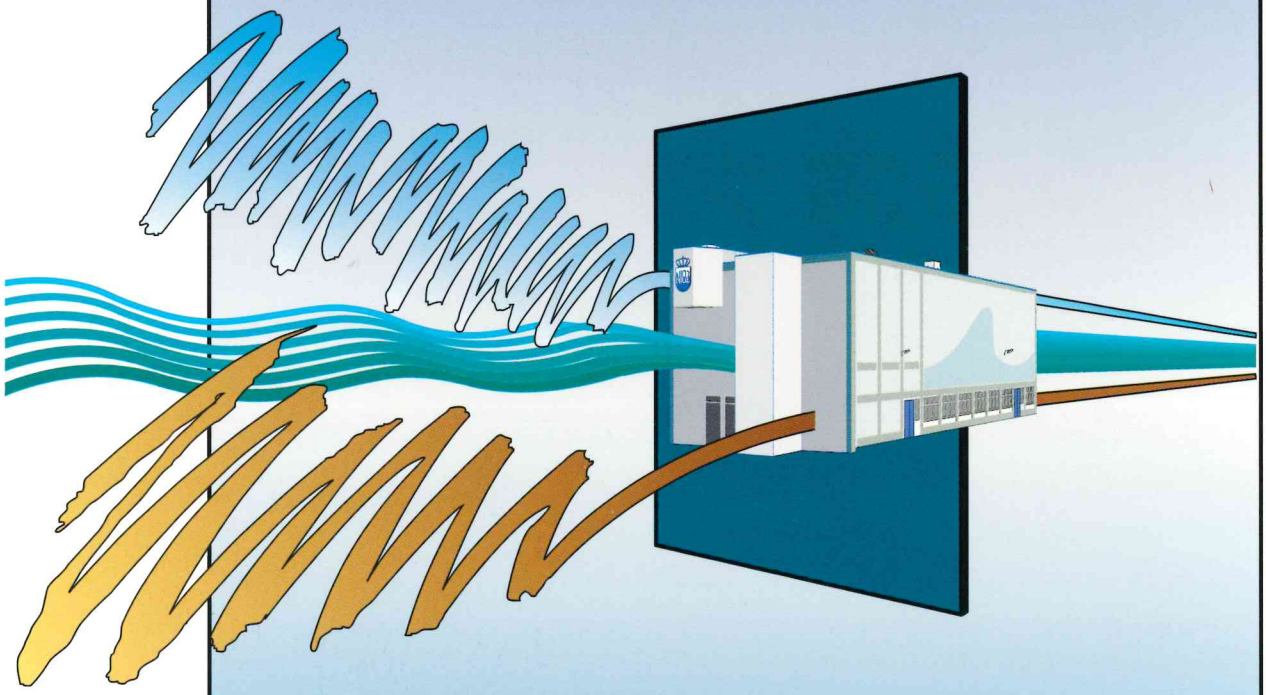
ANNUAL Report 2003



ROYAL NETHERLANDS INSTITUTE FOR SEA RESEARCH (NIOZ)

ROYAL NETHERLANDS INSTITUTE FOR SEA RESEARCH
ANNUAL REPORT 2003

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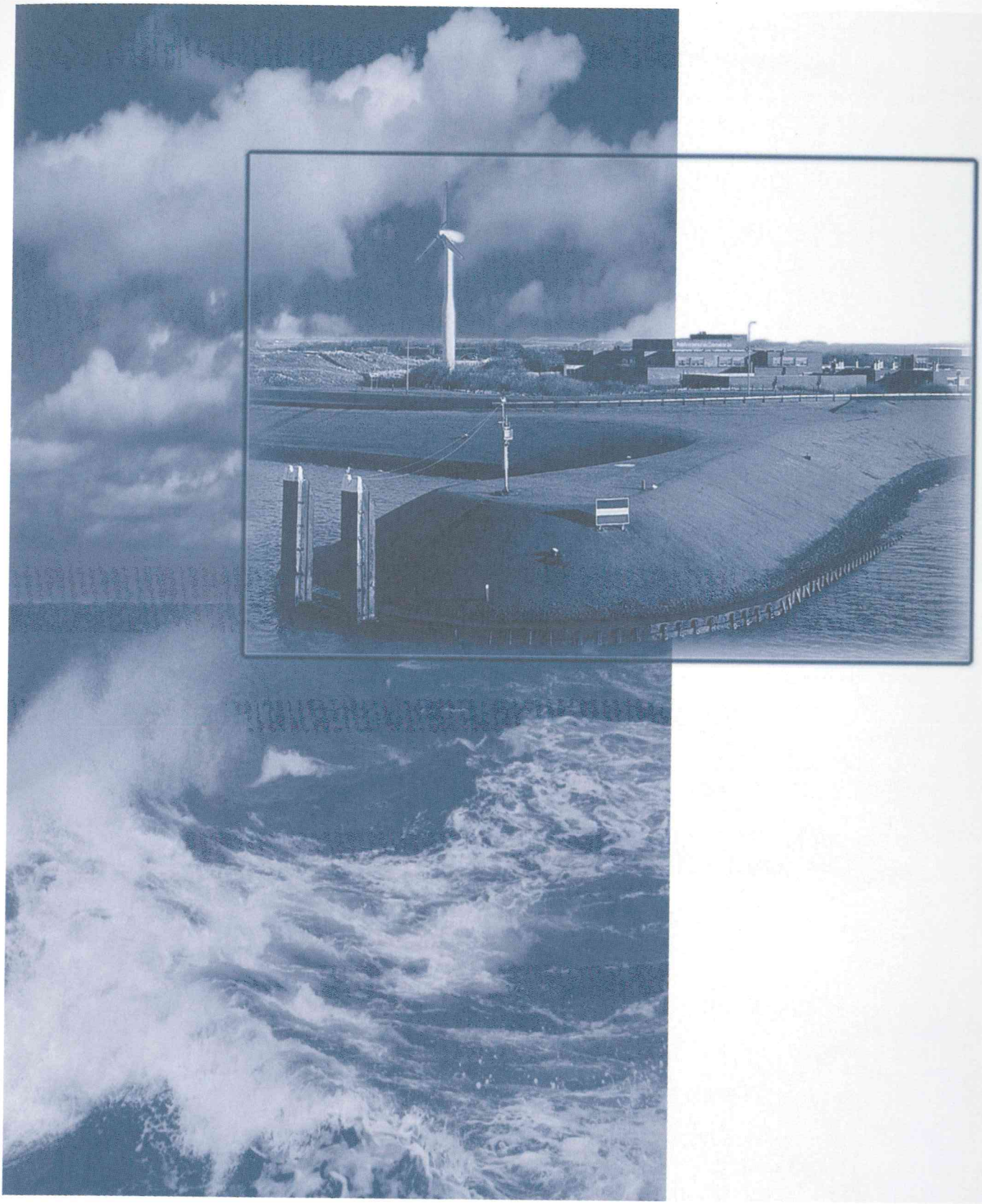


ROYAL NETHERLANDS INSTITUTE FOR SEA RESEARCH (NIOZ)

CONTENTS

The deck of the British RV Charles Darwin loaded with floats to be deployed in the Mozambique Channel. LOCO project.

The year 2003 can be considered as the beginning of a new episode for Royal NIOZ. After a financially difficult period of about 7 years, the Board of NWO has decided very early in 2003 to substantially enhance the basic annual funding as well as making available a very significant once-only contribution to improve working environment and labour conditions, to renovate some of our ships and harbour facilities, and to start the renovation of the older part of our institute. As a consequence of this financial injection and the financial transparency for the years to come, the atmosphere changed from one of uncertainty to one of enthousiasm with a view on the future, generating a myriad of building, logistic, technical and scientific activities, mostly based on already existing plans.

One of the highlights in 2003 was the official opening of the 3000 m^2 newly built offices, laboratories and canteen and the completely renovated large Experimental Facilities Building by her Majesty Queen Beatrix on April 4, during a visit of 4 hours in the presence of 100 invited guests and the collaborators of Royal NIOZ and ALTERRA. The latter organization focuses on applied marine sciences and rents ca. 1000 m^2 of the newly built lab and office space from Royal NIOZ on a long-term basis, thus enabling the sharing of scientific ideas and logistics between the two institutes. The day after the royal visit, Royal NIOZ and ALTERRA opened their doors for the general public to show them the new facilities and to present the latest results of our research and technology.

Many other building projects were started in 2003 and some were even finished before the end of the year. The extension of offices and workshops for the technical departments started in November, the library offices have been rebuilt, the building of a formalin storage facility started, 600 m^2 of the existing institute was renovated and detailed plans have been made to renovate the rest of the old part of the institute and our harbour. The preparations to build a completely new and larger guesthouse to accommodate the ever-increasing numbers of temporary Dutch and foreign collaborators are nearly finished. On top of that, the building of a completely new and fast 20 m long transport and working ship for research activities in the Wadden Sea and the coastal North Sea was started just after summer and is nearly finished. This ship will be used together with another research organization nearby, i.e. TNO-MEP. The R/V Navicula is presently undergoing a highly necessary mid life turn-over to make it fully operational and up-to-date for sea-going activities in the decade to come.

On the logistic side several actions took place. The department Buildings and Installations (DGI), responsible for the maintenance of the buildings, was reorganized. The current three technical departments are in the process of integrating into one major technical department, whereas our financial department started to work with a completely new and modern financial software package. Furthermore, our largest research vessel, the R/V Pelagia as well as the large seagoing instrumentation became part of an international pool of research platforms consisting of English, French and German research vessels. As a consequence, shiptime is used more efficiently due to a major reduction of transit time, whereas the execution of expeditions on research platforms of other countries catalyses the exchange of expertise, technology, science, and culture.

The activities mentioned above all intend to create optimal facilities to further improve the quality of our science and technology. The direction of our scientific and technological efforts has been discussed in depth in 2003 and will lead to a new Science Plan with even more emphasis on integrated research themes. Two themes are currently being developed, related to the Wadden Sea/North Sea ecosystem on the one hand, and the Deep Ocean ecosystem on the other hand. The successful kick off of our major LOCO (Long-term Ocean Climate Observation) programme in 2003 was timely considering the world-wide political intention and scientific interest to implement a comprehensive, coordinated, and sustained satellite and in-situ earth observation system in ten years time. On the technological side it is worthy to note that the first phase of the German-Dutch collaboration to develop a moving lander (MOVE!) for advanced geochemical and microbiological research has been finished by performing successful tests in the Wadden Sea.

The Excellent Post-doctorate programme is a new internal initiative to strengthen and rejuvenate our scientific staff. Corina Brussaard and Helmuth Thomas have been appointed as the first two excellent post-docs to explore new and multidisciplinary research. The scientific ties with the universities were further intensified by the appointment of our senior scientists Tjeerd van Weering, Jaap Sinninghe Damsté and Theunis Piersma as part-time professors at the universities of Bremen and Amsterdam (VU), Utrecht, and Groningen respectively.

At the end of this introduction I wish to emphasize that starting in 2003, Royal NIOZ has entered a new, promising and fascinating era thanks to our major successful efforts to dramatically improve the facilities for marine science and technology at our institute and for the marine sciences of the Netherlands as a whole.

Jan W. de Leeuw

1. Scientific Report

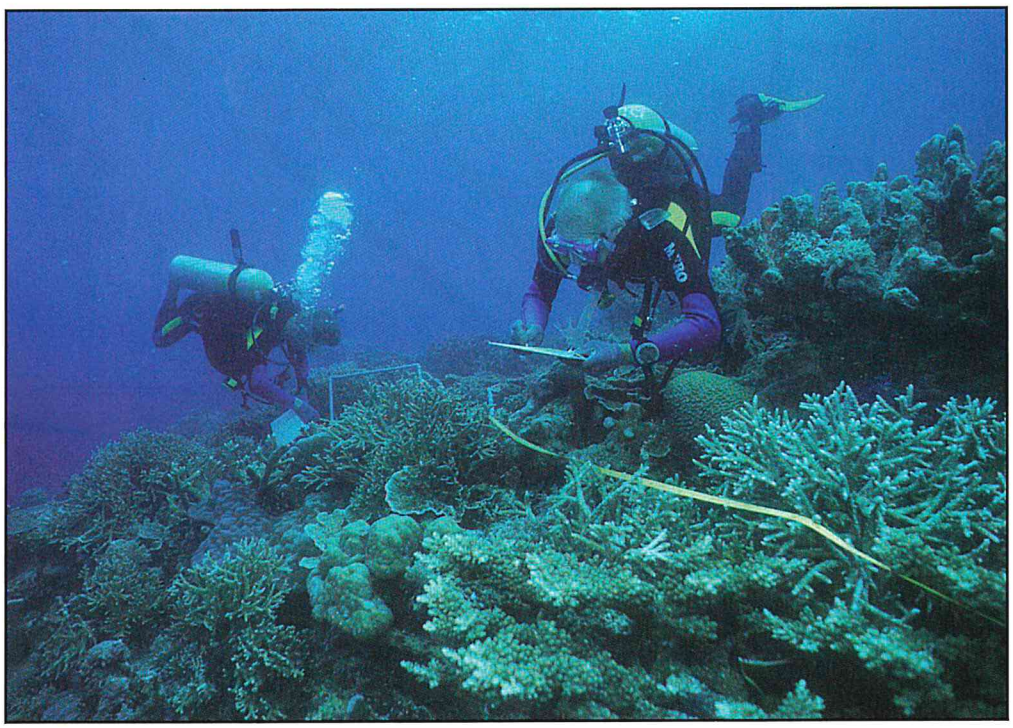
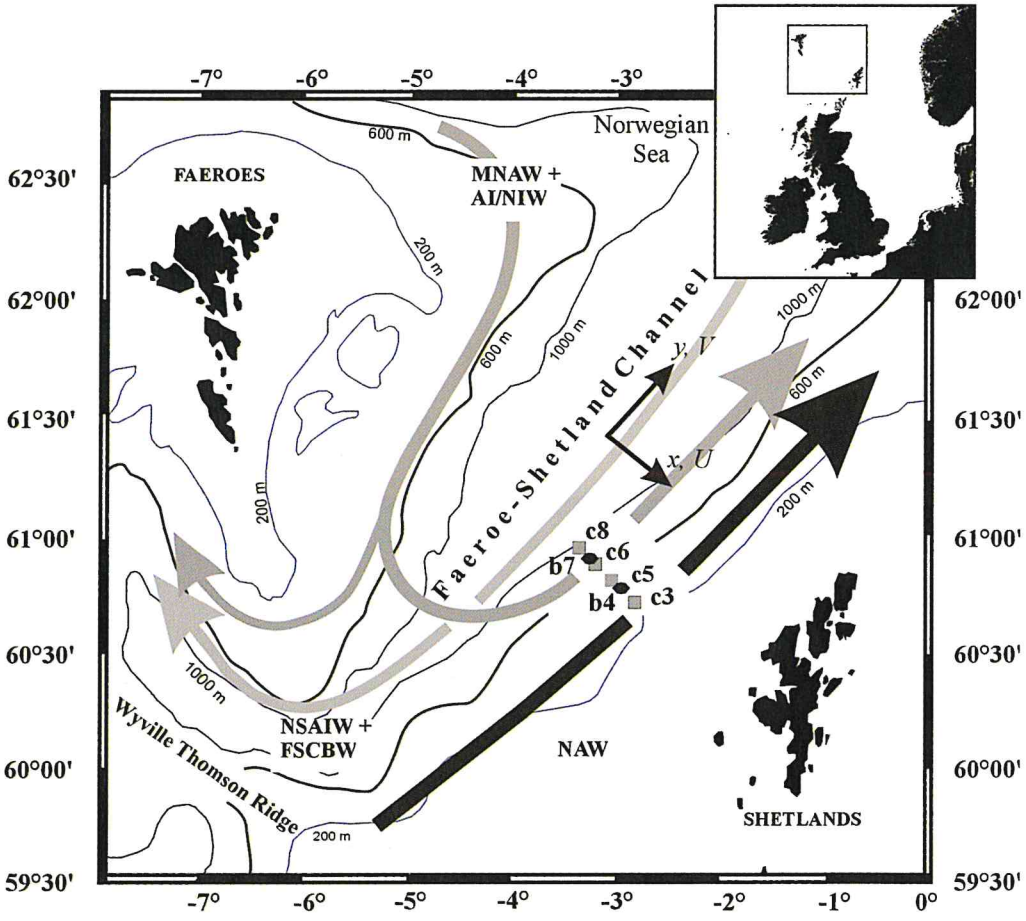


Photo: Maggy Nugues, NIOZ

PROCESSES AT CONTINENTAL SLOPES (PROCS) IN THE FAEROE-SHETLAND CHANNEL (FSC)

The PROCS programme (1999-2004) is an integrated study on the SE continental slope of the FSC combining physical, sedimentological, geochemical and biological investigations. Following a pilot study in 1997, NWO funded the NIOZ-programme proposed by H. Ridderinkhof (coordinator), H. van Haren (physics), the late W. van Raaphorst (geochemistry) and R. Daan (biology). The main objectives of PROCS were to determine the relation between the short-term variability of the hydrodynamic conditions and the cross-slope transport and fluxes of particulate biogenic matter and to assess the impact of these processes on the distribution of benthic fauna across the slope. A driving idea behind the project was that repeated reflections of internal waves would focus energy to attractors leading to localized energy dissipation by turbulent mixing affecting sediment resuspension and nutrient transport.

Thusfar, locally enhanced internal tidal energy regions have only been found in a numerical model of the FSC (Gerkema, p. 25 of the Royal NIOZ annual report 2002). Intensified currents appeared up to 100 m above the bottom between 300 and 600 m depth. They were not due to fully developed attractors. As will be reported in the next pages, small-scale and detailed observations mainly from sites in the figure below have revealed strong sediment fluxes and turbulent bursting, which were not solely due to internal tidal waves.



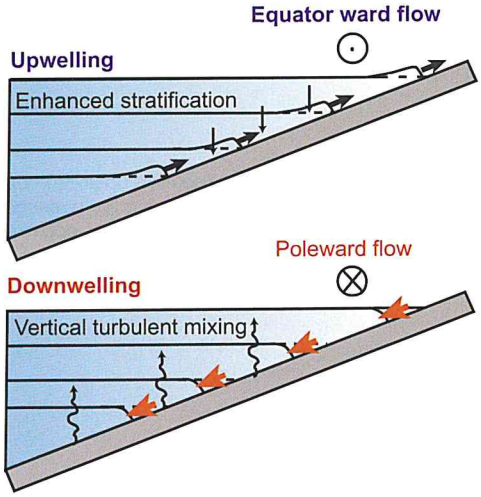
Faeroe-Shetland Channel with main PROCS mooring sites on the Shetland-slope. Cross-channel transects were conducted passed the moorings in a direct line to the 200 m isobath of the Faeroe shelf.

THE GENERATION OF STRONG TURBULENCE IN THE NEAR-BED REGION

Contributors: Phil Hosegood, Hans van Haren

In order to maintain the Meriodional Overturning Circulation (MOC) which represents the large scale ('thermohaline') oceanic circulation, a level of mixing of water masses is required that is observed to be an order of magnitude too small in the oceans interior; instead it is believed that enhanced mixing occurs at the oceans' boundaries. During PROCS, the processes that may facilitate such enhanced mixing were studied as well as their impact on sediment transport and the benthic biological community. We have found evidence of two processes that generate turbulence near the sea-bed, the first related to the asymmetric response of the bottom boundary layer to a variable flow along the continental slope, and the second due to the response of the deep thermocline to atmospheric forcing.

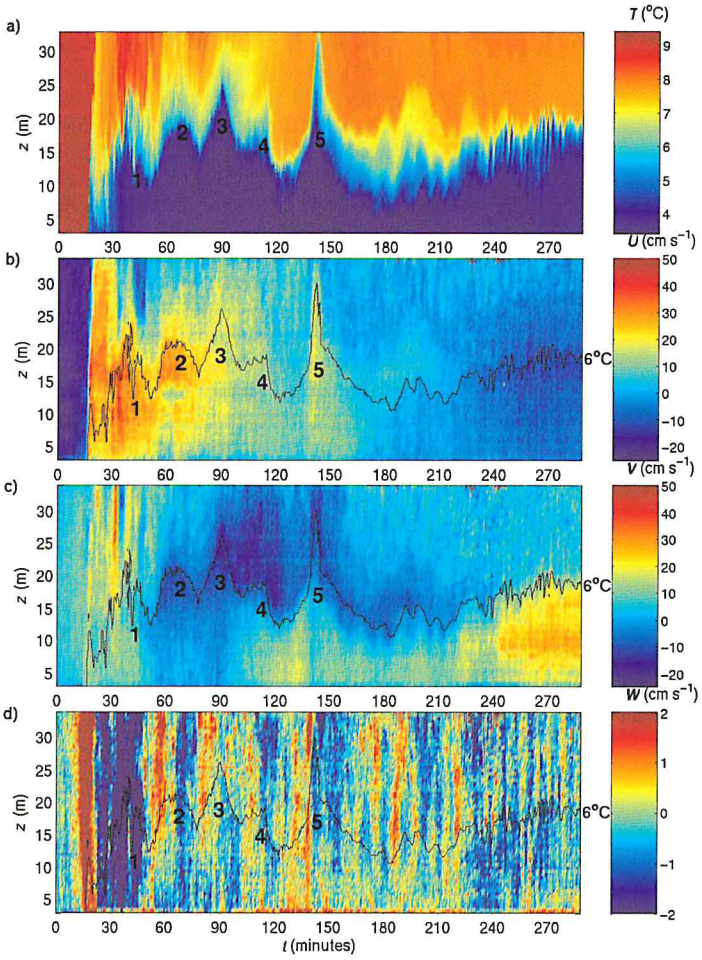
An initial inspection of data obtained from moorings deployed at the sea-bed during PROCS revealed spike-like reductions in current speed when sampled by mechanical rotor and vane type current meters at a rate of once per minute. Concurrent measurements by acoustic current meters on the same mooring exhibited higher noise levels than those periods during which no spikes were observed in the records of the mechanical current meters. Given the isolated nature of the spikes and their duration of only one data point (one minute), it was thought that they represented an instrumental error; this was rejected however due to a directional dependence which required the mean current to be flowing primarily to the north-east along the continental slope for the spikes to occur. Instead, it was found that the change in mean current direction between different heights on the moorings was consistent with Ekman dynamics which, through the influence of friction and rotation, causes the current direction to rotate anticlockwise towards the seabed. Over the slope in the Faeroe-Shetland Channel this results in upwelling at the seabed during periods when the mean long-slope velocity component is directed equatorward (towards the south-west), potentially resulting in enhanced stratification and suppressed turbulence. In contrast, during periods when the long-slope velocity is poleward (towards the north-east), static instabilities may occur as lighter water is advected beneath heavier water lower down the slope. The static instabilities then promote the growth of turbulence in the near-bed region which cause the spikes in the current meters due to their inability to resolve such short time-scale fluctuations in the current direction. The intermittent nature of the spikes is explained by the bursting phenomenon from a turbulent boundary layer.



