chondrichthyes off NW Africa

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Among the 77 families and 240 fishes species caugths during the MAROC-0411 Survey in Moroccan deep bottoms (Gibraltar Strait–Agadir; 500-2,000 m) 10 families and 41 species corresponded to chondrichthyes. Main specific richnness was found in Dalatiidae Family (14 sp.), being represented Centrophoridae, Rajidae, Scyliorhinidae, Chimaeridae y Rhinochimaeridae by 6 to 3 species. Condrichthies species contributed with 9.5% and 39.6% to numerical abundance and biomass to the

total fishes catch. *Deania calcea* and *Chimaera monstrosa* were the most frequent species, being found in the 56% and 50% of 88 trawling stations. Geographycal distribution and demographycal structure of four main species (*Centroscymnus cryptacanthus*, *Deania calcea*, *Deania profundorum* and *Scymnodon ringens*) are presented and discussed.

Demersal icthyofaune of Sierra Leone Rise seamounts (Gulf of Guinea, Africa)

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Ten seamounts were located on Sierra Leona Rise during an experimental long-line fishing survey carried out from January to August 2001. Depending of the richness index and the rate catches two seamount groups were characterized: The first one, composed by five submarine structures, presented richness index (41-34 species) and catches rate (71-11 %) highest than the second group (11 and <1 %, respectively); a clear relationship with the summit depth was observed: in the first group the seamount top was less than 800 m while that the second one grouped the deep seamounts (> 800 m). In spite of more than 9 tons of fishes was studied, the diversity was low and only fifty-seven species belonging to thirty-nine families were found. Only in three of them, the richness index was high (>34 sp). No species was found on the ten seamouns. The most important fish in the catches was *Beryx splendens* with 83% of the total weight; its was followed by *Beryx decadactylus* (5%), *Promethichthys prometheus* (3%), *Helicolenus dactylopterus* (2%), *Etmopterus princeps* and *Pontinus* sp. (1%). Faunistic composition were analyzed by seamounts and bathymetric strata; at the seamounts where *B. splendens* was present, the yields were highest (97-207 kg/1000 hooks) showing this species an absolute dominance; in the seamounts with summit depest than 900 m, where *B. splendens* was absent, the yields were lowest (28-38 kg/1000 hooks) and *E. princeps* and *P. prometheus* were presents.

Bacterial diversity in oligotrophic abyssal surface sediments of the South-Atlantic Ocean

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The microbial population of oligotrophic deep-sea sediments has been studied in, e.g., the North-Western Atlantic [1] and in the Pacific Ocean [2]. Now we characterized the biodiversity of the sediments of the South-Atlantic, namely Cape Basin, Angola Basin and Guinea Basin. The three basins differ in bottom water distribution. The Guinea and Angola Basins are mainly filled by the North Atlantic Deep Water (NADW) and the Cape Basin is dominated by the lower Circumpolar Deep Water (CPDW). These sites were chosen to investigate whether the different deep-sea water masses influence the microbial diversity of bacterial communities in deep-sea sediment. In the framework of the Census of Marine Life (CoML) and the Census of the Diversity of Abyssal Marine Life (CeDAMar), the Meteor cruise DIVA II (M63/2) sampled sediments by use of a multicorer in depths ranging from 5000 – 5500 m. DNA was extracted from the surface layer sediments (0-2 cm) of all three different basins, and respective 16S ribosomal DNA clone libraries were created. A total of 1058 clones were sequenced and phylogenetic trees were calculated for all of them. The bacterial biodiversity of the basins was found to be the highest ever detected in oligotrophic deep-sea sediments, probably due to the huge number of clones analyzed. For each bacterial community 17 to 20 different phyla could be detected. The biodiversity of 1058 clones was grouped in 522 operational taxonomic units (OTUs), defined by > 98 % similarity in the 16S rRNA gene. The majority of the OTUs (415) were unique to one basin. These results suggest a basin-specific population, which are distributed independently of the deep-water masses. [1] Vetriani, C. et al., (1999) Population Structure and Phylogenetic Characterization of Marine Benthic Archaea in Deep-Sea Sediments. Appl. Environ.Microbiol. 65, 4375-4384. [2] Parkers, R.J. et al., (1994) Deep bacterial biosphere in Pacific Ocean sediments. Nature 371, 410-413.

Modelling biogeochemical processes associated with symbiotic shrimps in deep-sea hydrothermal environments

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The vent shrimp *Rimicaris exoculata* dominates the megafauna at many of the deep-sea hydrothermal environments at the Mid-Atlantic ridge. Reduced chemical species, originated from the emission of hot fluids, constitute potential geothermal energy that can be converted into biogeochemical energy through microbially mediated oxidations. It was proposed that sulfide-oxidizing bacteria within the branchial chamber of the shrimp could sustain the exceptional productivity of these swarms. Recently, the redox cycling of iron has been suggested as an alternative pathway for chemosynthetic microbial communities at the Rainbow site (36°14'N; 33°54.1'W) where fluids are depleted in sulfide but highly enriched in iron(II). The colonization of *R. exoculata* was observed in the mild part of the interfacial zone where cold, oxygenated seawater mixes turbulently with hot, reduced hydrothermal fluids. As with most vent habitats located on basaltic rocks, the shrimp habitat at TAG (26°08'N; 44°49.' W) is relatively high in sulfide, in comparison to Rainbow where the environment is exceptionally enriched in methane and iron. The main objective of this study is to quantify the energy-budget of the iron transformation in association with symbiotic vent shrimps and to compare these settings to other potential oxidative pathways (e.g.: sulfide- and methane-oxidation). To investigate which geochemical processes liberate adequate energy to drive chemosynthetic processes, the evolution of the physico-chemical parameters as a function of temperature was determined applying computational tools. This enables a first quantitative comparison of the maximum energy available for chemolithoautotrophic primary production in shrimp swarms from different oxidation pathways at the two sites.

On the depth and scale of metabolic rate variation

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Body mass and temperature impose important constraints on the physiology of organisms, a fact appreciated for more than a century. The recently proposed "Metabolic Theory of Ecology" (MTE) argues, in fact, that the majority of variation in metabolic rate can be accounted for by mass and temperature. This theory assumes a universal influence of body mass and temperature on metabolism and allows only a minor role for taxon-specific lifestyles in shaping the pace of life. In contrast, here I demonstrate 200-fold variation in metabolism within a single class of organisms, the Cephalopoda, beyond the effects of mass and temperature. Although cephalopod metabolism scales in accord with apparent exchange surfaces, there is no universal quarter-power scaling coefficient. The majority of metabolic variation observed here results from changes in selection for locomotory capacity across a depth gradient. The influence of such ecological demands on metabolism is universal, but exaggerated within the expansive pelagic biosphere by the depth-related gradient in light available for predator- prey interactions. Mass and temperature are secondary, and relatively minor, determinants of global metabolic variation.

Seasonal feeding success and otolith zones in juvenile NE Atlantic orange roughy

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Rings (zones) in the otoliths of deep-water fish commonly have been used to estimate age on the assumption that zone development is annual. The validity of such estimates has been shown for several deep-water species, indicating that there exists some seasonal cycle in growth rate analogous to that in shallow-water fish. A (delayed) relationship between season and growth rate observed in NE Atlantic deep-water fish has been inferred to reflect changing prey availability. Although the deep-water environment is relatively constant, the benthopelagic community relies on downward transport of energy from surface production, and hence feeding success among slope species is connected to the surface environment and its seasonal shifts. This study examines stomachs and otoliths of juvenile

orange roughy (*Hoplostethus atlanticus*) from the slopes of the Porcupine Bank. A connection is established between declining feeding success (greater % empty or part-full stomachs) in winter (January-March) and development of a new opaque (slower growth) otolith zone. Stomach fullness was significantly greater in autumn (November-December) than in winter, with diet comprising mainly amphipods, mysids, decapod crustaceans and small fish. The opaque zone started to develop in January and was observed in 77% of juvenile orange roughy sampled in March. Sustained feeding success through December reflects the delay between declining surface productivity and reduced prey availability on the slope. The data contribute to validation of juvenile otolith zones in orange roughy and to understanding of seasonality in the deep-water.

The feeding guilds of polychaetes located along a latitudinal transect within the Northern Seas region

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The Northern Seas region is defined as extending north from the Wyville-Thomson Ridge, NE Atlantic to the marginal ice zone off Svalbard. Replicated quantitative samples were collected from the Vøring Plateau, Bear Island Fan, Svalbard Margin and Yermak Plateau using both the NIOZ box-corer and SMBA multiple-corer. Polychaetes families were separated according to feeding guilds, as first described by Fauchald and Jumars (1979), and similarities between stations investigated. Bioturbation potential of the polychaete feeding guilds is also discussed.

CoML/COMARGE-- Continental Margin Ecosystem on a Worldwide Scale

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COMARGE is one of fourteen Census of Marine Life (CoML) field projects. The overall aims are: 1) to describe assemblages and biodiversity patterns of benthic and bentho-demersal communities on continental margins, in their multiple habitats and at different spatial scales, 2) to identify the contribution of environmental heterogeneities (e.g. substrates, trophic sources, hydrodynamic features) to these patterns. Continental margins are biologically and structurally heterogeneous. They have “hotspots”, such as the boundaries of oxygen minimum zones, coral mounds, canyons and cold seeps, which are characterized by high biomasses, productivity, physiological adaptations and apparent high species endemicity. COMARGE is global in vision. It aims at integrating studies in different habitats and at different spatial scales on a worldwide basis. In order to understand why there are so many species in this oceanic province and what are the interactions between ecosystems, COMARGE will foster synergies between past, ongoing and future, local, national and multinational scientific programs. It will seek 1) to address the following questions: “How does habitat heterogeneity, as influenced by hydrodynamic, chemical and geological processes, affect the diversity and therefore functioning of continental margin ecosystems?” “How does habitat heterogeneity interact with latitude, depth and ocean basin effects?” “Which biodiversity patterns are global, which are not and what can we learn from relating patterns to processes?” 2) to encourage data sharing, standard sampling practices and data archiving 3) to promote common taxonomic identifications and assure a high level of taxonomic quality and comparability and 4) to develop standard analytical methodologies. COMARGE will work closely with other CoML deep-sea projects, such as ChEss and CenSeam, on hotspot ecosystems and CeDAMar, ArcOD, CAML and MAR-ECO on bathymetric and latitudinal trends for diversity and zonation in the deep sea.

The influence of oceanographic parameters and water depth on the distribution of Cuvier's Beaked Whale, *Ziphius cavirostris*, in the Bay of Biscay and the CapBreton canyon

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The purpose of this study is to understand the extent to which environmental variables influence the distribution of Cuvier's Beaked Whale, *Ziphius cavirostris*, in the in the Bay of Biscay, with particular interest in the CapBreton Canyon. The research focuses on the long-term data set for Cuvier's Beaked Whale gathered since 1995 from the Biscay Dolphin Research Programme (BDRP) and oceanographic data collected from a number of different sources. A series of bathymetric maps for the Bay of Biscay produced in GMT (generic mapping tool) show the distribution of Cuvier's Beaked Whale over the years 1996 to 2003. Spatial and temporal (annual & seasonal) distribution and areas of high concentration are evident for each year. Since it is unlikely that the depth alone can attract beaked whales, physical and biological interactions that may concentrate prey along the canyon and the steep continental slope are discussed. The oceanographic data gathered in the form of in-situ data, satellite data and a model will be used to interpret oceanographic conditions. Notable features to look for are areas of high productivity, frontal movement and low temperatures, with the latter indicting possible upwelling. Preliminary results show the majority sightings exceed the 1000m water depth and concentrate over two regions: the northern continental slope and the CapBreton canyon area, with scattered sightings in between. The number of sightings over the summer months is higher in comparison to spring, autumn and winter. High numbers of beaked whales are encountered in spring and autumn in comparison to the very low numbers or absence in winter. Both images from the satellite data and ferry box data are comparable. They show higher temperatures in the southeastern Bay of Biscay. Could this influence Cuvier's beaked whale in the southeastern part of the Bay of Biscay?