The asymmetric response of the bottom boundary layer under contrasting long-slope flows and the consequences for turbulent mixing in the near-bed region.

The turbulence generated by the above process is related to a downslope flow near the bed. At particular times during PROCS however, spikes were found when the flow was directed *upslope*, requiring an alternative explanation for the apparent generation of turbulence. The periods concerned, marked by strong temperature gradients observed at the sea bed, have been explained as 'solibores', which are intense internal wave trains which display the properties of both turbulent internal bores and nonlinear wave trains. Our observations are unusual because of the great depth (near the bed) at which these solibores occur and the origin of their forcing, which appears to be atmospheric rather than tidal, considering the 4 days periodicity. The mixing rates, measured as diapycnal diffusivity, K_P, associated with the solibores reach 10^{-2} m^2 s^{-1}. However, as the rapid passage of such strong solibore occurred only once in 14 days, the average $K_P < 10^{-4}$ m^2 s^{-1}, the value supposedly required to maintain the global thermohaline circulation. In contrast, the solibores appear to dominate the resuspension of sediment at the sea bed, with daily averaged fluxes measured at 10m above the bottom two orders of magnitude larger

than background levels. The solibores are forced due to a sudden depression of the thermocline caused by the passage of a nonlinear large-scale wave possibly generated by atmospheric storms. When the resulting hydraulic jump (bore) propagates obliquely up the slope it overturns due to kinematic instabilities when the particle velocities exceed the speed of the bore itself.



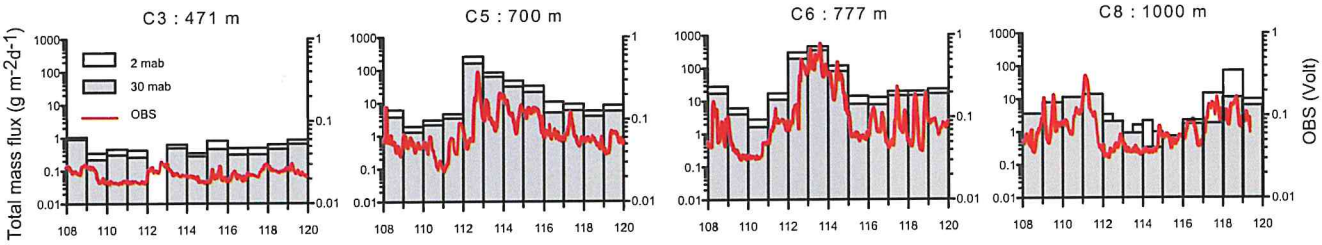
a) Temperature and b) cross-slope (positive upslope), c) long-slope, d) vertical velocity components during the passage of a large solibore during which large sediment fluxes occurred.

MASSIVE SEDIMENT RESUSPENSION AND ACTIVE SILICA REFUELLING

Contributors: Jérôme Bonnin, Geert-Jan Brummer

Ocean margins and slopes constitute important and complex regions that connect the shallow highly productive shelves with the deep ocean. The quantification of the fluxes of dissolved and particulate matter across these margins is therefore necessary to evaluate the global biogeochemical cycle of carbon and associated elements in the marine system. Such quantification requires understanding of the dominant transport and conversion mechanisms occurring on the slopes. However, detailed in situ measurements of resuspension fluxes on the continental slope are scarce and very few have been able to observe in situ the impacts of these short-term features on sediment resuspension.

During PROCS, four moorings, C3, C5, C6 and C8, each including 2 sediment traps with their aperture positioned at 2 and 30 meters above the bottom (mab) respectively were deployed on a transect across the Shetland slope at water depths of 471, 700, 777 and 1000 m, respectively in April/May 1999. Sediment resuspension was observed at all times at depths greater than 470 m and was related to the high bottom-current speeds measured in the study area. At depths less than 470 m little or no resuspension was observed, although currents measured near the bottom were strong. This absence of resuspension is attributed to the nature of the substrate composed essentially of coarse and consolidated sand as well as glacial boulders not likely to be eroded under the action of currents. Sediment resuspension was most pronounced at mid-slope (700-800 m) where an exceptionally intense event was observed at day 112 in association with rapid changes both in temperature and near-bottom current velocity. Results also suggest that during periods of low resuspension (background sediment flux) the material intercepted in the near-bottom traps is a mixture of debris from primary production settling in the water column and rebound particles that have already reached the seabed before

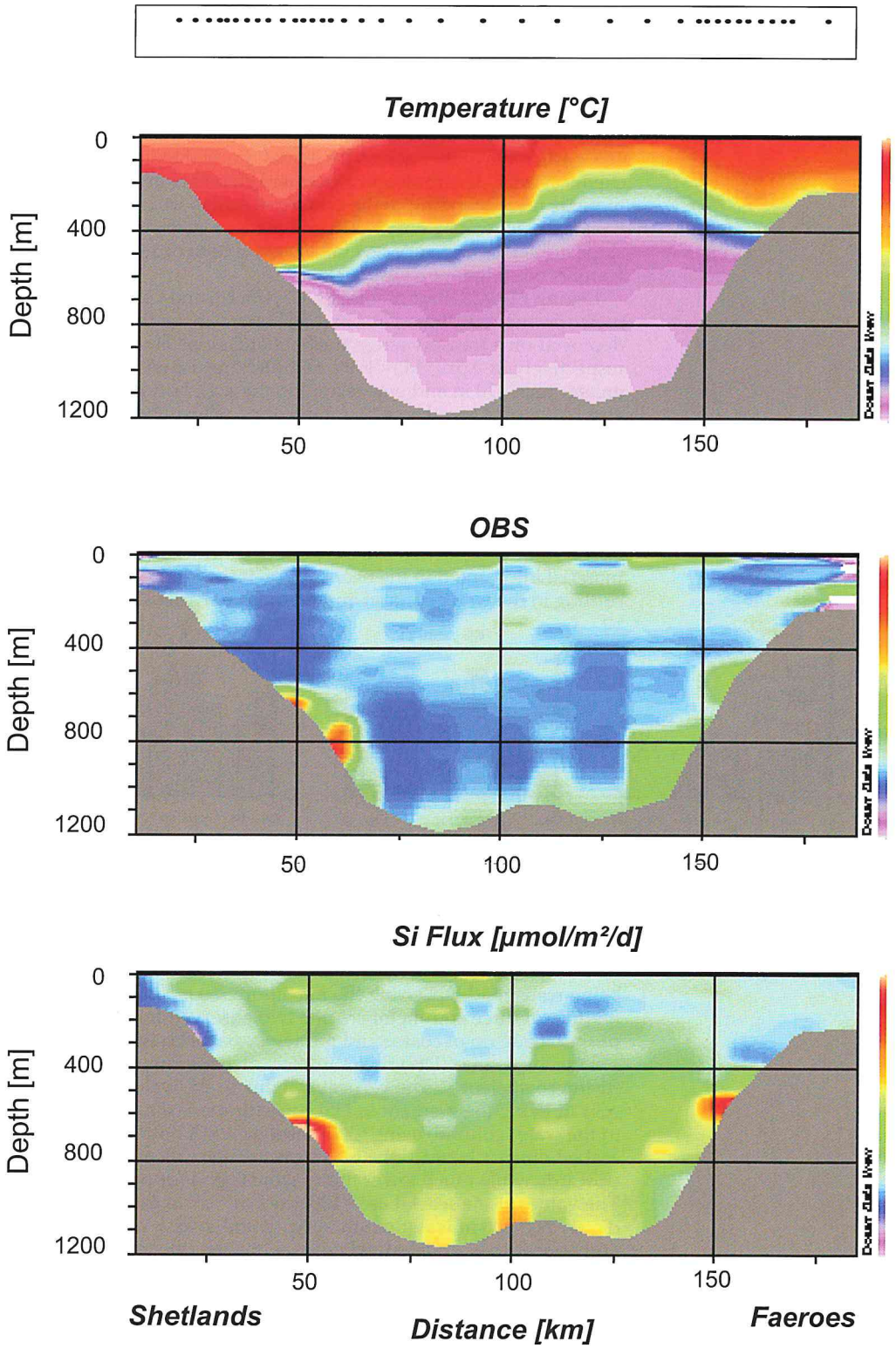


Sediment fluxes from traps positioned with their aperture at 2 and 30 m above the bottom (white and grey bars, respectively) and optical backscatter sensor (OBS) data (red lines) at 2 m above the bottom throughout deployment period. Sediment fluxes at mid-slope (700 and 777 m) were O(10^2) larger than at 471 and 1000 m after an intense and abrupt increase on day 112. In contrast to 700 m and 777 m, resuspension at 1000 m was low during days 112 and 113. The OBS signal shows a good correlation with trap data and indicate that the large sediment fluxes are genuine and not due to trapping artefact.

being resuspended. During the maximum resuspension period, the intercepted material is a mixture of three end-members, the two observed for low resuspension plus the sediment proper made up of coarse and refractory particles that can constitute up to 70% of the flux.

Dissolved silica (DSi) fluxes in the water column were calculated using the vertical eddy diffusion coefficient K. The vertical DSi flux in the water column is expressed as $K\Delta Si/\Delta z$, with $\Delta Si/\Delta z$ being the gradient in DSi concentration (measured from water samples at various depth in the water column, using CTD-rosette NOEX bottles). On the slope, in the vicinity of the seabed directly beneath the major pycnocline, calculated DSi fluxes are high and directed upwards while much lower fluxes were found for mid-depth water column and surface water. The values at the seabed are ~100 µmol m^{-2} d^{-1} at the upper slope, but as high as 450 µmol m^{-2} d^{-1} at ~600-800 m water depth in April and even > 1500 µmol m^{-2} d^{-1} in September (not shown) and appear to be constrained near the seabed due to the very strong pycnocline. Enhanced fluxes near the seabed particularly at mid-slope suggest that benthic dissolution processes are responsible for sustaining these fluxes. Benthic DSi effluxes on the slope, obtained from incubations and from modeled pore water DSi profiles, indicated highest fluxes at mid-depth corresponding to a zone of enhanced deposition and higher biogenic silica content. Benthic fluxes of DSi at mid-depth are in the order of 1000 µmol m^{-2} d^{-1} and can, for a large part, sustain the enhanced calculated flux in the water column at around 700 m. Furthermore, we estimated that the recurrent resuspension of bottom material as observed at mid-slope associated with turbulent flow contributes to increase the DSi concentration in the deep water of the FSC.

Our data suggest the importance of the geomorphological setting of the basin which, with its relatively shallow depth and funnel shape combined with strong currents favors massive resuspension of seabed material and its accumulation at mid-slope, hence facilitating refuelling of passing waters with DSi.



Temperature, turbidity (OBS) and dissolved silica flux in the water column along a section perpendicular to the FSC conducted in April 1999. The different panels show a strong gradient in all 3 measured variables at mid-slope on the Shetland slope of the channel. Dots at the top indicate observation locations.

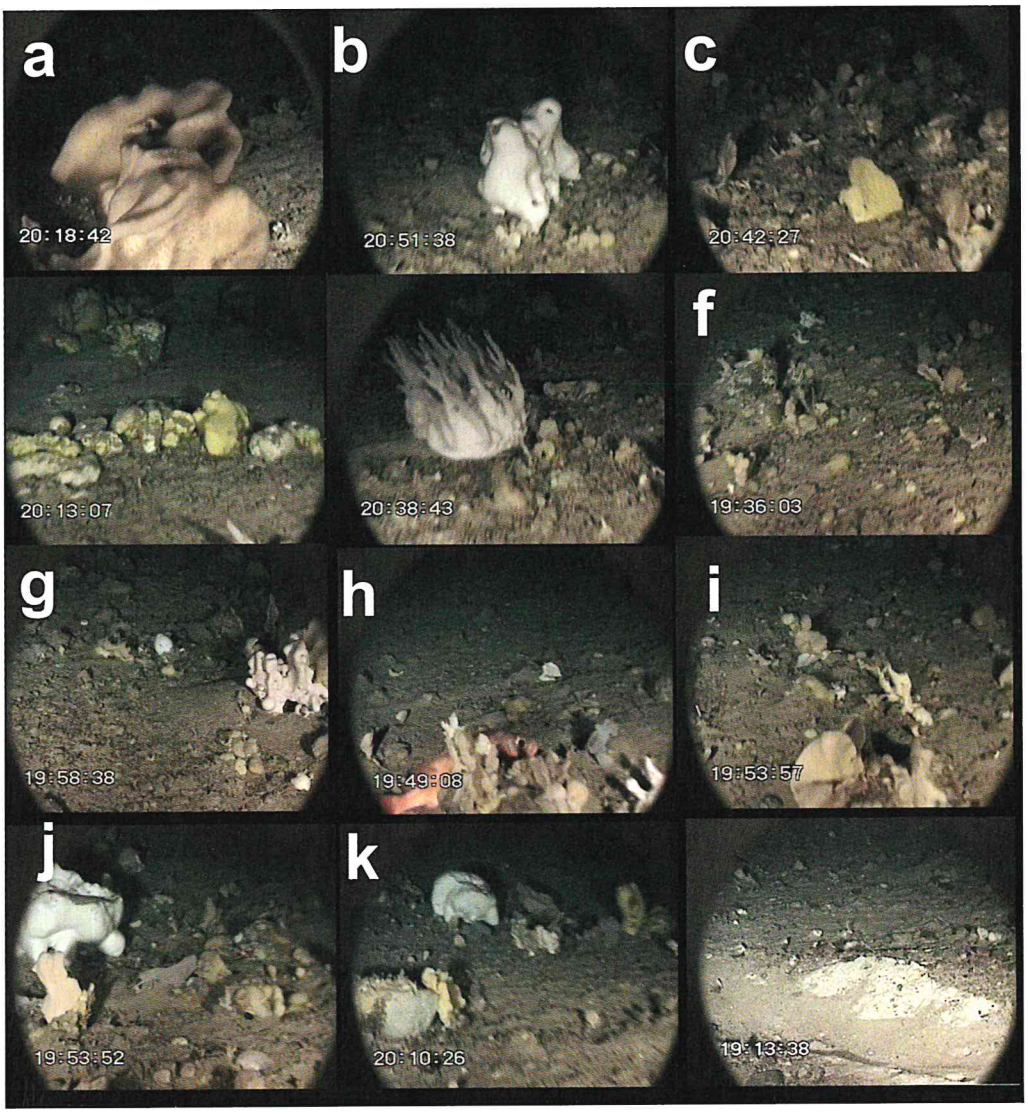
MACROBENTHIC FAUNA CHANGES ON THE SHETLAND SLOPE.

Contributors: Rob Witbaard, Rogier Daan and Maarten Mulder

Internal waves, which hit the continental slope, increase resuspension of fine sedimentary bottom material. If this is a recurrent phenomenon at specific depths, it is likely that it affects the composition of the bottom fauna by changing the environmental and feeding conditions. Especially filterfeeders which depend on such resuspended fine material will be affected.

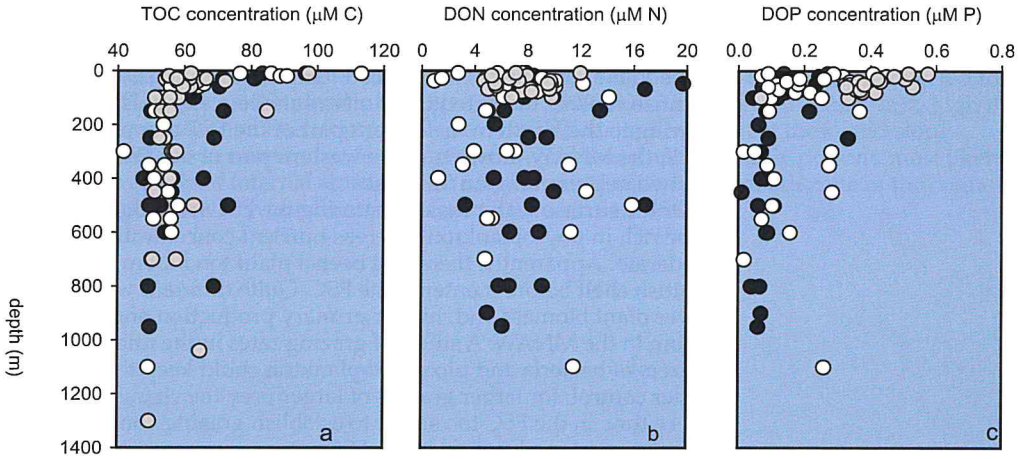
To assess whether the effects of the internal waves are indeed reflected in the fauna composition and distribution in the FSC, boxcore and dredge samples, supplemented with underwater video recordings, were taken along a depth transect across the channel. The boxcore samples were sieved and from the remaining fraction mollusc species were sorted and identified. From the same across-slope transect, epibenthic macrofaunal densities were estimated by quantifying some identifiable taxa visible in the video recordings.

The quantitative boxcore samples demonstrated that species diversity was greatest among the Gastropods (72 species) although their numerical abundance was low when compared to the abundance of the 44 bivalve species. In the living fraction, fourteen species dominated the mollusc fauna and represented almost 88 % of all specimens collected with the boxcorer. Typical for the upper region of the FSC are *Limopsis aurita*, *Barbatia nodulosa* and *Leptaxinus incrassatus*. At intermediate depths between 400 and 800 meter *Bathyarca grenophia*, *Dacrydium vitreum*, *Astarte sulcata* and *Thyasira flexuosa* have the largest proportion among the living specimens. *Yoldiella frigida* and *Cuspidaria glacialis* were mainly found in samples from depths beyond 500 meter. It was furthermore observed that the percentage of living specimens increases with depth. In the top 500 meter the percentage of dead specimens was about 70%



Snapshots from the sponge beds between 500 and 600 meter depth in the FSC. A wide variety of species and sizes were present. Locally a large fraction of the bottom surface is covered (e) with numerous small sponges. At other places reef like structures have been formed which provide a shelter for fish (k) and other invertebrates. Despite the great depth old marks of trawling activity were evident (l).

water, the cold overflow water from the Norwegian Sea moves through the FSC to the South. In turn, this Norwegian Sea water flows over the cold, more stagnant and aged water mass, which fills the lengthy narrow basin of the FSC below ca 600 m depth. The TOC- and DOP-concentrations showed a steep decrease with depth, which indicates a preferential utilization of these organic compounds by the bacterioplankton. The DON-concentrations showed no such pattern and had a high scatter over the whole water column. The absence of the commonly reported decline of DON with depth can be attributed to the higher concentrations in the intermediate water masses which transport N- rich dissolved organic matter (DOM) from the Arctic Ocean into the mesopelagic region of the FSC. Especially the deep FSC water is — from a wider oceanographic perspective - interesting for the microbial ecologists.



Depth distribution of total organic carbon (TOC), dissolved organic nitrogen (DON) and phosphorus (DOP) concentrations in µM at the oceanic stations (a, b, c). The different symbols indicate the samples from southern transect (transect 1, full circles), middle transect (transect 2, open circles), and northern transect (transect 3, gray circles).

DEPARTMENT OF PHYSICAL OCEANOGRAPHY

Scientific efforts within the department of Physical Oceanography (FYS) are organized under the following main themes:
1. Ocean circulation and hydrography
2. Processes near continental slopes, internal waves and mixing
3. Tidal and morphodynamics of coastal zones

Within the first theme ocean research with a significant seagoing component is performed. It has a strong emphasis on subjects relevant to climate, and is mainly focused on large-scale circulation and hydrography. Presently, research programmes are carried out in the framework of the international programme CLIVAR.

In 2003 many activities were carried out in the framework of the Long-term Ocean Climate Observations (LOCO) program. Instruments were acquired and tested, moorings were designed and in the course of the year moorings were deployed at different sites in the ocean. In the Irminger Sea 2 profiling moorings and in the Mozambique Channel an array of 7 moorings with current meters and T-S sensors were located. The former is mainly used to study watermass formation and the latter to study the variability in the meridional transport in the South-West Indian Ocean. Hydrographic observations were obtained during the bi-annual survey of the former WOCE AR1E section between Greenland and Ireland and as part of the TRANSAT program in which the biological degradation of North Atlantic Deep Water is studied. PhD and PostDoc studies using data obtained during recent programmes, like CAMP, MARE and ACSEX continued.

Under the second theme theoretical, numerical, laboratory and observational studies of the interaction between internal waves in a stratified ocean and topographic features are performed. As part of the LOCO program two arrays of 4 moorings each to observe the climatology of internal waves were deployed in the Canary basin and in the Irminger Sea. A study using data on internal waves was carried out in the Mediterranean. It revealed the alternating presence of thick, deep mixed layers, interspesed by stratified layers. Interestingly the internal gravity waves in the stratified layers correlate, suggesting that they are transferred by (observed but non-correlating) inertial waves of the same frequency in the mixed layers.

A PhD study is continued studying the impact of strong near-bottom currents on sediment resuspension. Results from this observational study in the Faeroe-Shetland Channel show that, despite strong tidal currents, internal tides do not have a major impact on on-slope sediment transport. The major mechanism triggering sediment resuspension is a single turbulent bore, rushing up the slope once every 4 days, approximately. It seems related to the passage of atmospheric disturbances.

A PhD thesis was completed with the analysis of the observed internal wave field in Mozambique channel and comparison thereof with predicted internal tidal beams from a numerical model. The thesis discusses internal and inertial wave pattern formation that may be relevant to the appearance of mixing hot spots in the ocean. A reanalysis of earlier experiments on focusing internal waves was carried out by a PhD student. A postdoc studied Rossby wave pattern formation in both homogeneous as well as stratified oceans, employing different simplifying assumptions, described in a following section.