Sexual chemistry in the deep sea - the link between phytoplankton and abyssal sea cucumbers

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Holothurians dominate the abyssal sea floor. They are important because they rework large amounts of organic matter, playing an important role in carbon cycling. Recent research has suggested that certain compounds required for their reproduction, such as carotenoids, are in short supply. It is believed carotenoids cannot be synthesised de novo by holothurians, only by phytoplankton. They are assimilated by the holothurians from phytodetritus that reaches the seafloor from the upper water column. My work aims to examine the link between diet and reproduction in the deep sea: how the supply of different carotenoids may influence community structure and diversity. This may help to elucidate if climate change - which has been shown to affect phytoplankton communities on large and global scales - will influence deep-sea ecosystems. Carotenoids in sediments as well as gut sediment, gut wall and gonads of 5 holothurians from a deep-sea site in the NE Atlantic were determined using HPLC. Reproductively important carotenoids were found in significantly higher quantities in the surface phytodetritus compared to the top 5mm sediment. This suggests species that are able to take advantage of this material would have a reproductive advantage. *Amperima rosea* and *Peniagone diaphana* have been shown to be primary consumers of phytodetritus. They have different carotenoid profiles from each other, but within species have similar profiles across their gut sediment, gut wall and gonads. The profiles suggest that they select reproductively important carotenoids from the phytodetritus and sequester them directly into their gonads with little or no modifications. The other holothurians have gut sediment profiles similar to the sediment suggesting less selective feeding. It is proposed that changes in phytoplankton communities will have an affect on carotenoids available to holothurians and in turn their reproduction, especially highly selective feeders that depend on fresh phytodetritus.

The life style of a deep-sea sponge, *Chondrocladia gigantean*

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Many megafaunal invertebrates change strikingly in appearance when brought from their natural environment onto the deck, not to speak of what they look like after years in bottles with formaldehyde or alcohol on the shelves in a museum collection. The live appearance of many deepwater species has been enigmatic until recent decades when observations from submersibles and analyses of in situ photographs and videos became possible. Sponges were not expected to have hidden secrets apart from the body-form of fragile species known only from fragments. Nevertheless seabed photographs and observations have brought surprises, the hitherto most striking being details of the life of *Chondrocladia gigantea*. Fresh on deck and in the preserved condition this species is cylindrical to club-shaped, up to more than 60 cm high. The central part of the body is a thick, massive stem. The lower 15-20 cm of the stem branches and forms a bunch of 'roots'. The sponge surface has numerous large, 1-3 cm long papillae each supported by a core of spicules branching off from the stem, with the soft parts somewhat swollen at the distal end. Alive on the bottom *C. gigantea* has shown to have a very special and obvious appearance. Photographs and videos show it standing upright, fastened by the 'roots' in the sediment. The distal part of each papilla is extended into a thin-walled, transparent bladder of 1-2 cm diameter. Although the bladders of neighbouring papillae never seem to touch each other, they are in places so large and numerous that it is difficult to see the stem. Members of the sponge family Cladorhizidae have reduced or peculiarly structured interior canal systems and choanocyte chambers. Apparently they do not live from filtering but are carnivorous or associated with methanotrophic bacteria. Diversity in feeding mode is probably one of the ways sponges can colonize the deep, calm parts of the oceans as well as special biotopes along sides of canyons, caves and areas near vents. The ability to recognise megafaunal species in vivo is an increasingly important element in the non-destructive assessment of biodiversity and condition of deep-water areas, and requires a collaborative approach to link specimens and seabed images.

HAUSGARTEN – multidisciplinary investigations at a deep-sea long-term observatory in the Arctic Ocean

Soltwedel T. & the HAUSGARTEN Scientific Party

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The past decades have seen remarkable changes in key arctic variables. The decrease of sea-ice extent and sea-ice thickness as well as changes in temperature and salinity, and associated shifts in nutrient distributions in Arctic waters will directly affect the marine biota, consequently altering food-web structures and ecosystem functioning. To detect and track the impact of large-scale environmental changes in a the transition zone between the northern North Atlantic and the central Arctic Ocean, the German Alfred Wegener Institute for Polar and Marine Research established the deep-sea long-term observatory HAUSGARTEN in the eastern Fram Strait. Multidisciplinary studies at HAUSGARTEN cover almost all compartments of the marine ecosystem from the pelagic zone to the benthic realm, with some focus on benthic processes. The observatory includes 15 permanent sampling sites along a depth transect (1000-5500 m) and along a latitudinal transect following the 2500 m isobath, crossing the central HAUSGARTEN station. Repeated water and sediment sampling, and the deployment of long-term moorings and bottom-landers, has taken place since the observatory was established in summer 1999. Visual observations with towed photo/video systems will allow to assess variations in large-scale distribution patterns of larger epibenthic organisms. At regular intervals, a ROV is used for targeted sampling, the positioning and servicing of autonomously measuring instruments, and the performance of in-situ experiments. First results from the time series exhibited interesting trends from which, at the moment, we do not know whether these already indicate lasting alterations or simply reflect natural variability on multi-year time-scales. Water temperatures in Fram Strait significantly increased over the last years; a slight temperature increase could still be detected even at 2500 m water depth. Analyses of various biogenic sediment compounds between the summers of 2000 and 2005 revealed a generally decreasing flux of phytodetritial matter to the seafloor, and subsequently, a decreasing trend in sediment-bound organic matter and the total

microbial biomass in the sediments. An ongoing trend in decreasing organic matter input will certainly affect the entire deep-sea ecosystem in this region.

Temporal variability in polychaetes assemblages of abyssal plain from NE Atlantic Ocean

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Temporal variability in Deep-sea polychaete assemblages was assessed. 300µm fraction samples from Porcupine Abyssal Plain, NE Atlantic, from 8 cruises between 1989 and 1998 were studied. Temporal and spatial differences in mean abundance were analyzed. Mean abundance increased with time, observing significant differences between cruises (p=0.005). Increasing trends in mean abundance vertical distribution over time were observed. In upper layer (0-1cm), a more clear tendency was recorded (p=0,004) about to 1-3cm layer (p=0,045) and 3-5cm layer (p=0,045). An Analysis of Variance showed significant differences in mean values between layers over time (p=0,002). Trophic groups temporal study showed significant differences between groups (p=1,40E-12). The high values observed in deposit-feeders and different trends for each group, would explain this situation. Cirratulidae, Spionidae, Ophelidae and Paraonidae were the most abundant families. An Analysis of Variance showed significant differences between them over time (p=1,3E-05). These differences also were observed between layers. Increasing trends in these families were observed, while this tendency was not significant in Paraonidae (p=0,070). The t-test made on pre and post Amperima event samples mean values showed significant differences in mean abundance, 0-1 and 3-5cm sediment layers; carnivores, deposit-feeders and burrowers trophic groups and Cirratulidae, Spionidae an Ophelidae families. Significant differences in 3-5 cm layer (p=0,085), filter-feeders (p=0,33) and omnivores (p=0,092), and paranoids (p=0,088), were not observed. Temporal variability observed would be explained by seasonal organic matter input mainly, which provided permanent food supply in time allowing the growth and development of diverse polychaete populations. A comprehensive taxonomic research will allow knowing and assessing what species played a protagonist role on this long-term variability. A longer time series would support the conclusions.