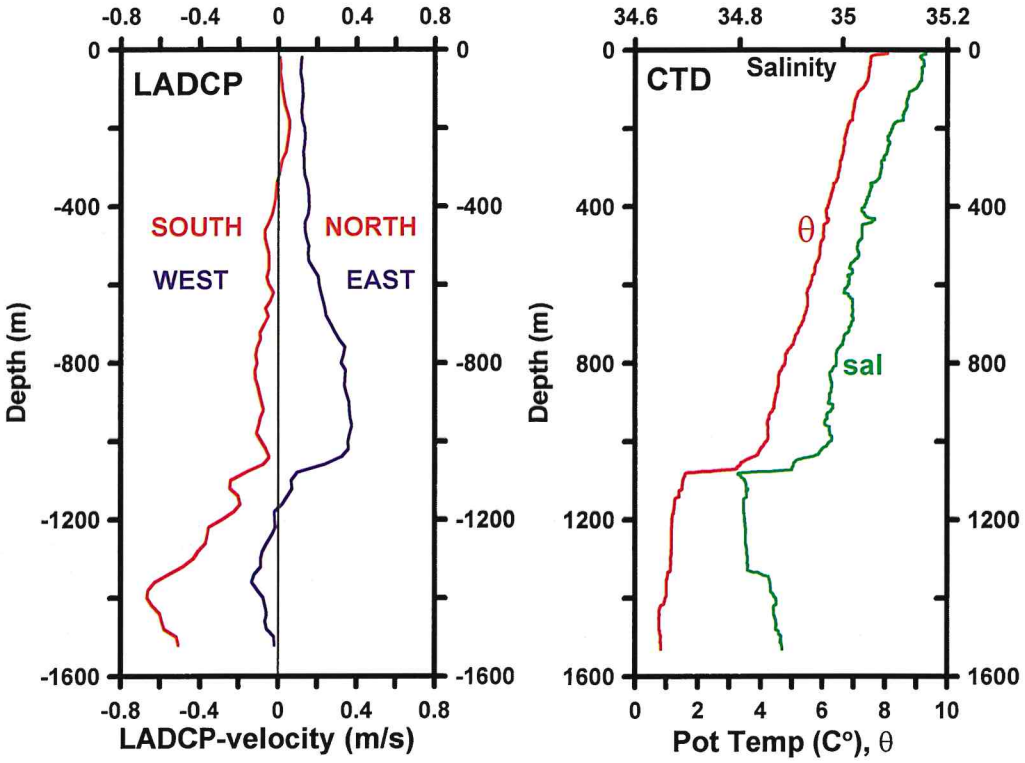
The third theme consists of studies in the relatively shallow coastal zone using both field and laboratory observations and theoretical modelling. A detailed analysis of ongoing ferry observations on currents and suspended sediments in the Marsdiep inlet forms an important part of this research programme. A PhD student and a PostDoc continued their research on the transport of sand (PhD) and fine-grained sediments through the Marsdiep inlet (PostDoc). During 2003 some 13 hour cruises with RV Navicula were done to obtain additional observations on the tidal current field at sections on the seaside of the ferry transect. A laboratory study by a PhD student supported the frequently employed Lorentz' linearisation of the nonlinear frictional damping acting on tidal flow in straits. This FOM project also revealed the presence of a new nonlinear mechanism, perhaps related to that operating in so-called U-tubes, that led to bending of amplitude response curves and multiple equilibria over a small range of frequencies, similar to what is expected to arise in large basins due to sloping bathymetry.

Most of the studies are part of these departmental themes. Other activities like the application of marine optics in oceanography, are mainly carried out in collaboration with other departments and/or institutes (and often made possible by the availability of external funds).

Apart from the scientific activities the department supports national seagoing research programmes with hydrographic observations, satellite data and overall data-management. For these national tasks the Data Management Group acts as a separate group within the department.

DENMARK STRAIT OVERFLOW IN ACTION.

Contributor: C. Veth



Flow measurements (left panel) determined with a lowered ADCP (Acoustic Doppler Current Profiler) at a station in the Denmark Strait between Greenland and Iceland demonstrates the presence of a strong bottom current below a depth of 1050 m. This current flows in a south-westerly direction, from the Iceland Sea into the Irminger Sea. The simultaneously measured CTD-salinity and potential temperature profiles are shown in the right panel. The properties of the water in the bottom current contrast strongly with those of the water above 1050 m. This Denmark Strait Overflow Water (DSOW) is one of the main constituents of the North Atlantic Deep Water (NADW). The measurements were done during the TRANSAT-II cruise with RV Pelagia.

ROSSBY WAVES AND "RAY CHAOS"

Marie Curie fellowship (HPMF-CT-2000-00935)

Contributors: Uwe Harlander and Leo R. M. Maas

To understand microscopic processes it is frequently necessary to switch from a particle point of view to a wave point of view and vice versa. For example, a laser beam can be seen as a narrow stream of particles, called photons. However, if we shine laser light through two slits and onto a wall we think of elementary waves superposing such that constructive and destructive interference lead to the well known stripy pattern on the wall. Even for macroscopic wave phenomena it is useful to attribute particle properties like path and position to waves. Throwing a stone in a pond we excite a surface wave in the form of a ring expanding in space. After a short time the leading part of the disturbance looks like a wave packet with circular crests. We can follow the packet with our eyes. Doing so we address typical local (particle) attributes to the wave: path, velocity, local wavelength, and local amplitude. In the example given above the corresponding rays consist of a bundle of straight diverging lines starting at the point where the stone has hit the pond's surface. The velocity of the wave packets (or wave groups) following the rays is called the group velocity.

Propagating wave packets can be observed both in the atmosphere and the ocean at many different length scales. The longest waves in the oceans and the atmosphere are called Rossby waves (after the Swedish-U.S. meteorologist Carl G.A. Rossby). In the atmosphere these waves are thousands of kilometers long and their crests and troughs form the well-known high- and low-pressure systems of the midlatitude weather. In the ocean, the scale is reduced by a factor ten, but similar structures, in the form of cyclonic and anticyclonic eddies betray the presence of Rossby waves. Rossby waves can propagate along complicated paths if they travel over topography or across currents. In some cases the ray path and the local wavelength and amplitude can sensitively depend on the initial conditions. Then we speak of "ray chaos."

The purpose of the study was to investigate the ray dynamics of Rossby waves in closed basins. We wanted to understand better i) trapping of Rossby waves in ocean basins and ii) the relationship between eigenmodes and periodic or chaotic wave rays. To do so we considered a particularly simple situation: an ocean channel with an almost rectangular cross section (x-z-plane). At the bottom of the channel we assume topography with a small constant slope in the x-direction. We will look upon modes constant in the along-channel y-direction. Then we can reduce the Rossby wave equation to a two-dimensional problem, tractable by ray techniques as well as more traditional methods.

Rossby waves reflect like we expect intuitively: the angle of incidence of the wave (angle between the ray and the boundary at the point where the ray intersects with the boundary) equals the angle of reflection. This simple Snell's law also holds for light waves, sound waves, and surface water waves. From the particle point of view it is immediately clear that wave solutions trapped in the deep part of the channel should occur. This is demonstrated in Fig. 1 where we can see that a wave packet following the path shown travels back and forth between one lateral boundary and a turning region in the middle of the channel. The wave packet cannot reach the lateral boundary at the shallow side of the channel. Indeed, eigenmodes (correspon-

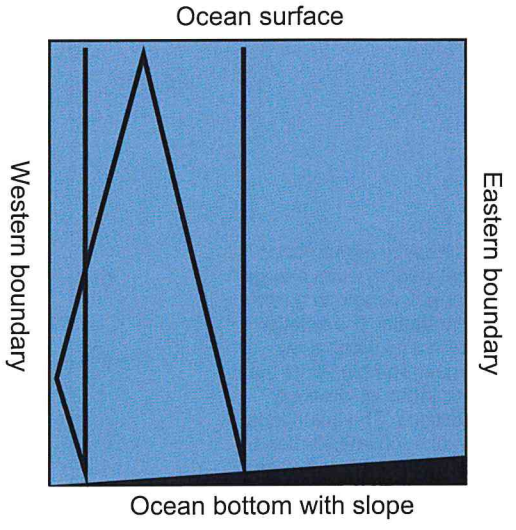


Fig. 1. Cross section (x-z-plane) of the ocean channel. The thick solid line corresponds to a ray path. Any ray hitting the lower or upper surface perpendicularly is periodic but non-closed. A wavepacket following the ray cannot reach the boundary on the right hand side. From this ray picture, trapped eigenmodes can be expected.

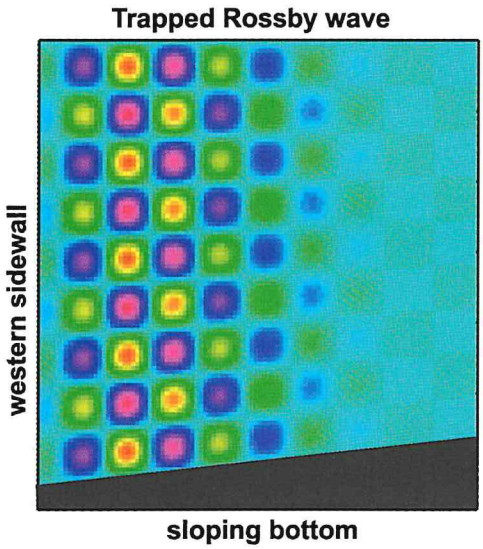


Fig. 2. Eigenmode showing wave trapping to the western (deep) part of the channel. Displayed is the vertical velocity in the x-z-plane of the ocean channel (see Fig. 1). Strong motion is indicated by red color. Only weak velocity can be found in the eastern half of the ocean. Note that the Rossby wave pattern shown is not a standing mode, but phase lines move from east to west.

ding to the wave point of view) computed analytically show this trapping behavior too (Fig. 2). We clearly see that wave energy cannot reach the shallow part of the channel but is trapped to the western (left hand) side. The particle picture suggests that any approximation to the true geometry of the basin will have a significant impact on the solution.

For internal waves (internal gravity waves or inertial waves) it is known that a clear mode-ray correspondence exists for a 2D closed basin: eigenmodes correspond to a periodic ray pattern, i.e., all ray paths form closed curves. On the other hand, wave energy can become concentrated (focused) on a certain region in the fluid, shown by convergence of the rays to that region. This indicates the existence of a new type of solution besides common eigenmodes, called wave attractor solution. Wave attractor behavior is quite the opposite from ray chaos since all waves will --sooner or later-- propagate along the attractor, independently from the initial conditions. The question arises what can be expected for Rossby waves in a closed basin, can we find a mode-ray correspondence similar to that of internal waves?

To answer this question we tried to construct a modal solution by using a ray technique. Thereby, from the experience with internal waves, we assumed that eigenmodes should correspond to a family of periodic rays. Fig. 3 shows an eigenmode constructed by the ray technique for a flat bottom case. This solution corresponds to the exact one, available for the simple basin geometry. The mode shown has a large vertical wavelength. Such modes are not trapped and

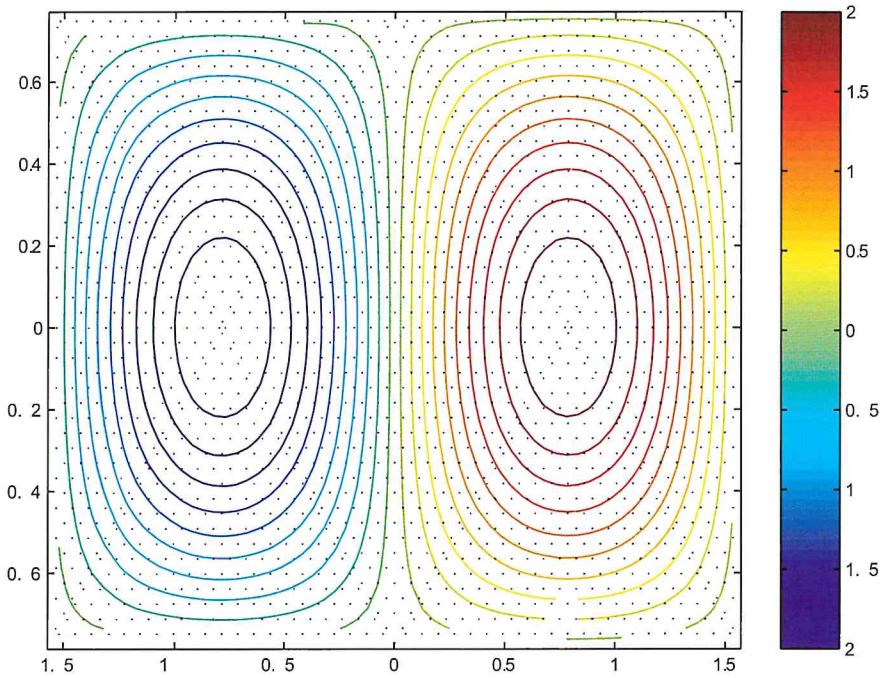


Fig. 3. Rossby eigenmode (vertical velocity) with a large vertical wavelength in a rectangular basin. The solution is obtained by using a ray technique. The blue dots indicate locations of wave ray intersections. The solution is known at such intersections and interpolated in between. Note that in contrast to the situation in Fig. 2 the mode shows no wave trapping.

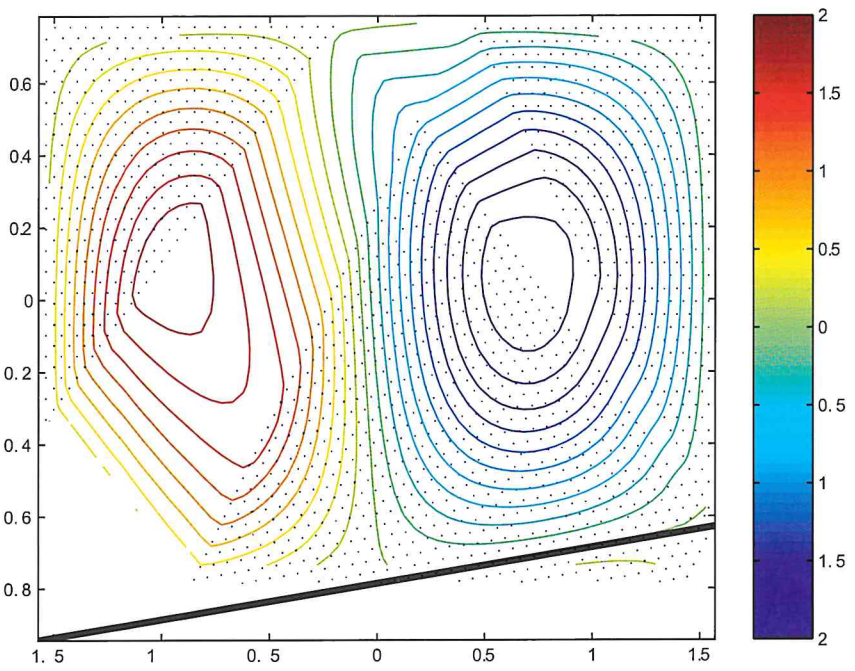


Fig. 4. The same mode as in Fig. 3 but for a basin with a sloping bottom. In the region with no blue dots (i.e., no wave ray intersections) the solution cannot be constructed by the ray technique. It looks straightforward to fill the gap by using rays starting from the lower right corner using different launch angles. However, these rays would not be periodic. Nonperiodic rays ruin the smooth structure of the mode and cannot be included in the ray/mode construction method.

corresponding rays should show reflections at both lateral boundaries, in contrast to the situation given in Fig. 1. That this is true can be seen from the fact that locations of wave ray intersections (shown in Fig. 3 by the blue dots) cover the whole domain, i.e. wave energy can reach any point in the basin.

Fig. 4 shows the same eigenmode but now for a basin with a sloping bottom. The solution agrees well with an analytical solution (obtained for small slopes, not shown here), except for the (white) fan-like region close to a ray, which connects the lower left with the lower right corner of the basin. Although the mode is not trapped, we cannot find ray intersections of closed orbits in this region, and therefore we cannot obtain a solution by using the ray technique. Fig. 5 (top) shows the closed periodic ray bounding the fan-like region in Fig. 4. The wave packet is launched at the bottom close to x = -1 with an angle of 45 degrees. All packets launched under the same angle to the right of this one will also propagate along a closed periodic path. Actually, this family of periodic orbits has been used to construct Fig. 4. In contrast, Fig. 5 (right) shows the ray path of a wave packet launched at about x = -1.2, i.e. in the fan-like region of Fig. 4. It seems to correspond to a "chaotic ray" that is filling the whole cross section without becoming closed. A field reconstruction from such chaotic rays looks very patchy and cannot be related to a smooth eigenmode. We can conclude that in contrast to the situation of internal waves, there is no simple mode/ray correspondence for Rossby waves in closed oceans. The asymmetry of the basin, introduced by a sloping bottom, leads to the fact that a single family of periodic orbits cannot cover the whole domain, as is the case for internal waves in asymmetric basins.

In summary, the study has shown that a simultaneous view of wave and particle properties can help to understand Rossby wave dynamics. E.g., geometric Rossby wave trapping can more easily be interpreted using the ray/particle picture. Eigenmode reconstruction by the suggested ray technique looks promising. However, further investigation is needed to overcome the problems discussed above.

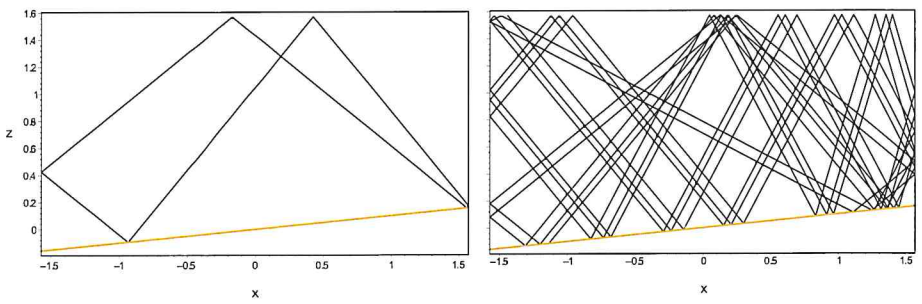


Fig. 5. Left: Periodic ray, which bounds the (white) fan-like region shown in Fig. 4. The ray is launched from the bottom at about x = -1 under an angle of 45 degrees. Bottom: "Chaotic ray", launched from the bottom at about x = -1.2 (i.e. in the fan-like region shown in Fig. 4) under the same angle. The ray corresponds to the same frequency as the one shown above but it is not closed.

FIRST DEPLOYMENT OF SUB-SURFACE MOORINGS AS PART OF THE LONG-TERM OCEAN CLIMATE OBSERVATIONS (LOCO) PROGRAM

Contributors: H. Ridderinkhof, H. van Haren, H. van Aken, L. Maas (FYS), G.-J. Brummer (MCG), K. Booij (MBT)

In 2002 a consortium of physical oceanographers from the Royal NIOZ, the Institute for Marine and Atmospheric Research (IMAU) and the Royal Netherlands Meteorological Institute (KNMI) obtained funding for the 'Long-term Ocean Climate Observations (LOCO)' program, a proposal for large investments which was funded by the 'NWO-Groot' program. The LOCO program intends to obtain long-term (at least 5 years) observations on some aspects of the (time-variability in) the global overturning ocean circulation. At some critical ocean locations observations on inter-seasonal and inter-annual variability in ocean currents, convection and internal waves will be obtained using sub-surface moorings. The program is embedded in the international WCRP - CLIVAR programme and forms the Dutch contribution to the 'Global Ocean Timeseries Observatory System' which implements a global network of moored time-series observatories.

The funding includes the purchase of the instrumentation and ship-time for the first deployment of the moorings. In 2003 all moorings have been deployed for the first time. The sites are shown in Fig. 1.

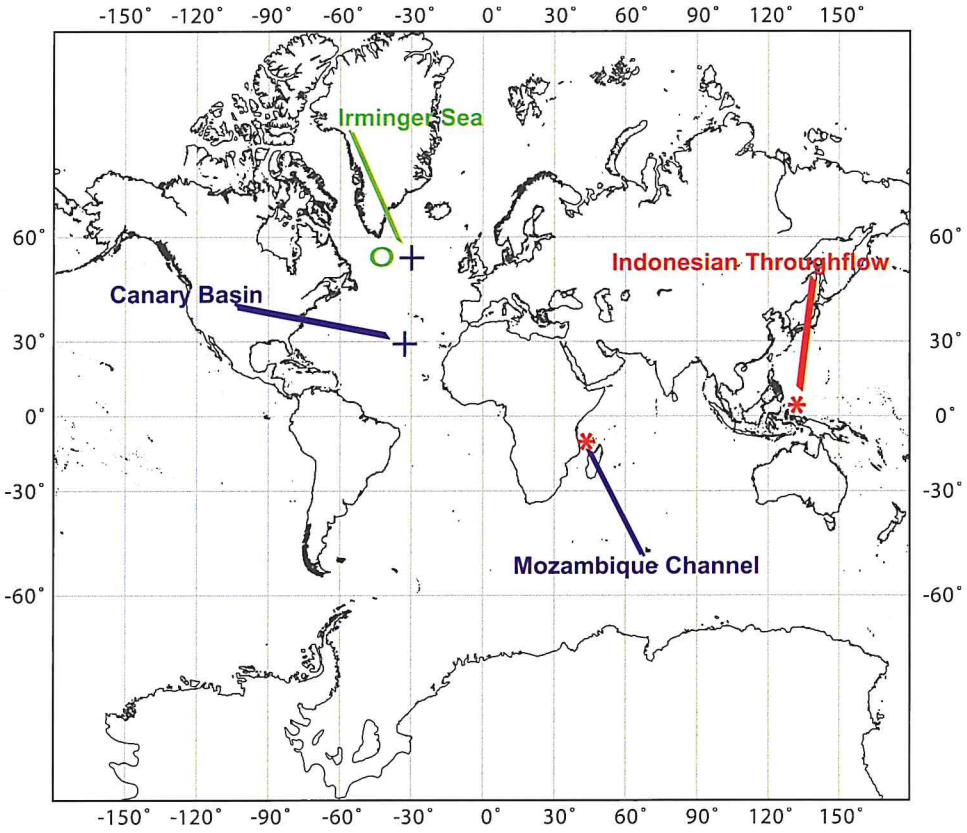


Fig. 1. Sites where LOCO moorings have been deployed in 2003

In the North Atlantic Ocean an array of 4 moorings was deployed both in the Canary basin and in the Irminger Sea to study the climatology of internal waves in these ocean regions. These internal wave moorings will be relocated yearly to obtain information on the internal wave climatology at different characteristic ocean regions. The two sites are complementary in that the Canary basin is near a latitude at which the internal (diurnal) tide can be expected to be trapped, leading to elevated levels of mixing, while in the Irminger Sea the frequency of the trapped waves is not of tidal origin, and is thus expected to be less energetic. The internal wave moorings in the Irminger Sea are located close to the sites where 2 profiling moorings were deployed. These profiling moorings are used to study the variability of deep convection in this region and form an extension of our bi-annual hydrographic repeat surveys along the former WOCE AR1E section. The profiling moorings will remain deployed in the Irminger Sea for a period of 5 years.

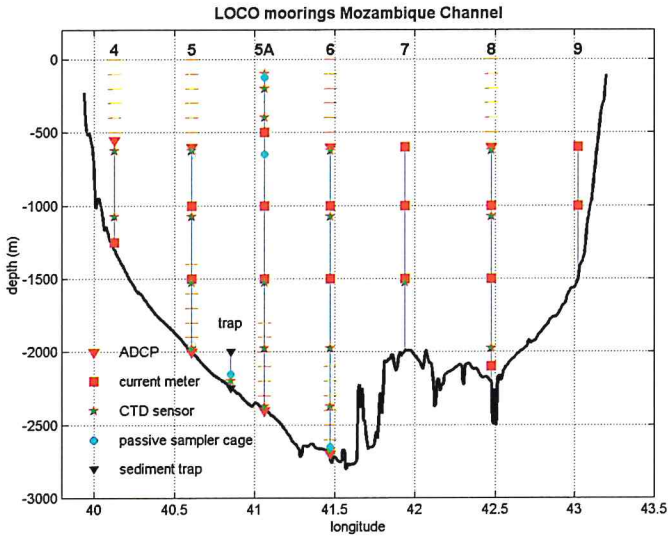
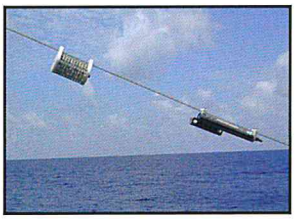


Fig. 2. Mooring array in the Mozambique Channel

In the Indian Ocean an array of moorings was deployed in the Mozambique Channel as a follow-up of a recent successful pilot experiment. The present array minimises the previous undersampling drastically and has a large number of acoustic Doppler current profilers, current meters and temperature and salinity sensors (fig. 2.). These observations will allow a quantification of the meridional fluxes both in the upper and lower layers. These flows form important contributions to the global overturning circulation as our previous experiment has shown. The present observations will be used to determine the seasonal and interannual variability of these flows and to study 1) the relation to large scale 'climate modes' in the Indian Ocean and 2) the connection to variability in the Agulhas current system.

In one of the Indonesian straits that connect the Pacific and Indian ocean, a mooring was deployed as part of the INSTANT program, a large internationally coordinated program to measure the variability in the Indonesian Throughflow over a period of 3 years. The Royal NIOZ mooring was deployed in the Lifamatola Strait, at roughly the same location where a Dutch mooring was located during the Snellius expedition in the early 1980's.

In addition to these moorings equipped with physical sensors, a sediment-trap mooring was deployed both in the Irminger Sea and in the Mozambique Channel close to the other moorings. These observations will be used to study long-term variability in vertical particle fluxes in relation to variability in the physical environment. Also, a large number of passive samplers for organic contaminants, recently developed at Royal NIOZ, were attached to moorings in the North-Atlantic ocean and the Mozambique Channel. These samplers adsorb organic contaminants from the water phase and will be used to study their presence (and transport) in the deep-sea, a subject about which virtually nothing is known presently.



Passive sample cage for organic contaminants and CTD sensor attached to a LOCO mooring cable.

Activities on the deck of the British RV Charles Darwin during deployment of the LOCO moorings in the Mozambique Channel

EXTERNAL PROJECTS OF THE DEPARTMENT OF PHYSICAL OCEANOGRAPHY

- Processes at continental slopes (PROCS); (NWO).
  H. Van Haren
- N.W.O.& Ifremer, French-Dutch co-operation on Mediterranean Sea Research.
  H. Van Haren
- Internal waves in the polar ocean (EC-INTAS)
  T. Gerkema, L.R.M. Maas
- Ray-chaos and wave focusing of barotropic Rossby waves (EC-Marie Curie fellowship)
  U. Harlander, L.R.M. Maas
- Secondary tides and quasi-periodically forced nonlinear oscillators (NWO-FOM).
  L.R.M. Maas, G.M. Terra
- Theoretical analysis of 3D internal gravity and inertial waves. (NWO-ALW)
  L.R.M. Maas, U. Harlander
- Processes on the Continental Slope (PROCS, NWO-ALW)
  H. Ridderinkhof, H. Van Haren, L. Maas, P. Hosegood
- Long-term Ocean Climate Observations (LOCO) (NWO-groot)
  H. Ridderinkhof, H. Van Haren, L. Maas, H. van Aken, J.T.F. Zimmerman, T. Gerkema together with Utrecht University and KNMI
- Outer Delta Dynamics (NWO-ALW)
  H. Ridderinkhof, J.T.F. Zimmerman, M. Buijsman
- The transport of suspended particulate matter in the Dutch coastal zone (NWO-LOICZ)
  H. Ridderinkhof, L. Merckelbach
- Ferrybox (EC)
  H. Ridderinkhof, F. Eijgenraam, T. Hillebrand
- Mixing of Agulhas Rings Experiment, Component MARE-A Observations of Agulhas Ring Mixing (CLIVARNET, NWO-ALW)
  C. Veth, H.M. Van Aken, T.F. De Bruin

(continuing contributions to terminated projects)

- Integrated North Sea Programme (INP); NWO funded.
  H.Van Haren
- Bay of Biscay Boundary Layers (TripleB); NWO funded.
  H.Van Haren
- Processes of vertical exchange in shelf seas (PROVESS); EC-MAST3 funded.
  H.Van Haren, H. Ridderinkhof, F. Eijgenraam, T. Hillebrand

DEPARTMENT OF MARINE CHEMISTRY AND GEOLOGY (MCG)

Scientists of MCG aim to identify and quantify biogeochemical processes involved in ocean-climate interaction and to develop a mechanistic understanding of their temporal variability. The ensueing insight in the modern ocean is also crucial to understand, reconstruct and predict past and future impacts and feedbacks of ocean induced climate change.

The research in MCG is divided into three distinct themes:
1. Biogeochemical processes in ocean waters and air-sea exchange.
2. Export and settling from the upper ocean and early diagenesis.
3. Sedimentation and palaeoceanography.

Moreover MCG is responsible for the national facilities for nutrient analyses and XRF core scanning, and it supports the Scanfish undulating instrument. Several projects cross-link with the other NIOZ departments FYS, BIO, and MBT. Scientists of MCG play leading roles in European, international, and national projects. Some 40 people work in the department, including 7 tenured scientists, 9 postdoctoral investigators, 4 PhD students, 10 technicians and about 10 undergraduate students and trainees.

Theme 1. Biogeochemical processes in ocean waters and air-sea exchange.
The efficiency of the biological pump, that is the uptake of CO_2 from the atmosphere and subsequent export of biogenic particles into the deep oceans, is determined by the food-web in the upper ocean. This food-web is in part structured by the species composition, size distribution, and activity of the phytoplankton community. Iron, an essential trace element for CO_2 fixation and phytoplankton growth, has been identified as a limiting resource in High Nutrient Low Chlorophyll areas in the world ocean. The bio-availability of and competition for Fe is considered crucial in driving the biological pump and biogeochemical cycles in the upper as well as in the deep ocean.

Theme 2. Export and settling from the upper ocean and early diagenesis.
This research theme aims to quantify the biogeochemical cycling of major elements in the bottom boundary layer and surficial sediments by combining direct measurements of deposition- and rebound fluxes of particulate matter with model estimates of deposition-, recycling-, and burial fluxes. The transfer of organic particles from an advection dominated water column to a diffusion controlled porous sedimentary matrix invokes a succession of microbially mediated primary redox-reactions, resulting in the oxidation of organic matter and the reduction of oxidants. This change in biogeochemical conditions drives secondary reactions, being the re-oxidation of reduced oxidants, the dissolution of inorganic fractions (biogenic silicate, carbonates), and the precipitation of newly formed minerals (authigenesis).

Theme 3. Sedimentation and paleoceanography.
Sediment deposits on the continental margins represent a repository for particulate matter originating from different sources, primarily including terrigenous sediments resulting from continental erosion, and organic matter and siliceous and carbonate skeletal material produced by a variety of pelagic and benthic organisms. The biogeochemical and physical processes involved in the production of these materials and the physical processes and pathways involved in the transport of these materials to the site of ultimate deposition are controlled by the interaction of local and regional geology and geomorphology of the continental margin with oceanographic and climatological forcing conditions operating on both regional and global scales. Research theme 3 aims to study both currently active processes of sedimentation on the continental margin, and at the same time use the sedimentary archive of continental margin deposits to reconstruct variation in climatological and oceanographic forcing conditions in the past, as a reference to expected future change.

IRON RESOURCES AND OCEANIC NUTRIENTS - ADVANCEMENT OF GLOBAL ENVIRONMENT SIMULATIONS (IRONAGES). CONTRACT : EVK2-CT1999-00031. PROJECT DURATION: 2000 — 2003.

Contributors: Klaas Timmermans and Hein de Baar

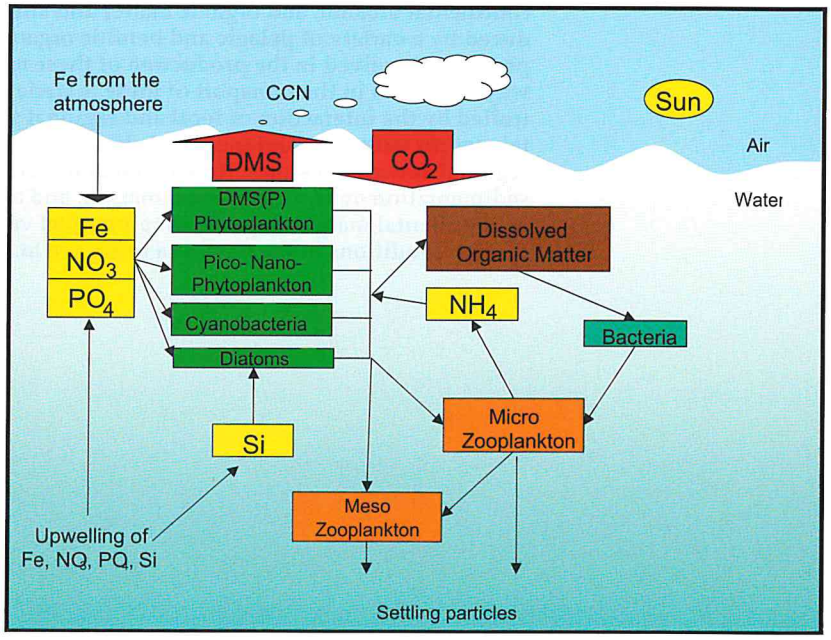
The overall objective of the IRONAGES project was to develop new realistic Ocean Biogeochemical Climate Models (OBCM's) for budgeting the exchanges of the greenhouse gases CO_2 and DMS (dimethylsulphide) between the atmosphere and the ocean. This was done by studying:

1) Effects of co-limitation by four nutrients (nitrogen, phosphate, silicate and iron) on 5 major taxonomic classes of phytoplankton,
2) DMS(P) pathways in the oceans,
3) global oceanic iron cycling,
4) different chemical forms of iron and
5) supply of iron from marine sediments and from atmospheric sources into the ocean.

Major scientific achievements were the quantification of iron input originating from anoxic sediments of coastal margins and quantification of aeolian iron input from Sahara-derived dust blown over the central Atlantic Ocean. The field campaigns for these quantifications were done on our research vessel Pelagia. In an experimental set-up, we could show that diatoms receiving extra desert dust grew considerably faster than the controls . We also discovered that the diatoms could utilise only a limited part of the dissolved iron from the dust. This was established by culturing the diatoms in seawater without dust, but with different concentrations of dissolved iron. The growth of the algae that received known quantities of iron was subsequently compared with that of the diatoms which grew on dust, thereby indicating the fraction of bio-available iron from the dust. These experiments were the first ever to show the causal effect of atmospheric dust on phytoplankton growth, with concomitant effects on exchange of CO_2 and DMS between the atmosphere and the surface ocean.

Literature studies were performed to observe lacks in knowledge on five groups of marine primary producers, including two major DMS producing colony-forming algae *Phaeocystis* sp. and calcifying *Emiliania huxleyi* , as well as three other major classes of marine phytoplankton: diatoms, N_2-fixing diazotrophs and small pico- and nanophytoplankton. Where lacks in knowledge were observed, additional experiments were done. These experiments focussed on the effects of N, P, Si, Fe and light limitation on the physiology of five phytoplankton groups. The ensuing know-how was used for improvement of an existing phytoplankton ecosystem model (SWAMCO). This, in combination of improvement and expansion of a global iron model was used for improvement of the existing ocean biogeochemical climate models, resulting in a better understanding of global CO_2 and DMS fluxes between the atmosphere and the ocean.

The main products of the IRONAGES project were publications in international, peer reviewed journals, oral and poster presentations at (inter)national conferences and/or seminars and a website (http://wwwold.nioz.nl/projects/ironages/index.htm) where detailed information on the results can be found.



Simplified cartoon of a marine ecosystem incorporating multiple phytoplankton species, CO_2, DMS, and Fe from sedimentary and atmospheric sources.

Cold water corals and carbonate mounds in the North Atlantic Ocean

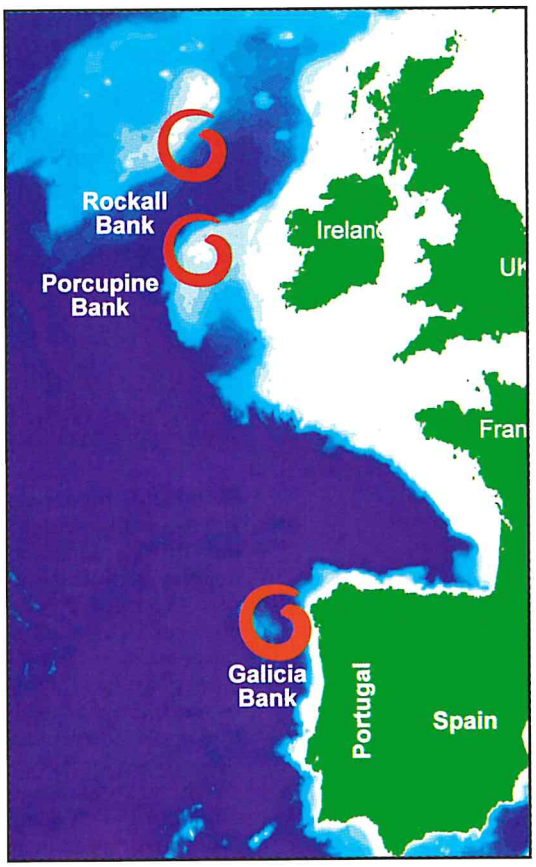
Contributors: Tjeerd van Weering, Gerard Duineveld (MEE), Marc Lavaleye (MEE), Henk de Haas, Henko de Stigter, Thomas Richter and Furu Mienis

Coral reefs are usually associated with the sunlit tropical coastal waters of the world. Cold water corals (although described in scientific papers for over a century) were found to build reefs of similar dimension as the tropical reefs in cold, deep, and dark waters of continental margins only recently. Numerous recent occurrences of cold water corals are concentrated in a belt along the European Atlantic margin, stretching from southern Spain to northern Norway at several tens to more then thousand metres water depth.

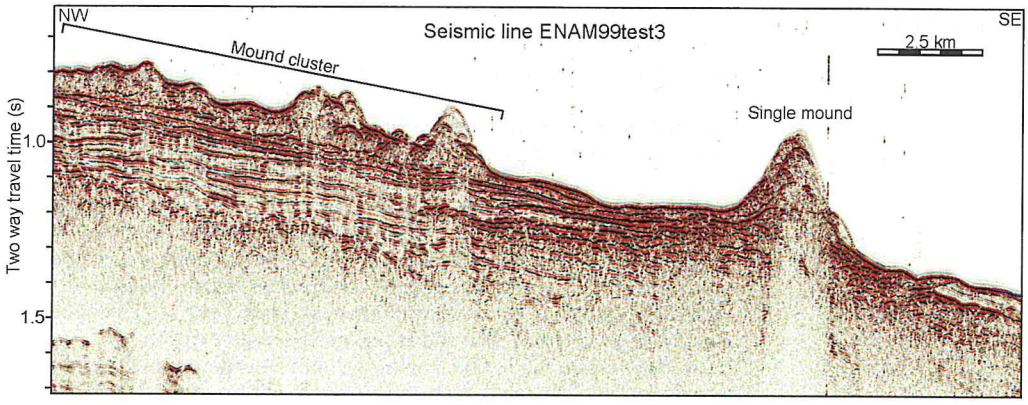
In the period 2000-2003, ecological, environmental and geological aspects of cold water corals found along the western European continental margin were investigated within the ACES, ECOMOUND and GEOMOUND projects, funded by the European Commission. The GEOMOUND project focused on the geological evolution of these mounds, while the major objective of ECOMOUND was to define their environmental controls and to study the processes involved in the development and distribution of these phenomena. The main goal of ACES was an environmental baseline assessment of the status of the deep-water coral community and to provide recommendations for future sustainable development of the European margin.

Within these international projects, the MCG department focused on the corals of giant carbonate mounds found on the margins of the southern Rockall Trough, situated W to NW of Ireland. In close co-operation with the European partners in these projects NIOZ, organised three cruises with R.V. Pelagia to the Rockall Trough. A NIOZ team also participated in the Caracole cruise with R.V. l'Atalante organised by IFREMER (Brest), during which the corals and carbonate mounds were studied using the ROV `Victor'. Within the framework of the ACES project the department of MEE made a study of the ecology of a cold coral community living at 800 m depth on top of Galicia Bank, a seamount off NW Spain. The area was visited during a number of cruises with the R.V. Pelagia.

The locations of the various research areas are shown on the map.



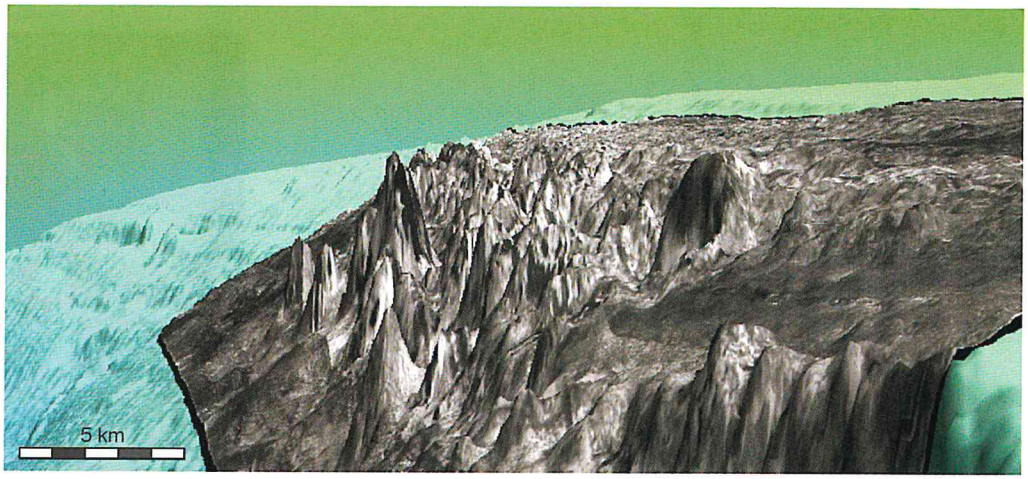
Map of the European margin with cold-water coral research areas indicated.



Part of seismic line ENAM99test3 located on the SW Rockall Trough margin showing a large single mound on the lower part of the slope and a cluster of mounds on the upper slope.

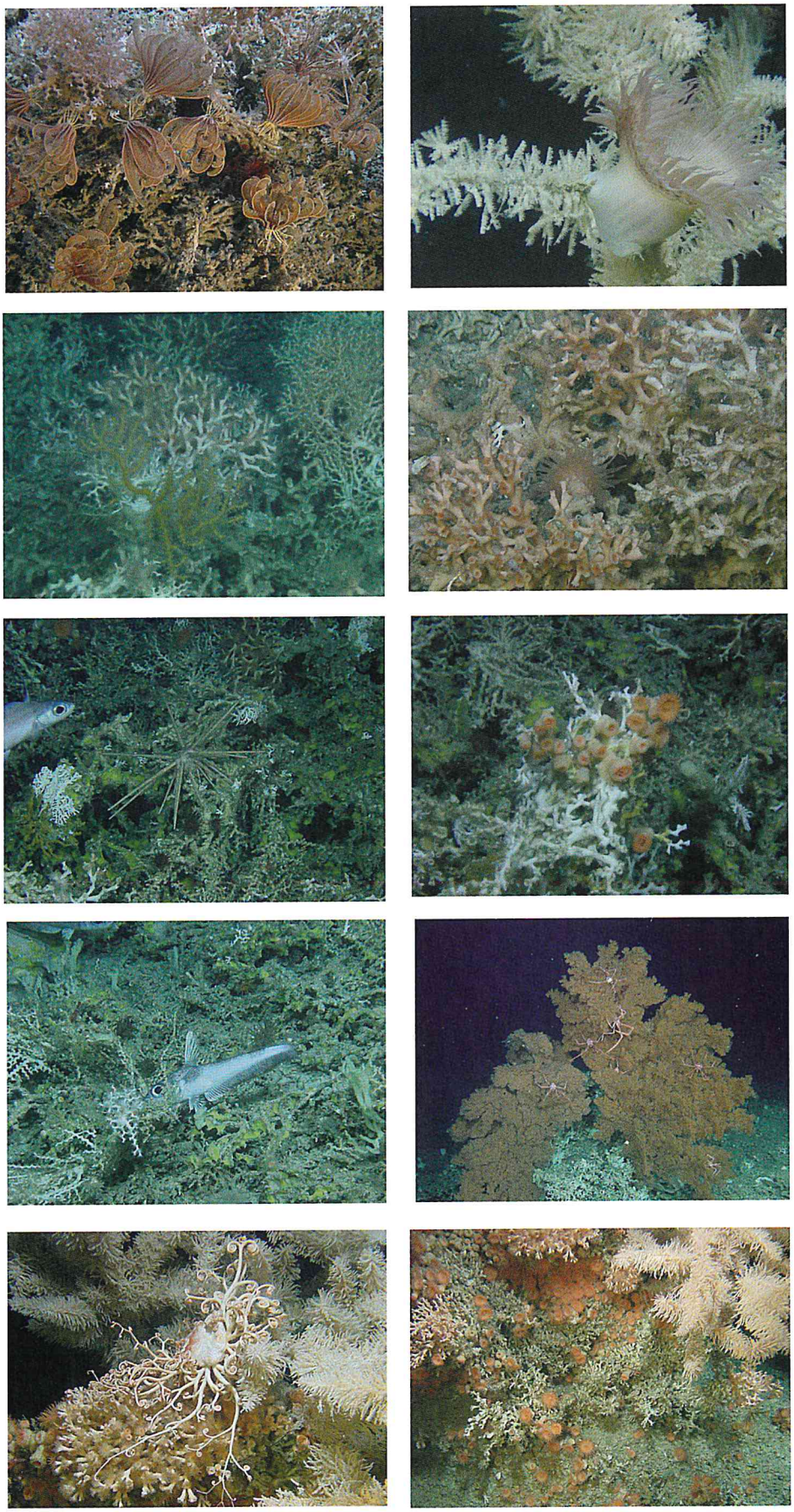
Giant carbonate mounds of the southern Rockall Trough

Whereas the first recordings of giant carbonate mounds on seismic profiles of the Rockall Trough (see example) seemed pure chance hits, more detailed echosounder surveying of the area showed that numerous mounds are present. These giant mounds range from a few tens to 350 metres in height and have a maximum diameter of several kilometres. The most striking images of the variety of mound morphologies present on the Rockall Trough margins were obtained during a survey with the TOBI side-scan sonar, operated by the Southampton Oceanography Centre, and carried out on board of the R.V. Pelagia. This survey showed a field of giant mounds on the SW Rockall Trough margin, stretching out more than 70 km between the 600 and 1000 m isobaths. To get an impression of the size of these mounds see the image of the side-scan sonar data draped over a 3D bathymetric map of the area. The mounds often occur in elongated clusters, separated from adjacent clusters by valleys oriented roughly perpendicular to the depth contours. Toward shallower depths a transition from giant to smaller mounds to coral-covered giant sand waves to active sand waves is observed. On the southeastern margin of the Rockall Trough mounds usually occur as isolated objects. Only one cluster of mounds has been observed on this part of the margin.



TOBI side-scan sonar image of the SW Rockall Trough margin draped over high resolution bathymetry of the area. View is towards the south-west. Water depth at top of the side-scan sonar image (grey) is 550 m, depth at lower boundary is 1300 m. The horizontal scale bar only applies for the front part of the image. Vertical exaggeration about 25 times. (Image in co-operation with the Southampton Oceanography Centre.)