Deep-sea megabenthic invertebrate fauna off Namibia: Preliminary results

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During the Namibia-0502 and Namibia-0602 surveys, 137 deep stations (500-2000 m) were sampled between Angola (17º 30´ S) and South Africa (29º 30´ S) frontiers. The aims of these research works were evaluate the demersal resources and studying megabenthic invertebrate fauna collected as bycatch. The surveys were carried out during February 2005 and 2006 on board of Spanish R/V "Vizconde de Eza". Samples were obtained with a Lofoten otter-trawl during thirty minutes trawling effective time. The large volume of invertebrates brought onboard was minutely sorted into 28 high-range taxa (Phyllum, Class, Order), which were counted and weighted. A representative collection of each sample was preserved for latter study. A total of 12.6494 specimens/colonies were collected, which biomass were 31.383,94 kg (wet weight), belonging to nine Phyla: Porifera, Cnidaria, Priapulida, Sipunculida, Annelida, Mollusca, Arthropoda, Echinodermata and Chordata (Ascidiacea). Echinodermata showed the highest abundance in number of individuals (65%) with a dominance of Holothuroidea that represents 69% of this Phyllum. Cnidaria (mainly Actiniaria) and Arthropoda (mainly Decapoda) represents the 13% each one, whereas the abundance of the remaining Phyla are <5%. The biomass follows the same pattern but with a stronger dominance of Holothuroidea that reaches 81% of the total, followed by Cnidaria (8,5%), Arthropoda (4%) and Mollusca (mainly Cephalopoda, 4%).

Snailfishes of the central California coast: video, photographic, and morphological observations

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Video and photographic images of snailfishes (family Liparidae) collected by the Monterey Bay Aquarium Research Institute, augmented by specimens collected simultaneously, were analyzed. Nine species in five genera were identified, including *Careproctus melanurus* Gilbert 1892, *C. ovigerus* Gilbert 1896, *C. longifilis* Garman 1892, *C. gilberti* Burke 1912, *C. filamentosus* Stein 1978, *Osteodiscus cascadiae* Stein 1978, *Nectoliparis pelagicus* Gilbert and Burke 1912, *Paraliparis dactylosus* Gilbert 1896, and *Rhinoliparis barbulifer* Gilbert 1896. Voucher specimens were collected of all except *C. gilberti* and *C. filamentosus*. In addition, individuals of the *Paraliparis* "*rosaceus*" Gilbert 1890 species group were abundant but could not be identified to species. Many liparids were identified only to family, but an individual of a very distinctive unknown species, presumably undescribed, was videotaped. Relative abundance of *C. melanurus* was estimated, and several in situ snailfish behaviours are described for the first time.

Distribution of a new arcturid species (Crustacea: Isopoda: Arcturidae) on the Greenland-Iceland-Faeroe Ridge

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The submarine Greenland-Iceland-Faeroe-Ridge (GIF-Ridge) is one of the most remarkable biogeographical barriers in the world oceans. It separates the deep-Arctic (> 4000 m) from the North Atlantic, with a mean depth of 300-400 m, having a channel depth of 650 m. Additionally, a variety of water masses flow over or along the ridge. During the BIOICE (Benthic Invertebrates of Icelandic waters; 1991–2004) project, samples were taken at 579 stations around Iceland at depths between 20 and 3000 m on the research vessels Bjarni Sæmundsson, Håkon Mosby and Magnus Heinason by means of epibenthic sleds and dredges. Additional material was collected off Southern Greenland during an epibenthic sampling in 2001. *Astacilla* is a cosmopolitan genus with > 30 described species worldwide. New information is presented on a new species of *Astacilla* occurring in that area. The species was found at 40 stations south of Iceland and at a single station off South Greenland. From this new species, several developmental stages and both sexes were found. It shows a pronounced sexual dimorphism and undergoes several morphological changes during its development. It occurs at a fairly restricted depth zone, with most of the findings occurring at depths between 800 and 1400 m, but extending to 204 m off South Greenland and 256 m off South Iceland. The bottom temperatures range between 3.2°C and 7.1°C, with most findings between 3.2^{o} and 5.5°C. The species seems to be restricted to warmer water masses (Atlantic Water) and to the southern margin of the Greenland-Iceland-Faeroe Ridge and does not extend into the colder water north of the ridge. The east-west distribution of the species does not seem to be limited by cold-water masses crossing the ridge. The species seems to occur only deeper in areas where cold-water masses pass the ridges (i.e. Irminger Strait).

Discovering the unknown: experimental laboratory studies in deep-sea organisms

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Deep-sea biology has traditionally been rather descriptive and dependent on the availability of organisms obtained by means of trawls or grabs. Only in recent years the increased use of underwater video systems and ROVs has allowed in situ studies of deep-sea organisms and communities in their environment. Here, we advocate that the study of deep-sea organisms under controlled lab conditions

(monitored experimental parameters) is still essential to elucidate ecological and physiological life history adaptations of deep-sea organisms to their environment, complementing field observations. We present an infrastructure for work on living deep-sea organisms under controlled lab conditions of pressure and temperature available at the National Oceanography Centre. The IPOCAMP(™) (Incubateur Pressurisé pour l'Observation et la Culture d'Animaux Marins Profonds), originally designed at the University Pierre et Marie Curie, allows the study of organisms under deep-sea conditions in the laboratory, including controlled conditions of temperature and pressure, in a closed seawater circulation system. The pressure vessel (size: 20x60cm) can contain several cages of limited size that contain ventilation holes and are positioned in the system's water flow. Using an endoscope system the behaviour of organisms during the experiment can be recorded. The study of living deep-sea organisms in the lab is essential if we are to understand life history adaptations to an environment that covers two thirds of our planet, as well as the challenges to life in the deep in light of increased exploitation and climate change. It is astonishing how little technology to study living deep-sea organisms under controlled lab conditions is currently available and the technology involved needs substantial financial support for advancement. In order to mobilize the scientific capacities available, including funding to advance this emerging technology, we will increasingly need to rely upon joint international cooperation and funding support.

How to estimate scavenger abundance with confindence

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Baited cameras are often used for abundance estimation wherever alternative techniques are precluded, e.g. in abyssal systems and areas such as reefs. This method has used models of the arrival process, which are deterministic and therefore permit no estimate of precision (confidence). Furthermore, errors due to multiple counting of organisms returning to the bait have restricted the technique to using only the time of first arrival, leaving a lot of data redundant. Here, we reformulate the arrival process using a stochastic (hidden Markov) model, allowing the precision of abundance estimates to be quantified. Developing the stochastic model we show how multiple counting errors can be avoided, enabling the use of the whole time-series of camera data, rather than just the first-arrival time. We demonstrate the new model with an example of a non-gregarious cross-current scavenger and show how precision varies with abundance. Use of the stochastic model enables estimates of scavenger abundance from baited camera studies with quantified and theoretically greater precision than before.

Biodiversity and distribution of the suprabenthic megafaunal assemblages in an abyssal polymetallic nodule province of the eastern equatorial Pacific ocean; recommendations for a high seas conservation issue

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This project is funded by Government of Flanders (Belgium) and coordinated by the Intergovernmental Oceanographic Commission. It proposes to describe a referential state of suprabenthic megafaunal assemblages within a nodule ecosystem in the Clarion-Clipperton Fracture Zone (CCFZ) based on the analysis of about 200 000 photographs and some 55 hours of film collected by French and American exploratory cruises. The video and photographic sampling has been achieved by means of different towed and remote control devices designed for Ifremer and NOAA including the manned submersible "the Nautile". Results show that the taxonomic diversity is of 240 taxa, of which 46 are echinoderms. Cnidaria express the most diverse phylum in the Clarion-Clipperton fracture zone (CCFZ) encompassing 59 different taxa. Suspension feeders are the best-represented trophic group in the zone. NIXO 45 site (130°00'W/130°10'W, 13°56'N/14°08'N), particularly well sampled by IFREMER at a mean depth of 4 950 m, was chosen for the quantitative analysis. Results show that whatever the nodule-facies, suspension feeders are more abundant than detritus feeders, carnivores and scavengers. The highest total faunal abundance is on facies C+10 % (nodules 10 cm diameter, well sunken) and facies C+ (smaller hummocky nodules, 7.5 cm diameter) on slopes (> 15°). The greatest density of suspension feeders is observed on facies O (no nodules) and on facies C+ on slopes while detritus feeders are more abundant on facies C+10 %. Similarities among taxa and among some

types of environment and substratum were emphasized by a factor analysis of Reciprocal Averaging, allowing discrimination of preferential habitats and 'faunal facies', ranked according to an edaphic gradient. Spatial heterogeneity in the distribution of populations has been analyzed at a taxa level. Comparisons are made with the different means of in situ observation and at different sites within the CCFZ. Recommendations for the conservation of this High Seas biodiversity within the nodule ecosystem are drawn on basis of non-conventional ecological parameters enhancing distinctive habitats (such as complementarity and beta-diversity more than biodiversity centred on species or taxa measures). A strategy of suprabenthic monitoring and of a high seas protected area system is suggested in view of minimizing the impacts of deep seabed mining.

Gametogenic periodicity in the chemosynthetic mussel genus "*Bathymodiolus" childressi*

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The gametogenic periodicity of the cold seep mussel *Bathymodiolus childressi* is analysed from a time series of samples from depths of ~650m surrounding the Brine Pool on the continental slope along the northern Gulf of Mexico. Occasional samples were retrieved from Bush Hill and GC 234 for comparison. At the Brine pool both female and male showed strong reproductive periodicity with the initiation of gametogenesis from December to March, followed by a period of gamete growth or proliferation with spawning from October through to February. Synchrony of gametogenic development occurred at all three sites. The control on gametogenic periodicity is believed to be the downward flux of surface production that occurs in the winter months providing food for larvae and also for the adult that is able to filter feed as well as having bacterial endosymbionts that can undergo chemosynthesis. Individuals in all three populations carried parasites and these were common at Bush Hill and GC234 where it is suggested they have a major impact on reproductive output.

***Idas washingtonia*: why be a protandric hermaphrodite on whale fall?**

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The small mytild bivalve *Idas washingtonia* is found abundantly on whale falls in the eastern Pacific. Examination of the gametogenic biology of this species shows it to be a protandric hermaphrodite. A high proportion of all specimens examined are functional males but when it reaches 7mm length oocytes start to appear in the gonad. It is only in the largest specimens up to 9mm length that fully developed oocytes are found. The population in this size range is very small. Oocytes grow to a maximum size of ~50µm indicative of planktotrophic development. There is some indication of reproductive seasonality in the samples examined, that may be related to upwelling in coastal waters of California. The benefits of being a protandric hermaphrodite are discussed in relation to the adult maximum size and the nature of the quasi-ephemeral substratum.

Accumulation of persistent organic pollutants and tributyltin in nine species of Atlantic deep-sea cephalopods

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Nine species of deep-sea cephalopods were collected from seven locations in the western Atlantic Ocean in May 2003. The species (*Haliphron atlanticus*, *Gonatus fabricii*, *Histioteuthis reversa*, *Mastigoteuthis magna*, *Octopoteuthis sicula*, *Taonius pavo*, *Teuthowenia megalops*, and *Vampyroteuthis infernalis*) were selected for analysis based on their importance as prey for toothed whales and other pelagic predators. Samples were analyzed for butyltins, polycyclic aromatic hydrocarbons, and halogenated organic pollutants. Most samples contained detectable butyltin

concentrations and ranged up to 2 ng/g TBT wet weight. PAH were detected in all samples and included biphenyl, pyrene, flouranthene, chrysene, and benzo flouranthenes. Halogenated organic compounds were detected in the majority of the samples at ng/g concentrations and included PCB, hexachlorobenzene, chlordanes, DDT, DDD, DDE, toxaphene, mirex, BDE and methoxy tetra BDE. Accumulation of persistent organic pollutants in these important pelagic prey species has implications for the trophic level transfer of POP in the Atlantic Ocean.