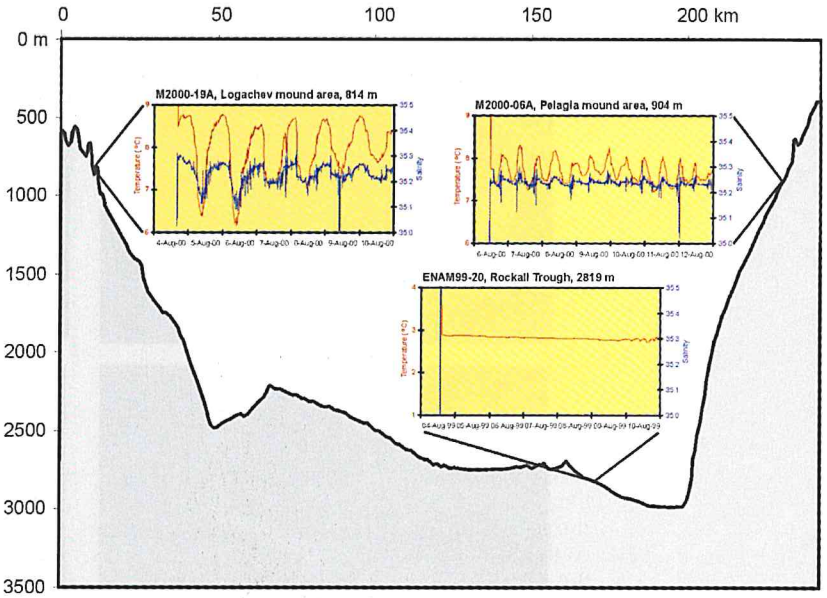
Photo and video imaging of the seabed reveals that the areas surrounding the mounds are often littered with pebble to boulder sized dropstones, derived from icebergs that drifted over the area during glacial times. The fact that these relicts from glacial times are not covered by recent sediments indicates that since the last glacial period no net sedimentation occurred. In the direct vicinity of mounds, dropstones are colonized by a variety of sessile fauna, such as sponges, octocorals, solitary hexacorals, bryozoans and brachiopods. Small isolated colonies of hexacorals are found. Travelling from the base towards the top of the mounds, the amount of coral debris and living coral increases. As is shown on the photographs, the summits of most mounds are marked by the presence of abundant living cold water corals (mainly *Lophelia pertusa* and *Madrepora oculata*) and associated fauna (other species of corals, brachiopoda, crinoids, pelecypoda, bryozoa, hydrozoa, echinoids, various types of shrimps, sponges, fish, etc.). Often the living corals are not evenly distributed but occur in decimetre to many metres sized patches alternating with dead colonies or coral debris. New coral colonies can settle on any hard surface present (dead corals, rocks, shells, hardgrounds, man-made objects dumped from ships,



Cold water corals and associated fauna at the Rockall Trough margins. Photographs taken with ROV Victor (copyright IFREMER).

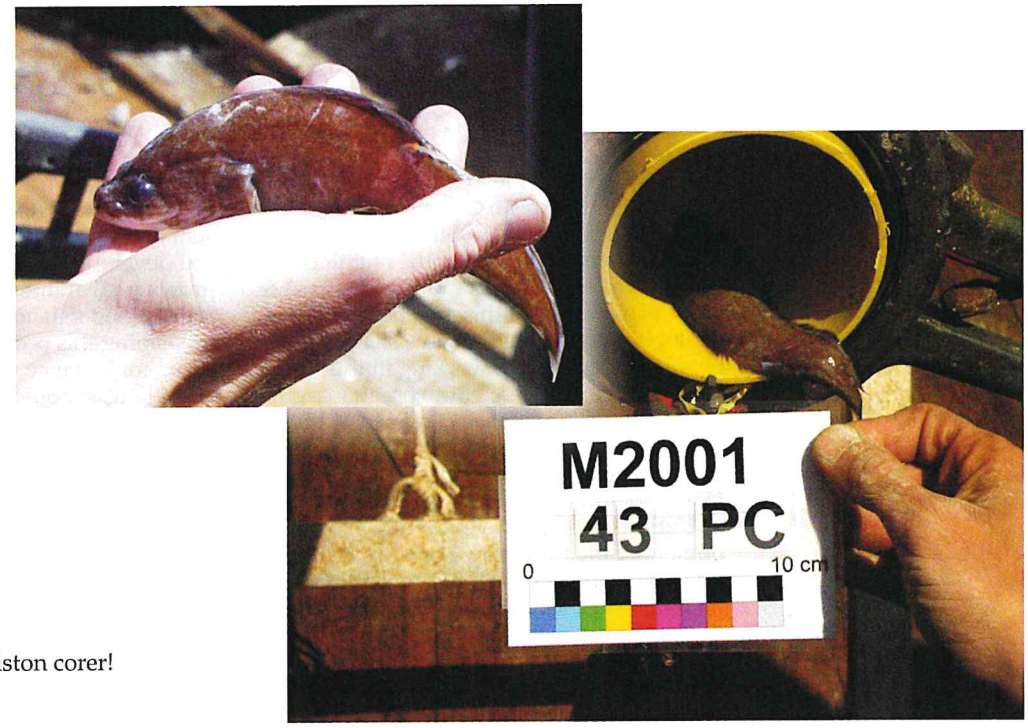
etc.). Seismic profiling, seabed photographs and video and core data suggest that the mounds are formed by baffling of sediment particles (predominantly skeletal debris of corals and other benthic animals and planktonic foraminifera) in the three dimensional coral framework. In this way sedimentation on the mounds occurs much faster than on the surrounding sea floor resulting in the vertical growth of the carbonate mounds.

The dominance of suspension feeding fauna on the carbonate mounds, and the presence of exposed glacial material on the areas surrounding the mounds, both indicate that the mounds are swept by relatively strong currents. This has been confirmed by observations made with free-falling benthic landers, recording near-bottom current velocity, temperature, salinity and turbidity on and in between mounds for periods of days up to one year. Examples of these measurements are shown plotted in relation to the position of the observations in the Rockall Trough. Instantaneous current speeds of between 10 and 20 cm s^{-1} on average were measured, with peaks exceeding 40 cm s^{-1}. Current directions showed a distinct tidal variation, of semi-diurnal frequency on the SE margin of Rockall Trough, and diurnal frequency on the opposite, SW margin. Associated with the tidal variations in bottom currents, temperature and salinity of the near-bottom water were found to fluctuate by more than 1°C and 0.1, respectively, on the SE margin, and by over 2°C and nearly 0.15, respectively, on the SW margin. CTD observations made concurrently with the benthic lander deployments showed that the near-bottom hydrodynamic regime is imposed by large tide-induced internal waves at the base of North Atlantic Current waters that flow northward through Rockall Trough. Observations on suspended particulate matter distribution over the mounds suggest that the tidal waves are active in transporting phytodetritus settled on shallower areas of the Rockall Trough margins downslope toward the mound areas. This phytodetritus is likely to be the prime food source for the cold water coral community.



Cross-section through the Rockall Trough, with bottom water temperature and salinity records obtained with the BOBO lander over a 7 days period at three different locations. Large diurnal temperature and salinity fluctuations were observed on the SW Rockall Trough margin (left), smaller semi-diurnal fluctuations on the SE margin (right), and fluctuations were negligible in the deep Rockall Trough (lower right). The salinity record at the latter location was unreliable.

An alternative hypothesis, explaining coral growth and mound formation as the result of microbial production fuelled by hydrocarbon seepage from the subsurface, has failed to be supported by evidence so far. Stable carbon isotope analysis on cold water corals in co-operation with the Free University of Amsterdam did not produce anomalous isotopic ratios that would support the hypothesis of a hydrocarbon-based food web. However, the fact that the corals presently living on the summits of the carbonate mounds appear to derive their existence from recent rather than fossil food sources does not preclude the possibility that the foundations of these mounds were laid under different conditions. Seismic profiling has revealed that the base of most of the mounds is located on a reflector that is most likely Late Early Pliocene (± 4.5 million years) in age. The question remains about what changes occurred during this period in the Rockall Trough that initiated the abundant growth of cold water corals. We hope to answer this question by drilling through a mound. It is planned that during the MOUNDFORCE program, started this year, strategic future drill sites will be selected.



Deep-sea fishing.....by piston corer!

Cold corals of Galicia Bank

The upper part of Galicia Bank is relatively flat except for the easternmost part which consists of a series of steep peaks along the precipitous eastern slope of the Bank. The flat part is covered by a thick layer of foraminifera ooze with a low organic content. The surface of the sediment consists of numerous small current ripples and occasional megaripples of ~50 cm height indicating mobile sediment and high current velocities. Under water video images show that the cold corals (*Lophelia pertusa, Madrepora oculata*) grow as isolated patches amidst the ripples of foraminifera sand and serve as shelter and substrate for a variety of organisms. The particle supply and carbon mineralisation in the coral community were studied with two benthic landers deployed for 18 months at Galicia Bank. The landers were equipped with sediment traps, flux chambers, current and turbidity meters. The sample record of the sediment trap revealed a large seasonal and annual variability in the flux of phytodetritus and carbon. The daily carbon flux in the first 5 months of 2000 was on average 37 mg C m^{-2} while in the same period of 2001 this was only 17 mg C m^{-2}. Quantities of fecal pellets and swimmers collected in the trap were highly variable as well as between years. A comparison between the daily carbon flux and the sediment carbon oxidation rate, i.e. 7 mg C m^{-2} d^{-1}, measured by in-situ community oxygen consumption (SCOC) indicate that a surplus of carbon is not oxidized in the sediment. Most likely the strong tidal currents (max. 30 cm s^{-1}) and the mobile sediment lead to winnowing of the sediment and near bed transport of the organic material. The low biomass of the benthic community and the dominance of filter-feeding organisms support this. To determine whether the corals on Galicia Bank thrive on particles imported from the upper water column or on an autochtonous food source fueled by seeping hydrocarbons, we analysed stable isotope contents ($\delta^{15}N$, $\delta^{13}C$) of particles in the sediment trap and of the coral tissue. The $\delta^{13}C$ value of coral tissue, -20.55‰, excludes a carbon source supported by methane seepage as earlier suggested for corals off the Norwegian coast. The $\delta^{15}N$ signature of the phytodetritus in the trap (2.2‰) was more than one trophic level lower that of coral tissue (9.5‰) indicating that sinking algae are not the sole food source. As polyps of cold corals have been seen catching zooplankton, the $\delta^{15}N$ signatures of swimmers (copepods, amphipods) caught in the trap were analysed in addition. The resulting values, ~10‰, were close to those of coral tissue. Possibly corals have a mixed diet of zooplankton and algae which would be an advantage in a habitat with large year to year fluctuations. Future analysis of other (lipid) tracers in coral tissue will hopefully provide further insight into food sources of the cold corals on Galicia Bank.

CONNECTING IRELAND TO NORWAY

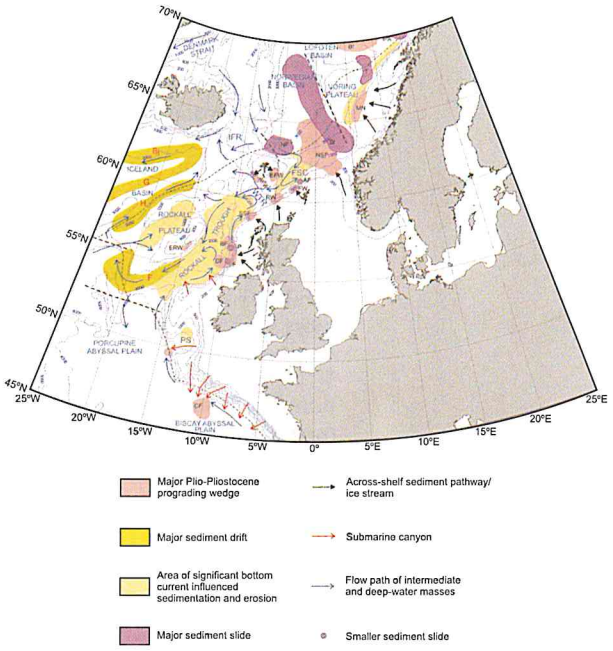
Stratigraphic Development of the Glaciated European Margin

Contributors: Henk de Haas, Tjeerd van Weering and Thomas Richter

From 2000 to 2003 the Royal NIOZ department of Marine Chemistry and Geology has participated in the European Commission funded Fifth Framework STRATAGEM project. `STRATAGEM' is the acronym of `Stratigraphic Development of the Glaciated European Margin'. A scientific interest as well as the ongoing economical development of the NW European margin (oil and gas exploration and exploitation) and a growing awareness of the need for a sustainable development of this area has increased the need to understand the nature and frequency of geological processes that have shaped and are still shaping this ocean margin. The safety of people and structures working in this offshore setting for instance requires knowledge of the nature of the risk inherent to ocean margins. Special interest should go to continental slope instability which is (partly) related to the rapid deposition of sediments during glacial periods. Unstable slope sediments provide a potential threat to offshore construction. One way of learning to understand the shaping of a margin like this is to develop a time scale, or stratigraphy, for geological events that have affected the margin.

Until recently however there was a lack of a regional approach to the stratigraphical development of the European glaciated margin. In order to solve this problem STRATAGEM was set up with partners from 7 European universities and research institutes and one partner from the oil industry. The STRATAGEM project has received further support from the oil industry through four joint industry projects that represent 31 oil companies working in the area covered by the project. The oil companies' support existed of financial support and mainly the supply of seismic and core data. In addition to the oil industry data, existing data at the individual partner institutes, publicly available data and new seismic and core data acquired during the project were used. The sedimentary packages from Lofoten in the north to the Porcupine margin in the south were defined and a unified stratigraphic framework and common terminology for the mid-Cenozoic (Mid- to Late Eocene, ±40 million years ago) to Recent sediments of the region was produced. Additionally a geological model for the evolution of the margin was produced.

The glaciated European margin can be divided into three main areas: the Porcupine-Rockall Trough area, the area around the Faeroe Islands and the Norwegian margin. Although each of these areas shows its own geological history and resulting deposits, all of them are influenced by some major large scale tectonic events that influenced the basin morphology and thus oceanography. This in turn resulted in the formation of major unconformities in the sedimentary record that could be used to make a margin wide stratigraphical correlation possible. From the Eocene until the Early Pliocene (±4.5 million years ago,) sedimentation along the entire margin was characterised by contourite and basin-floor drift deposition, so the formation of



Simplified map showing the main controls on sedimentation at the NW European margin during the Neogene (24 million years ago to recent). [After STRATAGEM Partners, 2002. The Neogene stratigraphy of the glaciated European margin from Lofoten to Porcupine.]

several tens to hundreds of kilometres long sediment bodies deposited by ocean currents following the depth contours or deep-water bottom currents. Around 4.5 million years ag,o a large scale plate-tectonic event is thought to have occurred, resulting in changes in margin morphology and thus ocean currents. This event is marked by the presence of an unconformity (break in the sedimentary record) along the entire investigated margin. After this event sediment drift formation continued, although locally the depocentres of the drifts and the focus of erosion changed. The most important change in sedimentary regime since 4.5 million years ago is the start of shelf margin progradation, so the oceanward growth of the shelf edge as a result of increased sediment supply, probably resulting from uplift of the continent, and thus increased erosion. The intensification of northern latitude glaciation during the Pleistocene (the period of the ice ages) resulted in an increased erosion of the continental rocks by the glaciers and thus increase in sediment supply to the shelf edge. Especially after the Mid-Pleistocene (0.9 million years ago) the glaciers themselves reached the shelf edge and large amounts of sediment were deposited, resulting in an increased shelf margin progradation. During interglacial periods (including the present day, the Holocene) not much sediment is transported to the shelf edge and bottom currents widely erode the sea bed. The thick sediment packages deposited during the ice ages sometimes became unstable (and might do so in the future) resulting in massive sliding events.

SURFACE-WATER CONDITIONS IN THE NORTHERN BENGUELA REGION (SE ATLANTIC) DURING THE LAST 460 000 YEARS

Contributors: S. (Bas) West and J. H. Fred Jansen

The Benguela region near the coast of Africa in the SE Atlantic Ocean is one of the world's largest coastal upwelling areas. It plays a vital role in the transfer of heat and salt from the Indian Ocean into the Atlantic Ocean, which is a critical factor in driving the global conveyor belt. Thus, the variations in the Benguela Current system, can affect our climate on a global scale. Other important features are the leakage of warm Angola Current (AC) water from the north, and the influence of variations in the southern Benguela upwelling region introduced by the Benguela Current (Fig. 1 left). South of Walvis Ridge, the Benguela Current (BC) splits in a coastal (Benguela Coastal Current, BCC) and an oceanic branch (Benguela Oceanic Current, BOC). We applied planktonic foraminifera, a group of zooplankton producing calcitic tests, to investigate the variations of the surface water masses in the region and their driving forces. The foraminifera tests were sampled from the core ODP 1083 collected during Leg 175 of the Ocean Drilling Program in (1997).

The different foraminifera species in the surface sediments appear to reflect the major watermasses in the area (Fig. 1). *Neogloboquadrina pachyderma* (left + right coiled) mirrors the nutrient-rich coastal upwelling, the left-coiled species mirroring the coldest conditions of the two. *Globorotalia inflata* indicates the cold BOC, a group of tropical species the more oligotrophic central South Atlantic, and Globigerina bulloides the transitional environment between the upwelling cells and the BC.

During the last 460 000 years, archived in the upper 44 m of the core, the strongest variations are in the upwelling intensity as shown by the abundance record of *N. pachyderma* (l+r) (Fig. 2). The upwelling is orbitally controlled by Milankovic insolation cycles, with the strongest upwelling and highest productivity during glacial and precessional maxima (cycle period 100

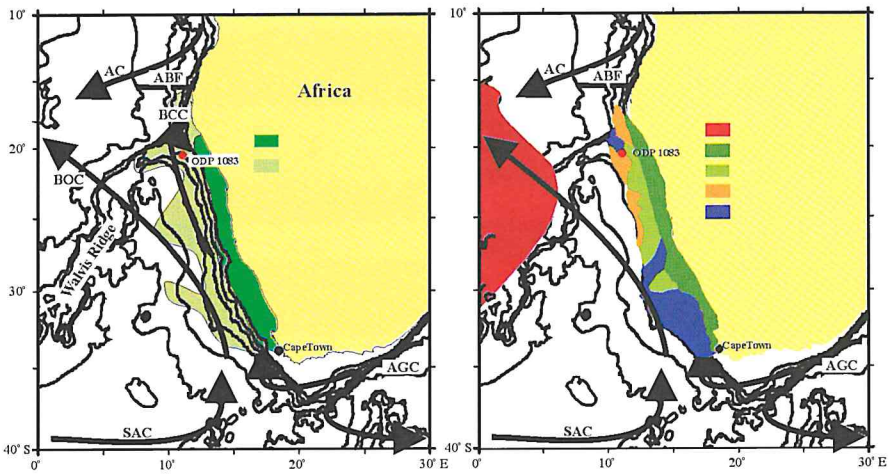


Fig. 1. Hydrographic features in the surface waters (left) compared with the actual distribution of planktonic foraminifera in the surface sediments (right) in the Benguela region, and location of core ODP 1083.

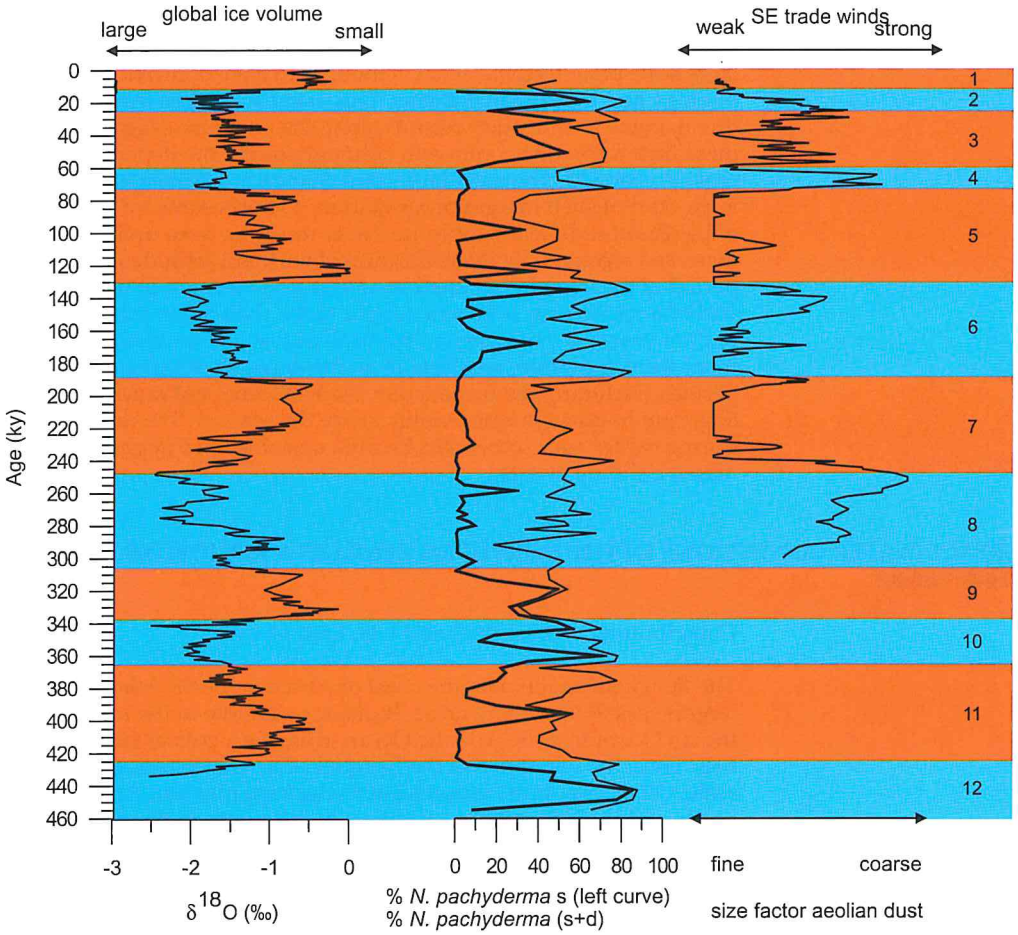


Fig. 2. Abundance of the upwelling species N. pachyderma (left coiled) and N. pachyderma (left + right coiled) compared with the grain size of the aeolian dust. The grain size reflects the strength of the SE trade winds. The global climate history is indicated by the δ18O of *G. inflata* in a nearby core. Red and blue time intervals represent interglacial and glacial stages respectively.