A new species of *Kliopsyllus* (Copepoda, Harpacticoida) extends the genus' deep-sea range

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The members of the meiobenthic harpacticoid copepod genus *Kliopsyllus* typically are small, cylindrical, interstitial animals that inhabit sandy beach ground water and shallow-water sandy sediments. Recently, studies of collections from two international deep-sea cruises (DIVA and ANDEEP) to the Angola Basin, the Scotia Arc, and the northern Weddell Sea unexpectedly revealed the presence of two *Kliopsyllus* species in the deep sea. The new species presented here extends the genus' deep-sea range into the Pacific. It is from a muddy site at 1200 m deep off California. As for the two previously described deep-sea species, the idea of a purely interstitial life style has to be rejected because this species also inhabits a fluid mud.

Canyon and slope assemblages on the oceanic island of Oahu: detrital enrichment in the deep blue sea

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Submarine canyons on continental margins can be important hotspots of production and biodiversity due to detritral entrainment, current intensification, and trapping of vertical migrators. The ecology of canyons on oceanic islands remains wholly unexplored, even though food-rich canyon habitats could be disproportionately important as fish recruitment sites and biomass hotspots when imbedded in an oligotrophic ocean. Alternatively, the steep topography and energetic flow regimes typical of oceanic islands could sweep canyons clear of detritus and depress detritivore populations. We used the PISCES IV submersible to study megafaunal and scavenger assemblages at depths of 350, 650, 1000, and 1300 m in Kaneohe Bay Canyon and at open-slope stations on the island of Oahu, Hawaii. We tested the hypotheses that even on oceanic islands, canyons may trap macrophytic debris, and contain higher abundances of invertebrate megafauna, juvenile fish, and mobile scavengers than the open slope. Macrophytic debris occurred much more frequently in the canyon than on the open slope, with giant "tumbleweeds" of macroalgae rolling down the axis and trapped among rocks. Megafaunal abundance was higher inside the canyon at 350 m, and was characterized by large numbers of shrimp, juvenile fish and squid. In contrast, at 1300 m, megafaunal abundance was higher on the open slope, although the canyon continued to harbor a distinct faunal assemblage. Megafaunal species richness was similar inside and outside of the canyon (~ 40 spp.), although dominance was higher in the canyon, as might be expected under conditions of high disturbance/enrichment. Crustacean scavengers (primarily *Heterocarpus* shrimp at 350 and 650 m, and lysianassid amphipods at 1000-1300 m) were trapped at substantially higher rates, and shrimp had higher proportions of gravid females, inside the canyon, suggesting that the canyon provided especially good foraging for necrophages. In conclusion, while macrophyte production rates on the Oahu coastline appear to be low, Kaneohe Canyon entrains substantial amounts of macrophyte detritus, and the upper canyon is a preferred habitat for juvenile fish and scavengers. Thus, on oceanic islands, canyons appear to play important roles in the coastal ecosystem, as has been postulated for continental margins.

Rhythms on the bottom of the deep sea: Cyclic current flow changes, and melatonin patterns in two species of demersal fish

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We have studied physical and biological rhythms in the demersal habitat near the bottom of the Northeastern Atlantic deep sea (Porcupine Seabight). Current velocity and direction changes were monitored with a DOBO platform over 1h intervals for twelve months. They occurred at intervals of 12.4h, demonstrating the impact of tidal activity, and also showed indications of other, seasonal changes. For studies of biological rhythms we collected pineal organs of the grenadier *Coryphaenoides armatus* and the deep-sea eel *Synaphobranchus kaupii* during five cruises with RRS Discovery. As indicators of rhythmic activity we studied two aspects of the neurohormone melatonin: First we measured its content per pineal. Second, we kept isolated pineal organs of *S. kaupii* under constant conditions (darkness) in culture for a minimum of 50h and determined the amount of spontaneously released melatonin at 4 h intervals. The results of the release experiments show clear signs of synchronicity indicating the presence of an endogenous clock. The melatonin content data show high error bars typical of cross sectional population studies. When plotted according to a lunar cycle both species show peak values around the middle of each phase and lower values in the transition at moonrise and moonset. By contrast, when referred to a solar cycle, melatonin content data were randomly distributed. These observations strongly suggest (1) that biological rhythms are present in demersal fish, (2) that the melatonin metabolism follows a lunar cycle, and (3) that tidal currents act as zeitgeber in the deep sea.

The Reproduction and Larval Ecology of Antarctic Deep-Water Corals

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The Southern Ocean presents a unique environment, where there are constantly low temperatures and seasonal processes, even to depth, are the most intense in the world. This environment has put unique pressures on the reproduction and development of the benthic invertebrates that inhabit the Antarctic continental shelf, as well as deeper waters surrounding the continent. Deep-water scleractinians are found to occupy these waters, and three species in particular appear to have adjusted their reproductive habit to allow for the harsh environmental conditions. This poster presents reproductive data on three species of solitary scleractinian - *Flabellum thouarsii*, *F. curvatum* and *F. impensum* that were collected between 300m and 700m from the Western Antarctic Penninsula. These three species represent the first deep-water scleractinians observed to brood their young. Using a combination of SEM, TEM, histology, molecular analysis and live larval culture, the reproductive ecology of these three species has been assessed and is presented here.

Anthropogenic Impacts on the Corner Rise Seamounts, NW Atlantic

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The removal of deep-water coral and other large biogenic structures as a consequence of deep-sea fisheries is well documented for seamounts in the SW Pacific and is presently the focus for strong conservation measures across the globe. As continental shelf fish stocks decline and fisheries regulations become stricter, there is continual movement of fisheries vessels into the unregulated and unreported high seas making the true impact hard to determine. As part of a broader study on deep-water corals of the North Atlantic, we investigated five seamounts in the Corner Rise complex using the ROV Hercules, and documented dramatic evidence of large-scale damage on the summits of Kükenthal peak (on Corner Seamount) and Lyman Seamount probably primarily resulting from a small-scale Soviet fishery. For twenty years (1976-1996) there was significant effort expended in the area of the Corner Rise Seamounts using both pelagic and bottom trawls and though many fish species were recorded in this fishery, there is no information on invertebrate bycatch. This poster

documents damage observed to the Corner Rise Seamounts during the Deep Atlantic Stepping Stones cruise, August 2005.

Specialized cirral activity inferred bacterial symbiosis in the vent barnacle *Neoverruca* sp. on the Myojin Knoll, Izu-Ogasawara Arc, Japan

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To survey symbiosis between bacteria and *Neoverruca* sp. inhabiting deep-sea hydrothermal vent field on the Myojin Knoll in the Izu-Ogasawara Arc of Japan, bulk carbon-isotopic analysis, SEM observations and fluorescence in situ hybridisation (FISH) analysis of the cirri (feeding appendages of barnacles) as well as in situ ethological observations were conducted. Bulk carbon-isotopic analysis revealed that the $\delta_{13}C$ values of *Neoverruca* sp. (–27.75 to –33.78‰) resembled those of vent molluscs (–27.3 to –34.8‰) more closely than previously reported vent crustaceans (–9.97 to –23.0‰). SEM observations revealed that the surfaces of the cirri were covered with many filaments that appeared to be anchored in cuticular crevices and articular membranes. FISH analysis indicated that most of the filaments were gammaproteobacterial microorganisms; in contrast, other vent crustaceans harbor epsilonproteobacterial episymbionts. This result is consistent with that of bulk carbon-isotopic analysis. Ethological observations revealed that *Neoverruca* sp. fanned its cirri rhythmically, resembling the pumping beat of intertidal barnacles, although it rarely curled the cirri inwards into the mantle cavity, suggesting that cirral activity in this species is not involved in transporting food particles from the cirri to the mouth. Neoverruca sp. appears to do specialised cirral activity and cultivate episymbiotic Gammaproteobacteria, on which it depends for nutrition.

The Bathymetric Zonation of Deep-Sea Macrobenthos in the Northern Gulf of Mexico

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Macrobenthos was collected at 51 locations along the continental slope and abyssal plain of the northern Gulf of Mexico (GoM) from 2000 to 2002. A total of 32,180 organisms, including aplacophorans, amphipods, bivalves, cumaceans, isopods, and polychaetes, were utilized to examine faunal zonation. Five zones, based on Bray-Curtis similarity of 957 species, occurred in bands parallel to isobaths (SIMPROF, $P<0.05$): upper slope (Zone 1), mid slope west (Zone 2W), mid slope east (Zone 2E), lower slope (Zone 3), and abyssal plain (Zone 4). The non-metric multiple dimensional scaling (MDS) however suggested that the turnover in faunal composition with depth was gradual from the shelf break to the abyss. The high correlations of water depth and exported POC fluxes with the faunal distribution patterns implicate the decline in food resources with depth as the main cause of zonation.

Oxygen consumption of the abyssal urchin *Echinocrepis rostrata*: BICS field trials at Station M, NE Pacific

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The Benthic Incubation Chamber System or BICS is a respirometer system used to measure the metabolic rate of deep-sea megafauna. BICS is a compact ROV delivered and operated system comprising of two water-tight respirometry chambers. The chambers measure oxygen levels and temperature using oxygen optodes (O2 optode 3930; Aaanderaa Instruments, Norway). During cruise 48 of the SIO Pulse programme at Station M, NE Pacific, BICS was deployed at a depth of 4110m using the ROV Jason II. One of the most active and abundant epibenthic organisms found at abyssal depths in NE Pacific is *Echinocrepis rostrata*, an irregular sea urchin with three distinct morphotypes ranging in observed widths from 50 to 150 mm. This species was selected as a test organism for

deep-water trials of BICS. Two deployments were completed with data collected for three individuals of *E. rostrata* and an empty chamber control. Oxygen concentration within the chambers was recorded over a 48hr period with data from the first 24hrs, prior to urchin death, used for analysis. Consumption rates were consistent across the three individuals and results are discussed in comparison to published data for temperate and polar echinoderms from shallower waters, indicating that temperature may well be a driving factor in determining metabolic rates of abyssal megafauna.

ECOMAR - A multi-disciplinary study of non-vent ecosystems on the Mid-Atlantic Ridge

Wigham B.D.[1] & the ECOMAR Consortium

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ECOMAR is a £2 million project aimed at understanding how physical and biogeochemical factors influence the distributions and structure of deep-sea communities, focusing on the fauna of the Mid-Atlantic Ridge at 4 sites in different environmental settings. The four sites are located on either side of the MAR and to the north and south of the Charlie Gibbs Fracture Zone (CGFZ), which coincides with the Sub-Polar Front. Using these localities we will investigate the effects of topography and currents on the distribution of the fauna, and the effects of varying organic input in two different biogeochemical settings. The work will focus on rocky slope fauna and sediment pockets in mixed bottoms rather than hydrothermal vents, which are relatively well known. We will study the physical, chemical and biological environment of the MAR in terms of circulation, production, biomass and biodiversity. The MAR is a topographically difficult place to sample, which has no doubt contributed to the current lack of knowledge of this region. Therefore ECOMAR will employ the latest technologies to overcome this problem including precision acoustic sensors, instrumented moorings, autonomous lander vehicles, suspended camera systems and the new 6,500m rated research ROV Isis. The use of remote sensing technologies, coupled with shipboard biological and physical measurements, will allow patterns of primary production over the MAR to be studied at higher spatial and temporal resolutions. By integrating satellite estimations of primary production with shipboard measurements estimates of export flux can be made and then compared with data from an array of four sediment trap moorings. The supply of food to the deep-sea floor plays a major role in structuring benthic communities and driving rate processes such as reproduction, metabolism and activity. By measuring the composition and quantity of this material both as phytoplankton, zooplankton and sedimenting aggregates the ECOMAR project will be able to identify the driving forces behind observed patterns of abundance, biomass and diversity in the fauna of the MAR.

The cosmopolitan carpet-worm: new species and records for *Vigtorniella* (Annelida) at both deep-sea and shallow-water reducing environments

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The polychaete genus *Vigtorniella*, commonly known as the 'carpet-worm', has been recorded from a range of reducing environments in both deep-sea and shallow-water locations. During our recent studies of experimentally implanted whale carcasses, we have discovered a new species of *Vigtorniella* living on a Minke whale carcass at 125 m depth in the North Sea. The new shallow-water *Vigtorniella* species seems to be morphologically indistinguishable from *Vigtorniella flokati* Dahlgren et al., 2004, described from deep-sea whale falls in the Pacific Ocean. However, molecular studies of cytochrome c oxidase subunit I (COI) reveals a difference between *V. flokati* and *V.* sp. n. of ~11,5 %, based on Kimura-2-parameter genetic distances. A calibration of the molecular clock for COI in deep-sea annelids (Chevaldonné et al. 2002) suggests a divergence time of about 30 million years for the two species, which would coincide with the evolution of modern whales. While *V. flokati* was thought to be a whale fall specialist, the new *Vigtorniella* species has also been found in benthic samples from fish farms in Norway, at depths of 80-150 m. Aquaria observations of live *V.* sp. n. indicate that it is grazing on *Beggiatoa* bacterial mats. Three specimens of the deep-sea species *V. flokati* were available for molecular studies, and these three individuals had identical COI-sequences. Of the new

shallow-water species *V.* sp. n., six specimens from fish farms in Sognefjord, Norway and six specimens from the whalebones in Sweden were sequenced, and 7 different haplotypes were found. Based on the distribution of haplotypes we could not detect any restriction in gene flow between the two shallow-water samples.