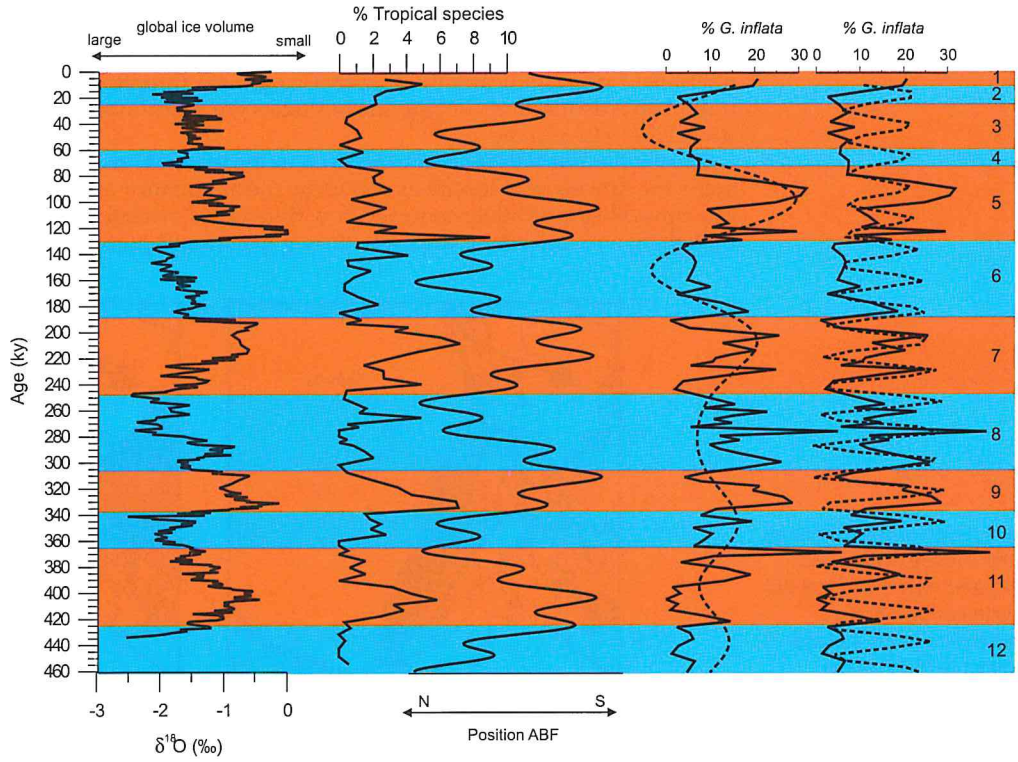


Fig. 3. Middle: Abundance of the tropical species compared with the predicted N-S movements of the Angola Benguela Front (ABF).
Right: Abundance of *G. inflata* and its 100-ky and 23-ky filtered components. The global climate history is indicated by the δ18O of *G. inflata* in a nearby core. Red and blue time intervals represent interglacial and glacial stages respectively.

and 21 thousand years (ky) respectively). The upwelling signal correlates well with the strength of the SE trade winds, showing that stronger atmospheric gradients intensify the trade winds and upwelling during glacials. The *N. pachyderma* (right) record appears to deviate from the upwelling record. This suggests variations in the temperature of the waters rising from the deep that are caused by variations in the stratification of the water column in the central South Atlantic, the source of this water.

The increase and decrease of the upwelling intensity explains partly the downcore pattern of the tropical species (Fig. 3). During strong upwelling, the cold and nutrient-rich waters suppress the influence of the warm, low-nutrient water masses from the South Atlantic current (SAC). There is, however, a phase difference being most obvious in glacial maxima, where the minima of the tropical species precede the maxima of the global ice volume and upwelling by 15 to 20 ky. This phase difference indicates warm AC-water intrusions from the north following the N-S movements of the Angola Benguela Front (ABF) which explains why the minimum sea-surface temperatures occurred 45-50 ky BP, 30 ky before the last glacial maximum, when the ABF was at its northernmost position. The signal of the ABF movements deviates from the global ice-volume record because there is no orbital 41-ky obliquity component, a typical high-latitude Milankovic periodicity. To test the AC origin of the tropical foraminifera species, we extrapolated the ABF movements back to 460 ky BP. The extrapolation shows a good agreement with the tropical record, and appears to predict the lead of its 15-20-ky lows over the maxima in global ice volume.

The influence of the Benguela Oceanic Current (BOC), indicated by *G. inflata* (Fig. 3), depends for a large part on the local wind strength and direction, and the associated upwelling system. When the upwelling intensifies, the influence of the BOC reduces. Moreover, more zonal trade winds cause a more zonal BOC. Consequently, the contribution of the BC increases during interglacials when the upwelling was weaker and the BOC more N-S. This is particularly true for the last 200 ky, when maxima of *G. inflata* occur during warm and interglacial periods. *G. inflata* also shows a long-term change at 250-200 ky BP, from a high-frequency variation related to the earth's precession and obliquity cycles to a lower one dominated by the eccentricity cycle (Fig. 3). This change is observed neither in the upwelling indicators nor in the tropical species. A similar transition, observed in the Southern Cape Basin, suggests a long-term southward shift of the Antarctic circumpolar fronts around that time. We hypothesise that a shift of these fronts has changed the dominant frequencies. When the fronts were situated relatively north, the smaller high frequency movements of these fronts could be transferred to the BC. When, however, the fronts were situated further away to the south, the movements were less readily recorded in the BC. In this way, the position of circumpolar fronts may regulate the inflow of Indian Ocean water, subpolar water, and water from the transitional zone between the subtropical and sub-Antarctic water masses into the BC.

CHEMICAL REACTIVITY/MOBILITY OF METALS IN THE SCHELDT ESTUARY

Contributor: Loes Gerringa

During a cruise with R.V. Navicula in March /April 2002 concentrations of dissolved Cd, Zn, Mn and Fe in 2 size fractions (<0.2μm and < 10kDa) were measured in order to understand their chemical reactivity in the estuary during transport to sea. Changes in salinity, and oxygen are important parameters for the chemical forms of the metals, but UV radiation might also be of importance due to photo-chemical reactions. The chemistry of dissolved Fe, colloid formation and complexation characteristics, was studied more intensively. The chemistry of Fe is completely depending on the oxygen concentration and dissolved organic matter (ligands), which are the variable parameters in the estuary.

The fine fraction (<10 kDa) contained almost all of the dissolved metals, with the exception of Fe (fig 1). Apparently dissolved Fe consisted for a large part of colloids >10 kDa. In the upper estuary the increase of the oxygen concentration with increasing salinity governed the concentration of the dissolved metals by oxidation of sulphides (Zn, Cd) and precipitation/colloid formation of oxides (Fe and Mn). In the middle and lower estuary complex formation ruled the dissolved metal concentration. The formation of chloride complexes increased the solubility and thus mobility of Cd and the presence of dissolved organic ligands permitted high concentrations of dissolved Fe and Zn. For Fe the concentrations of these dissolved organic ligands are equal to or a little smaller than the dissolved Fe concentrations in both size fractions (<0.2μm and < 10kDA) and this concentration decrease steeply with salinity as does the dissolved Fe concentration.

In the middle estuary Fe seemed to be more firmly complexed by the dissolved organic ligands, perhaps even irreversible complexed. The reason is probably the colloidal character of these complexes.

UV irradiation with intensities and wavelength distribution of the solar spectrum did not influence the dissolved ligand concentration of Fe-complexes.

The data indicate that the precipitation rate decreased with decreasing salinity, however the trend was not found to be significant. No precipitation occurred in the samples of a salinity of 0.3, <0.2 μm. We concluded that a high concentration of weak ligands prevented precipitation here. These weak ligands cannot be measured by conventional techniques.

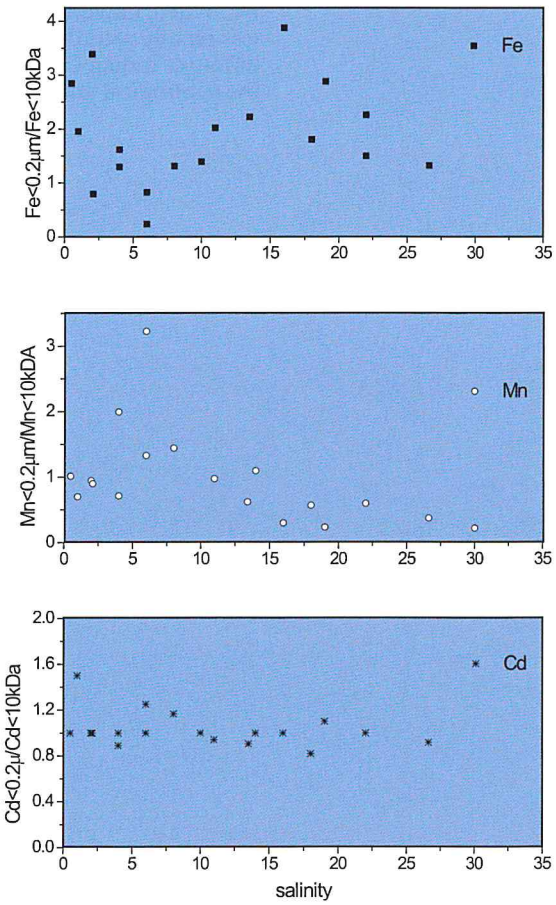


Fig. 1. The ratios of the dissolved concentrations of Fe, Mn and Cd in the size fractions <0.2μm and <10 kDa with salinity in the Scheldt estuary.

EXTERNAL PROJECTS OF THE DEPARTMENT OF MARINE CHEMISTRY AND GEOLOGY

- MARE-C (Mixing of Agulhas Rings Experiment): Palaeoceanographic observations of the Agulhas Ring Corridor (NWO-CLIVAR).
  G.-J.A. Brummer, J.H.F. Jansen, F.J.C. Peeters, N. Loncaric.
- CORTEX (COrescanner TEXel) (University Bremen).
  J.H.F. Jansen, S.J. van der Gaast, B. Koster, A.J. Vaars.
- NEBROC (Netherlands Bremen Oceanography) (Ministries of Science of Germany, Land Bremen and the Netherlands).
  J.H.F. Jansen, E. Koning, N. Loncaric, G.J.A. Versteegh.
- Tropical environmental change and its teleconnections during the last deglaciation: a lipid biomarker study dated with ^{14}C wiggle-matching. (NWO).
  G.J.M. Versteegh & J.H.F. Jansen, M. Rietkerk.
- Atlantic Coral Ecosystem Study (ACES EU-MAST).
  T.C.E. van Weering, H.C. de Stigter, H. de Haas.
- The internal mound factory (GEOMOUND EU-MAST).
  T.C.E. van Weering, H.C. de Stigter, H. de Haas.
- Environmental Controls on Mound formation along the European margin (ECOMOUND EU-MAST).
  T.C.E. van Weering, H. de Stigter, H. de Haas.
- Stratigraphical Development of the Glaciated Atlantic Margin (STRATAGEM EU-MAST).
  T.C.E. van Weering, H. de Haas, T. Richter.
- Carbon Cycle, Biological Forcing I (NEBROC).
  H.J.W. de Baar, K.R. Timmermans.
- Carbon Cycle, Biological Forcing II (NEBROC).
  H.J.W. de Baar, J. Kramer.
- Coastal and Continental Margin Processes (NEBROC).
  W. Helder, H.J.W. de Baar, H. Thomas.
- Iron resources and oceanic nutrients — advancement of global environment simulations (IRONAGES, EU-MAST).
  H.J.W. de Baar, P. Croot, K.R. Timmermans.
- COMET (EU-MAST).
  H.J.W. de Baar, L. Gerringa.
- Positive feedback of enhanced UV-B via the iron chemistry on the fixation of CO_2 in the Southern Ocean (NWO-NAAP).
  L.J.A. Gerringa, H.J.W. de Baar, M. Rijkenberg.
- The continental shelfpump: a pilot study in the North Sea (CANOBA, NWO-ALW).
  H. Thomas, H.J.W. de Baar.
- 6C (EU) WP 2.
  G.-J.A. Brummer, S. Schouten.
- Processes on the Continental Slope, zonation of settling fluxes (PROCS II, NWO-ALW).
  W. van Raaphorst, G.-J.A. Brummer, J. Bonnin, E. Epping.
- Enhanced carbon mineralization rates in permeable sandy sediments (EMIR, NWO-ALW).
  W. van Raaphorst, E. Epping.
- Key processes controlling biogenic silica preservation in marine sediments (NWO-ALW).
  E. Koning, E. Epping.
- MOVE!, a MObile VEhicle for long-term benthic research (NWO/BMBF).
  J.W. de Leeuw, W. van Raaphorst, G. Duineveld, R. Groenewegen, E. Epping.
- Canyons (NEBROC, NWO, EU).
  T.C.E. van Weering, H. de Stigter.
- Red River Delta Project, Vietnam (WOTRO/NWO).
  T.C.E. van Weering, G. v.d. Bergh.
- Climate history, North Atlantic (NEBROC).
  T.C.E. van Weering, T. Richter.
- East Kalimantan Project.
  G. v.d. Bergh, T.C.E. van Weering.
- PACLIVA, Palaeo Climate Variability.
  T. Richter, T.C.E. van Weering.
- ESONET, European Seafloor Observatory Network.
  T.C.E. van Weering, V. Karpen.
- MOUNDFORCE.
  T.C.E. van Weering, H. de Haas.
- "Divalent cations: development and validation of proxies", NWO-DFG Bilateral Cooperation Programme.
  G.-J.A. Brummer, R.P.M. Bak.

The department MBT addresses a field of research at the interface of the basic disciplines of chemistry, geology and biology. The basic questions are:

1. Which organic compounds of either natural or anthropogenic origin are present in the different compartments (biota, sediment, water) of the marine environment ?
2. What are the reaction pathways involved in their biosynthesis, biotransformation and diagenesis?
3. What are the reaction kinetics and how are these influenced by environmental conditions?
4. In the case of biogeochemistry: when did the reactions take place (geological component)?
5. In the case of toxicology: what are the biological effects of the observed concentrations of the parent compounds and their reaction products?

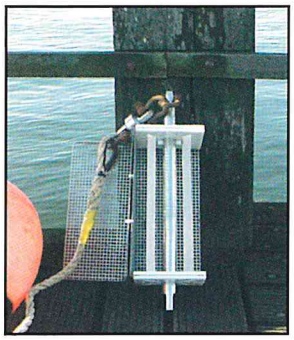
The research is divided into the two departmental themes, i.e. 'Biogeochemistry' and 'Environmental Chemistry & Ecotoxicology'. Both are intimately connected to the NIOZ prioritized research area 'transfer of energy and matter in the coastal, continental shelf and continental slope systems' and supply information that is vital to understand the impact of man's actions on ecosystems. A large part of the biogeochemical research is also closely related to the second NIOZ priority 'marine system variability through time'.

After the move of the marine biogeochemistry laboratory end of 2002, the new lab facilities were extensively used for the first time in 2003. All people working in the new facilities are very enthusiastic: they offer excellent conditions for state-of-the-art molecular biogeochemical analyses. Our advanced analytical equipment is performing much better since the analytical laboratory is characterized by constant environmental conditions. In 2003 our analytical equipment was also substantially expanded by two grants from the NWO-Middelgroot program for the acquisition of an LC-triple-quadrupole MS for the analysis for the analysis of polar and high-molecular-weight lipids and GC-time-of-flight MS for the ultra rapid analysis of biomarkers for palaeoclimate studies. Both instruments have been installed in the laboratory end of 2003 and are expected to be fully operational in spring 2004.

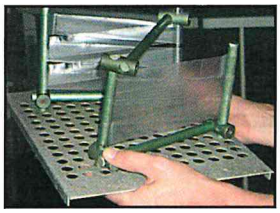
Three PhD students defended their thesis successfully in 2003, all at the University of Utrecht, Department of Earth Sciences. In January 2003, Enno Schefuß presented his thesis work on the use of biomarkers in the determination of the palaeo-environmental effects of the Mid-Pleistocene Transition in the tropical Atlantic and equatorial Africa, a nice collaboration between the MCG and MBT departments. In February 2003, Bart van Dongen, who was funded by the NEBROC program, defended his work on preservation of carbohydrates through sulfurization in marine sediments. Rienk Smittenberg got his degree in September 2003 on his thesis on the use of compound-specific ^{14}C dating in palaeoenvironmental reconstructions of fjord environments. Other outstanding scientific results of 2003 were the publication of two *Nature* papers with strong MBT involvement. One by a group of German and Dutch biogeochemists and microbial ecologists on the identification of the bacteria responsible for the anaerobic ammonium oxidation in the Black Sea water column and the impact of this process for the oceanic nitrogen cycle (Kuypers et al. 422, 608-611). The other (Schefuß et al., 422, 418-421), authored by NIOZ scientists from MBT and MCG, on the important role of tropical sea-surface temperatures on south African vegetation in the mid-Pleistocene. In 2003 MBT also became actively involved in the LOCO project through the involvement of Kees Booij, who intends to study the role of ocean currents in the worldwide transport of anthropogenic organic components by attaching SPMD sampling devices to moorings available in the LOCO program. Two other important research programs ended in 2003: the STW-funded project on the lipids of marine diatoms and the NAAP-funded project on the combination of lipid biomarker and fossil DNA in the reconstruction of Holocene environmental changes in Antarctic fjords and lakes. A detailed account of the results obtained in these projects is given below.

ORGANIC CONTAMINANT FATE ASSESSMENT WITH PASSIVE SAMPLERS

Contributors: Kees Booij, Ronald van Bommel



Semipermeable membrane devices, mounted for concentration measurements in water (top) and air (bottom).



Mankind produces a large number of different organic chemicals that are released into the environment. These compounds become globally dispersed via atmospheric transport and river and ocean currents. Losses from the biosphere occur via condensation in the Arctic and Antarctic environment during atmospheric transport, or via sedimentation (after sorption to suspended matter) during oceanic transport. Once polluted, marine sediments can act as secondary sources of contaminants, when the input of these compounds has ceased. Similarly, ocean surface waters can act as either sources or a sinks of contaminants relative to the atmosphere. Concentration measurements in the pore water, the water column, and the atmosphere can provide information on the direction of transport between these phases, and may ultimately allow for the estimation of fluxes across the interfaces.

The determination of the truly dissolved fraction of organic contaminants in water and air by traditional filtration/extraction techniques is a difficult task, due to the low concentrations, the high affinity of dissolved and vapour-phase contaminants to adsorb to sampling equipment, and incomplete phase separation between particle-bound and dissolved/vapour-phase analytes. These methodological difficulties are even more pronounced when concentrations of dissolved contaminants are to be determined in pore waters, because large volumes of pore water have to be isolated, and because of the high concentrations of small particles in these samples, which makes it virtually impossible to establish a significant degree of phase separation between dissolved and particle-bound contaminants.

Over the past decade, passive samplers have successfully been used to circumvent these difficulties. These samplers consist of an organic polymer strip, or a polymer tubing filled with a high-molecular weight organic liquid. Polymers used for this purpose are low-density polyethylene, or silicone. The working principle of these samplers is that organic contaminants are absorbed at a rate that is linearly proportional to their aqueous or vapour-phase concentration. The sampling rates are calibrated in-situ by monitoring the dissipation of reference compounds that do not occur in the environment, and that are spiked into the samplers prior to exposure. These samplers can be used in air as well as in (pore) water.

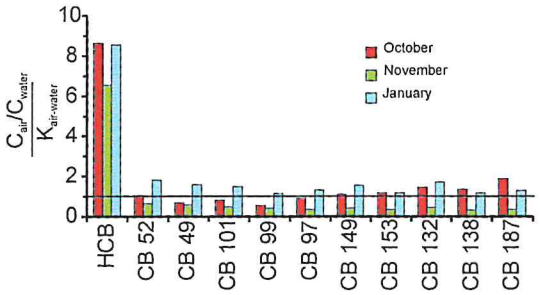


Fig. 1. Ratio of air/water chemical activity in the Marsdiep, Winter 1996-1997. The horizontal line represents the equilibrium ratio (Cair/Cwater equal to the air?water partition coefficient, Kair?water. A fair degree of equilibrium is observed for PCBs. Hexachlorobenzene is oversaturated in the atmosphere by a factor of ~8.

Simultaneous sampling of water and air in the Western Wadden Sea revealed that a fair degree of air-water equilibrium existed for polychlorinated biphenyls (Fig. 1). By contrast, the atmosphere was oversaturated relative to the water phase by a factor of about eight for the pesticide hexachlorobenzene. Similar findings were found for hexachlorobenzene during the Pelagia Around Africa cruise in 2001, where both water and atmosphere were sampled en route, on the transect Texel - Cape Town. A fair degree of air-water equilibrium was observed around the equator (Fig.3). Away from the equator, air was supersaturated with this compound, relative to the water phase, by a factor of two to four. Aqueous concentrations were higher in the northern transects than in the southern transects by a factor of two.

The extent of contaminant equilibrium between surface sediments and overlying water was assessed in two contaminated harbours. Equal aqueous concentrations are expected when equilibrium exists between the overlying water and the pore water. Instead, both sediments could be identified as secondary sources of contamination of the water phase for most compounds (Fig. 3). Concentrations in the pore water exceeded their equilibrium values up to a factor of 45.

Present efforts are directed towards assessing vertical and horizontal contaminant distributions in the open ocean, in order to understand the role of deep ocean currents in the global cycling of organic contaminants.

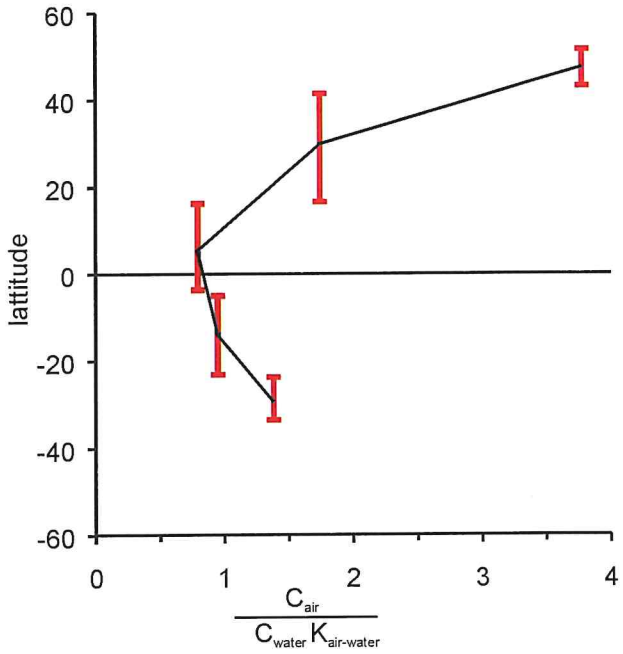


Fig. 2. Ratio of air/water chemical activity of hexachlorobenzene on a transect from Texel to Cape town (Jan/Feb 2001). The bars represent the latitude range over which air and water were sampled. Values >1 indicate that the atmospheric concentrations are larger than expected on the basis of the aqueous concentrations.

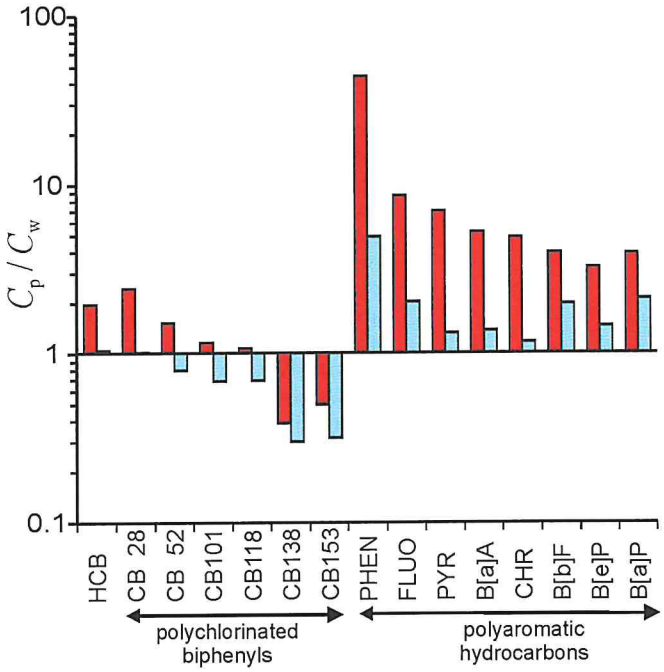


Fig. 3. Ratio of concentrations of hexachlorobenzene (HCB), polychlorinated biphenyls and polyaromatic hydrocarbons in pore water and overlying water in the harbours of Harlingen (red) and Delfzijl (blue) in October/November 1999. Upward directed bars are indicative of pore waters that are oversaturated relative to the overlying water (i.e. sediments as a contaminant source).

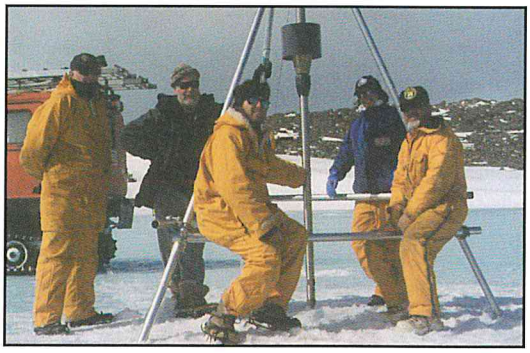
A HISTORICAL MOLECULAR RECORD OF HOLOCENE ENVIRONMENTAL CHANGES FROM ANTARCTIC SEDIMENTS OF STRATIFIED FJORDS AND LAKES.

Contributors: M.J.L. Coolen, G. Muyzer (BIO, currently at the technical University Delft), S. Schouten, J.K. Volkman, J.S. Sinninghe Damsté

Various post-glacial lakes of varying salinity, chemistry and biology are located in the Vestfold Hills, a 400 km^2 ice-free oasis in eastern Antarctica. Ace Lake is the best-studied water body in the area and went through several stages during its development. Ace Lake was originally a melt-water filled freshwater lake that became saline due to connection to the sea resulting from the Holocene deglaciation and sea-level rise, but it became subsequently isolated again due to uplifting of the entire Antarctic continent. After its re-isolation, new melt water was introduced causing stratification of the water column and the formation of anoxic, sulfidic, sulfate-depleted, and methane-saturated bottom waters. We expected that these climate-induced variations in the chemical and physical characteristics of the water column would have had a great impact on the diversity and abundance of species which thrived in the ancient water column of Ace Lake.

Fossilized organic components in sediment layers provide an archive of ancient aquatic microbial communities and hence can be used to reconstruct variations in climate and their impacts on the microbial biodiversity. However, the interpretation of these data is complicated by the limited source specificity of some traditional biomarkers, such as lipids and pigments. The ultimate biomarkers would be the genes coding for small sub-unit ribosomal RNA (SSU rDNA), which sequences provide information at the species-level by phylogenetic comparison. However, until now it was generally believed that labile biomacromolecules such as DNA become rapidly degraded even in anaerobic sediments.

During the field trip to the Vestfold Hills in the Austral summer of 2000, a 150-cm-long sediment core (spanning 10,450 years of deposition) was obtained from the depocentre of Ace Lake in order to study the composition of traditional lipid biomarkers and extant- as well as fossil rRNA genes. This revealed information about current and ancient biogeochemical processes and the organisms involved. These data were compared with the pool of lipids and rDNA obtained from the water column of Ace Lake which represented the extant biogeochemical processes and the organisms involved. Lipids were analyzed by gas chromatography (GC), GC-mass spectometry (GC-MS), and high performance liquid chromatogrphy (HPLC) with UV or MS detection. The environmental rRNA genes were amplified by PCR using domain- as well as newly developed group-specific primers, the latter to lower the detection limit for rare and possibly fossil rDNA of organisms which colonized the ancient water column. The obtained rDNA fragments were separated by DGGE and subsequently sequenced for phylogenetic comparison.



The following molecular remains were analyzed and discussed

Remains of green sulfur bacteria (GSB)

Within the chemocline of the present water column, high concentrations of chlorobactene were found. This carotenoid is known to be solely biosynthesized by some species of the GSB. All GSB are obligate anoxyphototrophs and depend on light and sulfide for growth. Since light is absent for the water layers below the chemocline and from the sediments, their molecular remains must be of fossil origin. Therefore, the fossil remains of GSB in sediments are indicative for density stratification of the water column and the presence of anoxic, sulfidic bottom water in the past. Chlorobactene was absent from the oldest sediment layers which were deposited at times when Ace Lake was still a freshwater lake that had not been in contact with the southern Ocean (unit III, Fig. 1a). The introduction of seawater into Ace Lake 9,400 years before present (BP) was a slow process leading to partial and occasional stratification of the water column and the occasional development of GSB (unit II, Fig. 1a). However, the amount of chlorobactene increased dramatically during the final 5,700 years. This indicated that Ace Lake was again no

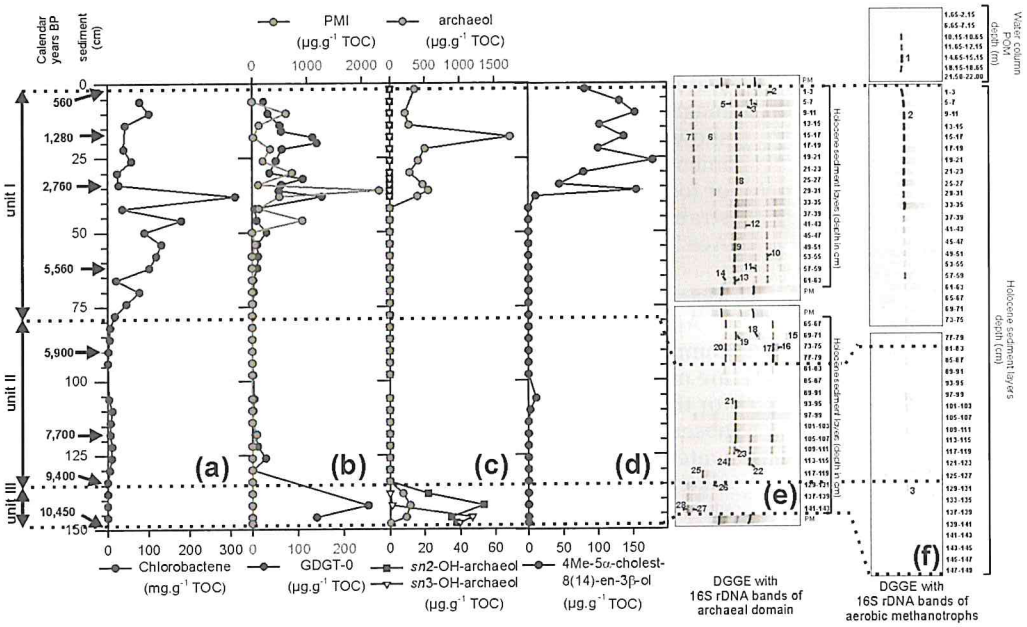


Fig. 1. Lipid biomarker and 16S rRNA gene stratigraphy indicative of euxinic conditions and the Holocene methane cycle in Ace Lake. (a) Chlorobactene (mg.g^{-1} TOC) indicative of fossil obligate photolithotrophic green sulfur bacteria derived from the ancient sulfidic chemocline. (b) glycerol dibiphytanyl glycerol tetraether (GDGT)-0 membrane lipid ubiquitous for archaea, and 2,6,10,15,19-pentamethylicosane (PMI) of methanogenic archaea (μg.g^{-1} TOC). (c) Diether membrane lipids (μg.g^{-1} TOC) ubiquitous for archaea (archaeol), as well as methanogens of the orders *Methanosarcinales* and *Methanococcales* (sn-2-hydroxyarchaeol and sn-3-hydroxyarchaeol). (d) 4-methyl-5a-cholest-8(14)-en-3b-ol (μg.g^{-1} TOC) derived from aerobic methane oxidizing bacteria (*Methylococcaceae*). (e) DGGE-profile of archaeal 16S rRNA genes recovered from the Holocene sediment layers. (f) DGGE-profile of 16S rRNA genes from aerobic methane-oxidizing bacteria recovered from the POM of the water column as well as the Holocene sediment layers. Twenty-eight archaeal and three methanotrophic sequences (indicated by numbers in Figs. e and f) were recovered from both DGGEs and used for phylogenetic comparison (data not shown).

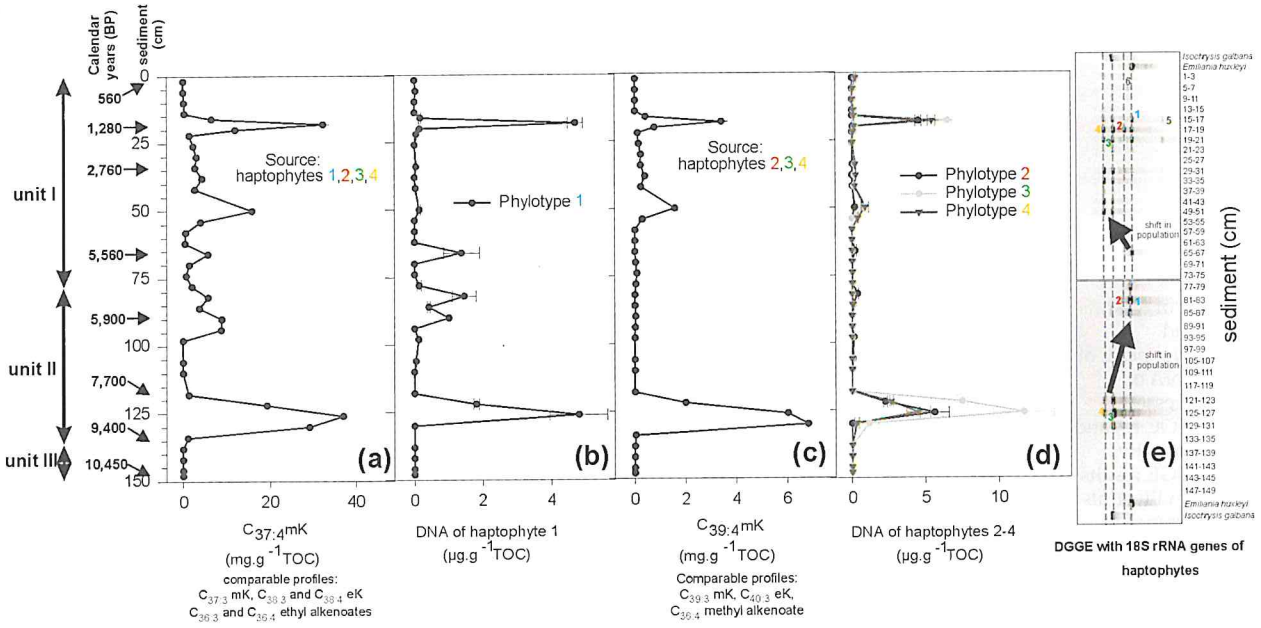


Fig. 2. Depth profiles of selected alkenones [$C_{37:4}$ methyl alkenone (a) and $C_{39:4}$ methyl alkenone (c)] and phylotypes of haptophytes most likely to be the source of these alkenones (b,d). Also shown are the DGGE results (e); the arrows in the DGGE indicate shifts in the haptophyte populations. The dashed vertical lines indicate identical melting behaviour of phylotypes 1 to 4 throughout the gel. For comparative analysis, PCR products of reference strains of the haptophytes *Isochrysis galbana* CCMP1323 and *Emiliania huxleyi* str. L were separated by DGGE along with the sediment samples. Unit III: freshwater lacustrine period. Unit II: Due to the rising sea level caused by Holocene deglaciation, marine waters with haptophytes entered Ace Lake. Unit I: Present-day meromictic saline lacustrine system with euxinic conditions as indicated by molecular remains of green sulfur bacteria (data presented in Fig. 1a).

longer connected to the ocean and received melt water resulting in a stable, permanent stratification of the water column where GSB could flourish (unit I, Fig. 1a). We found that the ratio between DNA and the carotenoid chlorobactene within the cells of green sulfur bacteria at a water depth of 18 m, where light for anoxygenic photosynthesis was absent, was 2 orders of magnitude lower compared to the cells thriving within the photic, sulfidic chemocline. This showed that a substantial part of the DNA was degraded in dead cells settling towards the sediment. Nevertheless, enough DNA of GSB survived in the Holocene sediments and the analysis of fossil 16S rDNA of green sulfur bacteria showed that the same chlorobactene-producing strain (related to *Chlorobium phaeovibrioides*) colonized the sulfidic and photic water layers of Ace Lake during the last 9,400 years.

Molecular remains of haptophyte algae

Alkenones and alkenoates, specific lipid biomarkers of haptophyte algae, were dominant compounds in many of the analyzed sediment layers of Ace Lake (Fig. 2a,c). Since haptophytes are mainly associated to brackish and marine environments, their fossil remains were indicative for the introduction of seawater into Ace Lake. As expected, alkenones and alkenoates were absent from the sediment layers of the freshwater period (unit III) and first peaked as marine waters slowly entered Ace Lake, 9,400 years BP (Figs. 2a,c). The presence of alkenones and alkenoates directed us to develop primers for the specific and sensitive amplification of fossil rDNA of haptophytes. Six different phylotypes of haptophytes were identified throughout the Holocene period (DGGE-bands 1-6, Fig. 2e) all related to the brackish non-coccolith species *Isochrysis galbana* (data not shown). The observed shifts in the populations (Fig. 2e) were most likely triggered by varying salinity concentrations throughout the Holocene, information which could not be obtained from lipid analysis alone. The replacement of freshwater by seawater and the introduction of silica resulted in a periodical bloom of the common coastal diatom *Chaetoceros* (Figs. 3b-d) and resulted in the periodic disappearance of haptophytes (Fig. 3a). The dominance of 18S rDNA of *Chaetoceros* in these layers (Figs. b-d) was in agreement to the presence of their fossil skeletons in the sediment core.

In a preliminary study, quantitative real-time PCR (Q-PCR) was used to quantify the sedimentary DNA of the four main fossil haptophyte phylotypes (Figs. 2b,d) and the concentration profiles were compared with the amount of alkenones and alkenoates (Figs. 2a,c). This allowed for the first time to identify fossil sources of biomarkers at the species-level. The species-specific identification of haptophytes is of importance in -based reconstruction of past sea-surface temperatures, since different species can have different alkenone-temperature calibrations.

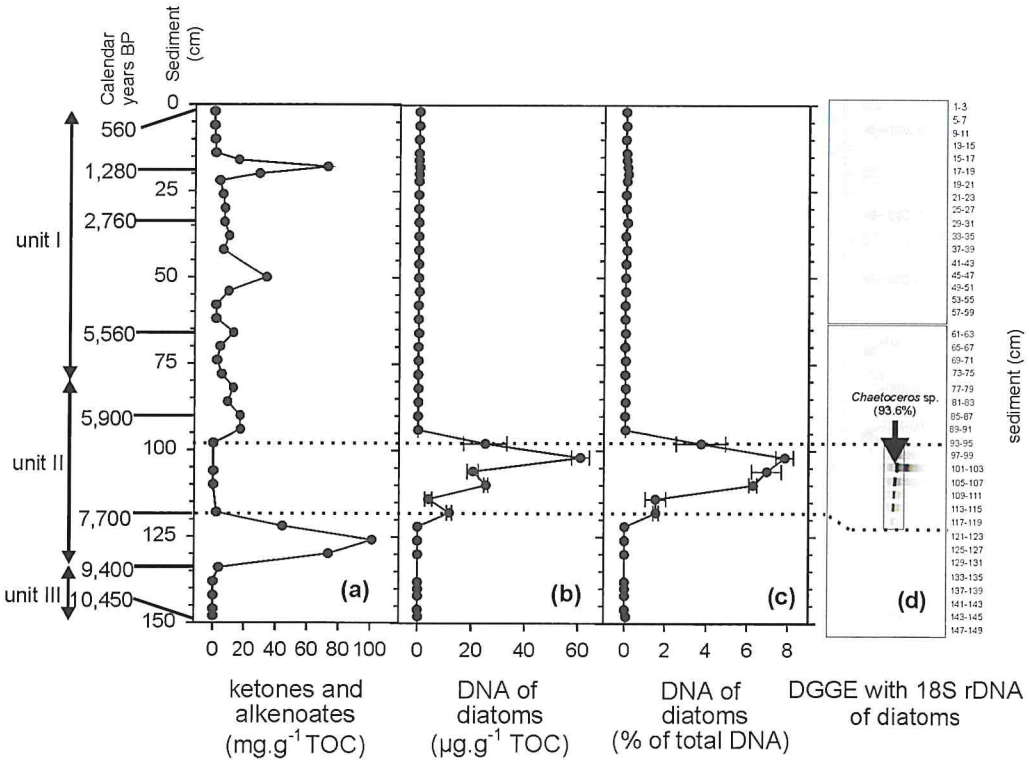


Figure 3. (a) Abundances of total alkenones and alkenoates (mg per g of TOC) and DNA of diatoms expressed as µg per g of TOC (b) and of total community DNA (c). DGGE results (d) are shown illustrating the occurrence of high contents of DNA from a diatom related to *Chaetoceros* sp. in the core section deposited after 7,700 years BP. Note that this diatom did not become abundant until after the haptophyte populations waned.

Evolution of the methane cycle in Ace Lake (Antarctica) during the Holocene: Response of methanogens and methanotrophs to environmental changes

The relative abundance of lipid biomarkers of methanogens as well as a specific $D^{8(14)}$-sterol (Fig. 1d) and the 16S rRNA gene of a fossil aerobic methanotrophic bacterium (*Methylococcaceae*) (DGGE-band 1-3, Fig. 1f) within the upper 39 cm of sediment showed that an active methane cycle occurred during the last 3,000 calendar years. This is about 2,700 years after Ace Lake became isolated and no longer received sulfate from the ocean. Since methanogenesis is restricted to sulfate-depleted waters of present-day Ace Lake and methanogenesis does not occur in other sulfate-rich anoxic lakes of the Vestfold Hills, we assume that the onset of the formation of an active methane cycle is indicative for the formation of sulfate-depleted ancient bottom waters. Sulfate depletion is most likely a result of bacterial sulfate reduction to sulfide and the occasional turn-over of the water column leading to losses of H_2S. According to our results, lipids indicative for methanogenic archaea were indeed below detection limit or present at low concentrations in the sediment layers attributed to the intermittent 'marine period' of Ace Lake. (Unit II, Figs. 1b,c).

Methanogenesis most likely occurred as well during deposition of freshwater unit III, indicated by the presence of remnants of (hydroxy)archaeol-producing archaea (Fig. 1c) of the methanogenic order *Methanosarcinales* (DGGE-band 27 and 28, Fig. 1e). Even though this environment was apparently methane-based, we did not find evidence for aerobic methane consumption since biomarkers and sequences for the aerobic methanotrophic bacteria were absent in Unit III (Fig. 1f). From the literature it was shown that the methanotrophic isolates in the present-day Ace Lake required a salinity of at least 20‰ for growth. Most likely, these methanotrophs were first introduced within Ace Lake from the surrounding ocean as a result of the post-glacial sea-level rise.

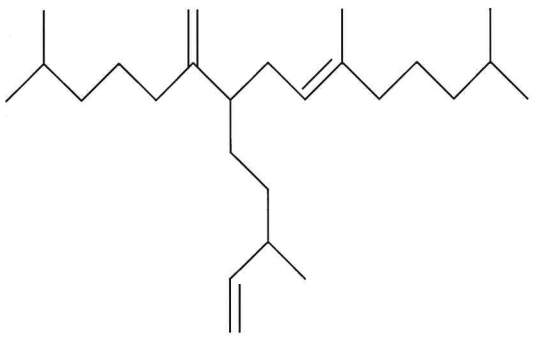
This combined analysis of traditional lipid biomarkers and the analysis of extant- and well-preserved fossil rDNA allowed an unprecedented reconstruction of the ancient microbial communities and hence climate-induced variations of the ancient water column.

AGE-DIAGNOSTIC BIOMARKERS OF DIATOMS: A COMBINED LIPID AND RIBOSOMAL RNA ANALYSES APPROACH.

Contributors: Stefan Schouten, Sebastiaan Rampen, Ben Abbas (BIO), Gerard Muyzer (BIO, currently at the Technical University of Delft), Jaap S. Sinninghe Damsté

This co-operative project between the departments of MBT and BIO was sponsored by the Dutch Foundation for Technological Sciences (STW). We have examined the potential of organic molecules from the cell-walls of diatoms (molecular fossils) to unravel their evolutionary pathways. Age-related biomarkers are frequently used by the oil and gas industry to constrain the age of petroleums with unknown source rocks. However, the number of useful age-related chemical fossils is still limited, especially in the age range 0-180 My. Chemical fossils of diatoms may provide useful age-diagnostic compounds, since they evolved especially during that time period. For instance, highly branched isoprenoids are specific diatom biomarkers, which we so far only found in Late Cretaceous sediments and younger.

To obtain age-diagnostic diatom biomarkers the currently used empirical approach can be used, i.e. analyse a vast range of sediments and oils of different ages and search for specific age-diagnostic biomarkers. However, we have been using a fundamentally different approach by combining lipid and 18S ribosomal RNA analysis of a wide diversity of cultured diatom strains (ca. 100 different species). These analyses allowed us to infer the molecular evolution of diatom species and link this to their lipid composition. It will then be possible with molecular clock calculations, to reconstruct at which point in time a specific group of diatoms producing diagnostic lipids radiated. This allowed us to predict the first occurrence of specific chemical fossils of these lipids in the fossil record. The results of these 'molecular clock calculations' were subsequently tested on a range of sediments and oils of different ages.