Faunal zonations and diversities of the deep-sea demersal fishes on the continental slope of Taiwan

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Taiwan is adjacent to the Taiwan Strait Shelf, and the south China Sea Basin, the West Philippine Sea Basin and the Okinawa Trough. More than half of the sea territory of Taiwan is deep basins down to nearly 5000 meters. The aims of this study are: 1) to compare the community structure of deep-sea fishes inhabited in the South China Sea and the West Pacific Ocean, and 2) to detect the general trends in the distribution of the fish fauna in relation to the environmental variables. Deep-sea fish samples were collected by otter trawl and French type beam trawl at 34 stations on the R/V Ocean Researcher during August 2002-July 2004. The following conclusions are proposed: 1) A total of 192 species comprising 1475 individuals were sampled. Only 31 species were caught from the Western Pacific Ocean, 72 species from South China Sea and 18 were common in both seas. 2) Distinct faunal assemblages are found in the depth of ~600 m and ~1300 m. Correlation of DCA axes with the environmental variables showed that depth, temperature and salinity are strongly correlated with 1st DCA axes, and the 2nd axes significantly correlated only with latitude and longitude. 3) Shannon-Wiener diversity of the samples from the South China Sea is higher than that from West Pacific Ocean. 4) The difference of demersal fish fauna between the South China Sea and the West Pacific Ocean could be due to the different water masses in the basins.

Techniques for aquarium exhibition of live deep-sea fishes in Taiwan

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For the exhibition of live deep-sea fishes in Taiwan, the techniques for collection, transport and cultivation of live deep-sea fishes have been developed from 2003 onwards. Deep-sea fishes were sampled by the fishery otter trawler from 200-600 m depth off Tashi, the northeast coast of Taiwan. Among the 33 families and 56 species of deep-sea fishes collected by otter trawl, 16 species of deep-sea fishes were kept in aquarium more than three days. Seven of the sixteen species, *Paramyxine sheni* (477 days), *Eptatretus* sp. (485 days), *Bathyraja trachouros* (345 days), *Pentaceros japonicus* (1062 days, till 2006/3/31), *Setarches longimanus* (121 days), *Helicolenus hilgendorfii* (603 days, till 2005/2/28) and *Galeus sauteri* (104 days), were successfully reared more than three months and fed with new foods. In order to find out the optimal conditions for live fish transport, with three kinds of filled air versus three levels of water temperature were tested. After at least two months cultivation, lighting conditions for deep-sea fishes were tested. The six kinds of light spectra versus two levels of intensities of illumination were tested by the Model I two-factor ANOVA. It was found that the behavior of deep-sea fishes was less influenced under red spectrum with weak light intensity on. Therefore, it is recommended for the exhibition illumination of deep-sea fishes.

Phylogenetic analysis of bacterial symbionts of vestimentiferan tubeworms in the western Pacific

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Vestimentiferans belonging to Lamellibrachiidae, Escarpiidae, Arcovestiidae, and Alaysiidae have been found in deep sea hydrothermal areas and cold seep environments in the western Pacific area. They have a large unique tissue; trophosome for intracellular chemoautotrophic symbiotic bacteria.

These symbioses are thought to be species specific and a single type of symbiotic bacteria is found in each host vestimentiferan species. However, the molecular phylogenetic identification of symbiotic bacteria of almost vestimentiferans in western Pacific remains to be studied. Recently, gene sequences other than 16S rRNA gene, such as rpoB, pmoA, gyrB, and cpn60, have been used for bacterial identification and phylogenetic relationships. The gene for chaperonin or GroEL (cpn60), is essential for the life of bacteria. For phylogenetic analysis, the chaperonin gene has advantages over 16S rRNA-based methods for the analysis of closely related organisms. Additionally, chaperonin is reported to be abundantly synthesized in several endosymbiotic bacteria. Chaperonin is reported to mask the effects of harmful mutations in endosymbiotic bacteria of insect. Chaperonin may play an important role in intracellular symbiosis. We are trying to examine the function of chaperonin in intracellular symbiosis. In this study, we determined the chaperonin and 16S rRNA sequences of symbiotic bacteria of vestimentiderans in the western Pacific. We analyzed the phylogenentic relationship of symbiotic bacteria of these vestimentiferans. Amplifications of chaperonin genes by PCR using a previously reported universal primer set failed. We designed a set of new primers based on highly conserved regions within the chaperonin genes from several bacteria. Partial chaperonin sequences were amplified by these newly designed primers. Topologies of the phylogenetic trees of the symbionts of the vestimentiferans based on 16S rRNA and chaperonin genes were almost the same. However, the resolution of phylogeny in the tree based on chaperonin was higher than that of 16S rRNA.

Development of hydrostatic pressure apparatus for marine zooplankton study

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A hydrostatic pressure apparatus was newly designed to investigate effects of hydrostatic pressure on marine zooplankton. This hydrostatic pressure apparatus made it possible (1) to incubate in constant temperature by connecting with temperature-controlled bath, (2) to observe live zooplankton through a window, (3) to increase pressure step-wise fashion from 1 to 150 atm, (4) to record the behavior of specimens for long time by using a CCD camera and a video-recorder and (5) to prevent corrosion of the pressure chamber by introducing a specimen holder that separates the pressure chamber from the seawater. Hydrostatic pressure is increased by pouring distilled water into a pressure chamber. A specimen holder fulfilled with seawater is set into the pressure chamber, which is made of acrylic resin and silicon tube. A wide size range of zooplankton is observed by altering the form of acrylic resin and the size of silicon tube of the specimen holder. This apparatus is useful for the study of mesozooplankton though their life history from egg to adult.

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