Carbonskeleton of a highly branched isoprenoid (HBI)

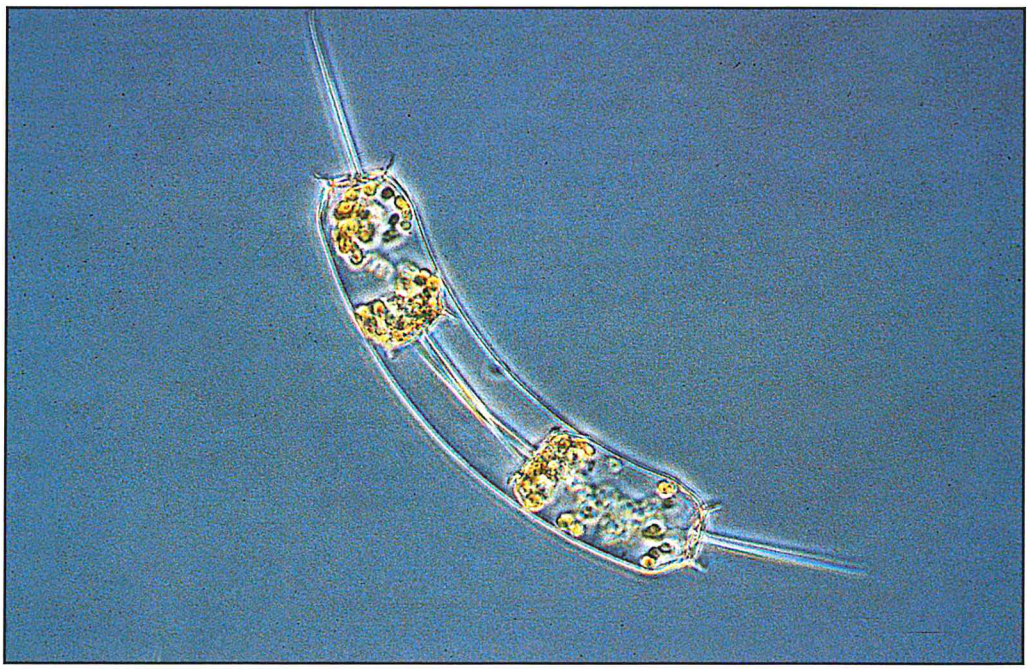
At the end of the project, more than 100 different species of diatoms have been cultured and most of them have been analysed for lipids and 18S rRNA. In

collaboration with the University of Plymouth we focused on several diatom species known to contain highly branched isoprenoids (HBI). 18S RNA analysis showed that HBI-producers fall into two specific phylogenetic positions: the first group of HBI producers consists of the centric diatoms of the genus Rhizosolenia, the second group comprises pennate diatoms of the genera Haslea, Navicula and Pleurosigma. Thus, HBI biosynthesis probably evolved independently at least twice in diatoms. Based on the constructed phylogenetic tree it is likely that the HBI biosynthesis evolved first in the older group of centric diatoms (i.e. the Rhizosolenia genus). In collaboration with Stanford University we investigated the fossil record of these HBI's. This extensive sediment and oil data set shows that HBI's were first found in sediments of 91.5±1.5 My, suggesting that HBI-biosynthesis evolved at that time. Therefore, we can date the evolution of the genus Rhizosolenia to 91.5±1.5 My. With this information, we can now accurately calculate the mutation rate of the 18S rRNA gene in diatoms to 1% per 14.8 My for Rhizosolenia, which is substantially faster than the 1% per 18-26 My reported previously for diatoms in general.

Long chain alkane diols were found in only one of the diatom genera, the Proboscia genus. Several species, including *Proboscia alata* and *Proboscia indica*, produced 1,14-diols and mid-chain hydroxy fatty acids. However, since these compounds leave no specific molecular fossils in the sedimentary record their use as age-diagnostic biomarkers is limited. In immature sediments where diagenesis is limited they can be used as indicators for *Proboscia* species as their silica skeletons are not always preserved. As Proboscia diatoms bloom early in the upwelling season, the abundance of long chain diols may be used as paleonutrient proxy.

Sterol distributions vary significantly among diatom species and with literature data. Several diatom species contained an early eluting di-unsaturated C_{28} sterol, which is probably identical to a compound reported for a *Thalassionema nitzschioides*, and was tentatively identified as an unusual 23-methylsterol. Hydrogenation of the sterol fraction of both diatom species yielded an early eluting C_{28} stanol, which was in higher abundance then the regular 24-methylcholestanol. The early eluting sterol seems to be restricted to a specific clade of diatoms and thus may yield a potential age diagnostic biomarker. Structural studies are underway to identify this sterol completely. Interestingly, we have also found 24-norcholesterols in one diatom species. These compounds have not yet been reported in diatom cultures, but they have already been used as age-diagnostic biomarkers in the literature, even though their origin was not known. Finally, in agreement with previous reports, cholesterol and C_{29} sterols were found in relatively high abundance in several diatom species suggesting that in aquatic sediments these sterols are not necessarily strictly derived from zooplankton and terrestrial plants.

The project has yielded a large database on the lipid and 18S RNA composition of diatoms. The results are now used to further investigate the evolution of diatoms using other molecular fossils and to examine the potential of long chain diols as a paleonutrient proxy. Furthermore, we can now predict the occurrence of specific molecular fossils in the sedimentary record thereby yielding valuable age-diagnostic biomarkers in sediments and oils for industrial purposes.



A dividing diatom (*Dithylum brightwelli*)
Photo: Biological Oceanography department

- Chemical fossils of diatoms for age determination of petroleum: Improved tools for solving exploration and production problems (STW).
  B. Abbas, S. Rampen, G. Muyzer, S. Schouten, J.S. Sinninghe Damsté.
- Bioaccumulation of persistent organic pollutants in small cetaceans in European waters: Transport pathways and impact on reproduction (BIOCET). (EU).
  J.P. Boon, B.N. Zegers.
- Risk assessment of brominated flame retardants as suspected endocrine disrupters for human and wildlife health (FIRE). (EU).
  J.P. Boon, B.N. Zegers (guest scientist).
- Three Marine Environmental Awareness Courses for the Dutch Maritime Universities of professional education.
  Dr. J.P. Boon, (together with EcoMare).
- First Marine Environmental Awareness Course for MBO schools for seafarers. Together with EcoMare (main contractor).
  Dr. J.P. Boon.
- 2003: Project ballastwater Greenship. Testing of a pilot plant to remove suspended particulate matter from seawater. Project granted by 'Greenship B.V.
  Dr. J.P. Boon, Dr. M.J. Veldhuis.
- Project 'Comparison of POP residues in blubber and blood of harbour seals. Project granted by Alterra.
  Dr. J.P. Boon.
- Project Ballastwater-DGG. The goal of this project is to establish a group that could submit a proposal to STW consisting of NIOZ, Royal Haskoning, manufacturers of ballast water treatment equipment, shipowners, and policy makers.
  Dr. J.P. Boon, Dr. M.J. Veldhuis, Dr. C. Brussaard , Dr. C.C. Ten Hallers-Tjabbes.
- Project Whale-Faroer: Biocehemical and *in vitro* biotransformation analyses on hepatic microsomes of pilot whales. Project granted by 'Denmarks og Grønlands Geologiske Undersøgeler', Copenhagen, DK. Together with the toxicology department of the university of Wageningen.
  Dr. J.P. Boon.
- A historical molecular record of Holocene environmental changes from Antarctic sediments of stratified fjords and lakes (NWO-ALW).
  M. Coolen, S. Schouten, J.S. Sinninghe Damsté.
- Rapid global change during the Cenomanian/Turonian oceanic anoxic event: Examination of a natural climatic experiment in Earth history (EU).
  A. Forster, S. Schouten, J.S. Sinninghe Damsté.
- Archaeal carbon fixation and burial and terrestrial organic matter input in the coastal system as revealed by tetraether membrane lipids (NWO-ALW and LOICZ)
  L. Herfort, E.C. Hopmans, S. Schouten, J.S. Sinninghe Damsté
- Early diagenetic transformations of carotenoids: A key to understanding past environmental changes (NWO-ALW).
  E.C. Hopmans, J.S. Sinninghe Damsté.
- A new sea surface temperature proxy based on planktonic archaeal membrane lipids, the TEX86 (NWO-ALW).
  C. Huguet, E.C. Hopmans, S. Schouten, J.S. Sinninghe Damsté.
- 6C: Climate change, carbon cycle and carbonate chemistry (EU)
  J. Ossebaar, G.J. Brummer, S. Schouten.
- Tropical environmental change and its teleconnections during the last deglaciation: a lipid biomarker study dated with 14C wiggle-matching (NWO-ALW).
  M. Rietkerk, G.J.M. Versteegh, F.H.J. Jansen, J.S. Sinninghe Damsté.
- Decadal climatic changes in the Holocene as revealed by biomarker records in finely laminated marine sediments (NWO-ALW).
  R.H. Smittenberg, J.S. Sinninghe Damsté.

- Recycling of respired CO_2 in stratified marine systems: Consequences for the interpretation of the stable carbon isotope record (NWO-ALW).
  Y. Van Breugel, S. Schouten, J.S. Sinninghe Damsté.
- Climate history of the South East Atlantic Ocean (NEBROC).
  G.J.M. Versteegh, F.J.H. Jansen, J.S. Sinninghe Damsté, J.W. De Leeuw.
- Development, evaluation and application of organic geochemical tracers for terrestrial carbon input into the marine environment (NWO-ALW)
  J.W.H. Weijers, E.C. Hopmans, S. Schouten, J.S. Sinninghe Damsté.
- Tetraether membrane lipids in the water column and sediments: Insights into the evolution and ecology of marine pelagic archaea.
  C. Wuchter, S. Schouten, J.S. Sinninghe Damsté.
- Palaeothermometry of the mid-Cretaceous greenhouse world using a new sea surface temperature proxy based on crenarchaeal membrane lipids.
  A. Forster, E.C. Hopmans, S. Schouten, J.S. Sinninghe Damsté.
- Molecular and geochemical analysis of hot spring cyanobacterial and *Chloroflexus* mats as stromatolite analogs.
  M.T.J. Van der Meer, D.M. Ward, F. Cohan, J. Eisen, J. Heidelberg, M. Madigan, S. Schouten.

AWARD

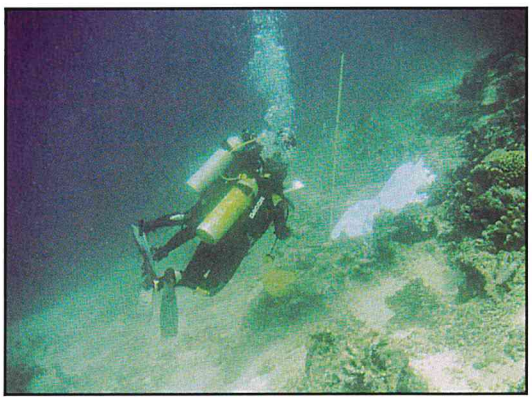
Stadnitskaia, A., Award of a Huygens grant from the Huygens Programme of the Netherlands organization for international cooperation in higher education (*Nuffic*) (2002-2003)

DEPARTMENT OF BIOLOGICAL OCEANOGRAPHY

The Department of Biological Oceanography focuses on the role of planktonic key species in the carbon and energy fluxes and nutrient recycling. Specific emphasis is put on the complex interaction between bottom-up and top-down control mechanisms in the lower planktonic food web.

In the year 2003, three cruises were executed. During the MOMAP-2 cruise in the North Sea, growth and mortality of phytoplankton during summer conditions was studied. An important component of this cruise was the assessment of the phyto- and bacterioplankton viral-induced mortality. At the TRANSAT-2 cruise performed in collaboration with FYS, the diagenesis of dissolved organic matter and the accompanying changes in prokaryotic community composition was followed in the North Atlantic Deep Water. This was done along a transect from Bermuda to the Greenland-Island-Norwegian Sea, covering roughly the first 50 years of the North Atlantic Deep Water in the oceanic conveyor belt. During the BADE-1 cruise, an anticyclonic eddy was followed in the western Mediterranean Sea over a period of three weeks and the dynamics of the microbial community in the surface layers including the air-sea interface was studied. Particular attention was paid to the role of ultraviolet radiation influencing the carbon and energy flow between the different compartments of the microbial community. In October, BIO participated in a Dutch/Indonesian interdisciplinary expedition along the east coast of Kalimantan, Indonesia together with MEE and MCG. In this project, we measured gradients in pico-and nanoplankton, inorganic nutrients and TOC in the benthic boundary layer (including coral cavities) over lagoonal reefs in the Berau river plume, over the barrier reef towards the oceanic reefs in the Sulawesi Sea. For the EU-funded AIRWIN project, a major field campaign was performed in the Mediterranean Sea, and for the BASICS project, the seasonal dynamics of the microbial community were monitored in the coastal North Sea, in combination with the long-term monitoring program coordinated by MEE.

Two EU-funded projects, BIOHAB and COMET, coordinated by BIO, were completed Reports on these 2 projects are included in the BIO and the MCG report. Christian Winter and Sander Scheffers completed their Ph.D. thesis work. Summaries of their work were included in the BIO contribution of this report. Corina Brussaard has been recruited within the Excellent-Post Doc program to work on the ecology of virioplankton.

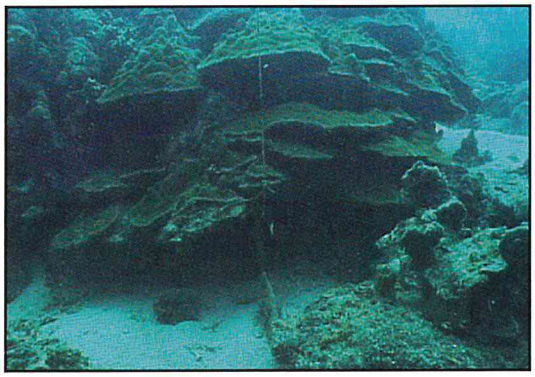


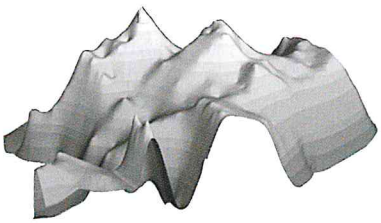
Divers conducting pelagic-benthic coupling studies on the coral reef slope at the W-side of Maratua (East Kalimantan, Indonesia)

LINKAGE OF BACTERIOPLANKTON DEPLETION AND NITRATE ACCUMULATION IN CORAL REEF WATERS WITH CRYPTIC SUSPENSION FEEDERS IN CAVITIES

Contributors: Sander R. Scheffers, Rolf P.M. Bak, Fleur C. van Duyl

Reports on reef degradation are accumulating at an alarming rate, but are mostly restricted to describing striking phenomena such as physical damages, coral bleaching and coral diseases. The importance of other kinds of changes is acknowledged, but few studies include changes in coral reef water quality with respect to suspended organic matter and inorganic nutrient concentrations, which may affect the trophodynamics on coral reefs. It is hypothesised that enhanced loads of inorganic nutrients and organic matter in the water, are beneficial to the growth and spatial cover of marine plants and heterotrophic benthic suspension feeders at the expense of corals. Benthic suspension feeders in cavities do not directly compete with corals for space, but supply the reef with extra inorganic nutrients after consuming predominantly allochthonous pico-and nanoplankton from the ocean.





left: A coral cavity on the reef slope of Curaçao (Netherlands Antilles)

right:: 3D-reconstruction of the geometry of the coral cavity shown in the photograph. Inner surface area is 2.47 m^2 and volume is 0.23 m^3.

We studied the diversity, cover and composition of cryptofaunal communities in relation to the physical characteristics of cavities along the coast of Curaçao (Netherlands Antilles) and assessed the role of cavity biota in the benthic-pelagic coupling. Cavities, the virtually inaccessible undersides of overhanging corals and holes in the Holocene and/ or Pleistocene reef framework, form the largest habitat of cryptic organisms on coral reefs. The cryptic reef fauna is highly diverse and includes suspension feeders such as polychaetes, bryozoans, tunicates, bivalves and sponges. We assessed the role of these cryptic communities as consumers of the very small but numerous bacteria flowing over the reef and their role as mineralizers of organic matter. Suspension feeding by cryptic communities may account for the widespread and unexplained observations of strong gradients in pico-and nanoplankton over reefs. The cryptic suspension-feeding fauna therefore potentially forms a quantitatively important sink of microorganisms and a link in reef trophodynamics.

For obtaining basic knowledge on cavity geometry and structure, a new device, the cave-profiler, was developed. With this device cavities were measured at varying depths on the reef slope along the coast of Curaçao. This way the 3D geometry, inner surface substratum area and volume of cavities was explored. Typical volume and surface area for slope cavities was ca 100 litres and 1.5 m^2 respectively. At 15 meters depth, the surface area within the cavities is up to 8 times larger than the surface area of the projected reef. An endoscopic digital video camera was used to penetrate the cavities and study the cryptofauna. Digital images, together with sampling for identification, were used to quantify the cover of cryptic organisms and identify the species. More than 60% of the inner cavity surface is covered with encrusting suspension feeders of which sponges were the most abundant. Forty different sponge species were identified of which 14 commonly occurred in cavities (e.g. Desmanthus incrustans, Diplastrella megastellata). Several a-biotic factors (turbidity, water movement, light) contributed to explaining the cryptobenthic zonation. Calcareous algae dominated in cover in the frontal part and encrusting sponges in the rear part of cavities.

Year round comparisons of bacterial densities in cavity water with ambient reef overlying water for cavities along the coast revealed an average depletion of bacteria of 50% (ranging from 1-60%) in cavity water. Within cavities gradients in bacterial densities from the middle of the cavity to the wall covered with encrusting suspension feeders, a further 30% depletion occurs, establishing the role of encrusting suspension feeders in the bacterioplankton depletion in cavities.

We found that under the replete inorganic nutrient concentrations in open coral cavities dissolved organic carbon (DOC) consumption by bacterioplankton exposed to cavity water is 2 times enhanced compared to such consumption in reef overlying ambient water. With seawater cultures we demonstrated that this was due to the higher inorganic nutrient concentrations in

cavity water and apparently not to higher bioavailable DOC concentrations in cavities, indicating that cavities are definitely not net sources of labile DOC.

With in situ experiments in closed-off cavities we showed that biota in cavities are a quantitatively important sink of bacterioplankton (0.62 $mgC.l^{-1}.d^{-1}$; 30.1 $mgC.m^{-2}$ inner cavity surface substratum.d^{-1}), a sink of SiO_4^{2-} and a source of dissolved inorganic nitrogen (0.67 $mmol\ N.m^{-2}$ inner cavity surface substratum.d^{-1}). As expected, higher (up to 60 mg bacterial $C.m^{-2}$. inner cavity surface substratum.d^{-1}), but still comparable rates were found in open cavities in which we accounted for the water exchange. Water exchange rate coefficients in cavities varied between 0.00004 and 0.0088 s^{-1} with a median exchange rate of 0.0038 s^{-1} (residence time of 4.4 min). Net effluxes of DIN and DIP occurred from open cavities (1.44 and 0.31 $mmol.m^{-2}$ cavity surface area.d^{-1} respectively). Significant net effluxes of NH_4 from cavities did not occur. On the contrary, NH_4 often disappeared in open cavities. The net NO_3 efflux exceeded the net DIN efflux suggesting that cavities are hot spots of nitrification. The differences in inorganic nutrient concentrations (NO_3, DIN) between ambient reef overlying water and cavity water declined with increasing water exchange, indicating conservative mixing with constant net inorganic N release rates from cavity surfaces. The relation between bacterioplankton depletion and water exchange in cavities pointed to non-conservative mixing, suggesting that bacterioplankton removal rate by cryptic suspension feeders increased with increasing exchange up to a threshold exchange and subsequently dropped to a significantly lower level. This illustrates that the hydrodynamic conditions in coral cavities affect and set boundaries to matter uptake by cryptic suspension feeders.

Coral cavities are quantitatively important net sinks of bacterioplankton and net sources of dissolved inorganic nitrogen (NO_3) and DIP (open cavities only). Cavities net released NO_3, but did not release net NH_4 or net labile DOC. Based on our results we argue that cryptic biota cannot live merely of the reef production but are dependent on the food advected to them by the ocean water passing the reef. As such cryptic suspension feeders play an important role in reef trophodynamics by incorporating ocean derived organic matter in the reef benthos and supply the reef with extra inorganic nutrients. Our results indicate that coral reefs should be considered as open in stead of closed ecosystems. Allochthonous nutrition of coral reef biota may contribute to explaining the Darwinian paradigm of a biologically diverse and extremely productive ecosystem surrounded by oligotrophic waters.

Encrusting sponges in cavities (scale ca. 4x5 cm)

TESTING THE INTERMEDIATE DISTURBANCE HYPOTHESIS ON PROKARYOTIC COMMUNITIES IN THE NORTH SEA.

Contributors: Christian Winter, Arjan Smit, Gerhard J. Herndl, and Markus G. Weinbauer

The advent of molecular techniques prompted the discovery of highly diverse prokaryotic communities in aquatic environments. As a consequence, the question arose how such high prokaryotic diversity may be maintained in relatively homogeneous aquatic environments with only a limited number of resources. This was first noted for phytoplankton and described as the 'paradox of the plankton' by Hutchinson, later extended to aquatic prokaryotes. However, it also has been argued that the high complexity of dissolved organic matter and the large number of different metabolic pathways of prokaryotes allow for a large number of niches and thus, diversity. Three major factors are thought to regulate the composition of prokaryotic communities: the availability of resources, size-selective grazing on prokaryotes by heterotrophic nanoflagellates, and viral lysis. Viral infection is a stochastic process and depends on the abundance of viruses and hosts. This is the basis for the 'killing the winner' hypothesis, suggesting that viruses selectively kill the most abundant members of the prokaryotic community and thus might be a driving force for maintaining community richness by allowing the survival of less competitive phylotypes (species).

In general, disturbance and productivity are often unimodally related to diversity. Highest diversity is found at intermediate levels of disturbance and productivity. Under the assumption that mortality caused by consumers such as viruses constitutes a form of disturbance, we hypothesized that bacterial species richness should be highest at intermediate levels of viral abundance and prokaryotic production. We tested this hypothesis by assessing the dynamics of the bacterial community composition in unfiltered and 0.8µm filtered seawater (representing free-living bacteria) in the North Sea using terminal restriction fragment length polymorphism (T-RFLP) analysis. The T-RFLP patterns were analyzed by recording the number of peaks (presence versus absence), serving as a measure of bacterial richness. The field work for this study was done during 6 cruises in the North Sea with *R/V Pelagia* between July–December 2000, June 2001, and April–May 2002.

The relationship between the parameters was further evaluated using artificial neural networks (ANNs). ANNs are computational modeling tools that can be used to develop models based on previously collected data. Conventional statistical methods to quantify the relationships between parameters such as correlation analysis or principal components analysis usually require the data to fit a pre-defined model (e.g. the normal distribution). Many complex ecological processes, however, cannot easily be constrained to fit into pre-defined conditions. The advantage of ANN-based models is that they are not *a priori* restricted to a specific class of models (e.g. linear or non-linear models). Feed-forward ANNs, as used in this study, are the most widely used types of ANNs. They consist of layers of neurons where each neuron is connected to all the other neurons in the previous and the following layer. As a consequence of this parallelism, ANNs have a high tolerance towards noise in the data. After an initial training phase, the ANN can be used for predictions on the basis of new input data.

In unfiltered seawater, bacterial richness ranged from 31-82 peaks (mean = 57 peaks) and in the 0.8µm fractions (free-living bacteria) from 27-84 peaks (mean = 51 peaks). Despite the similar range (Fig. 1), total bacterial richness in unfiltered seawater was only weakly correlated with

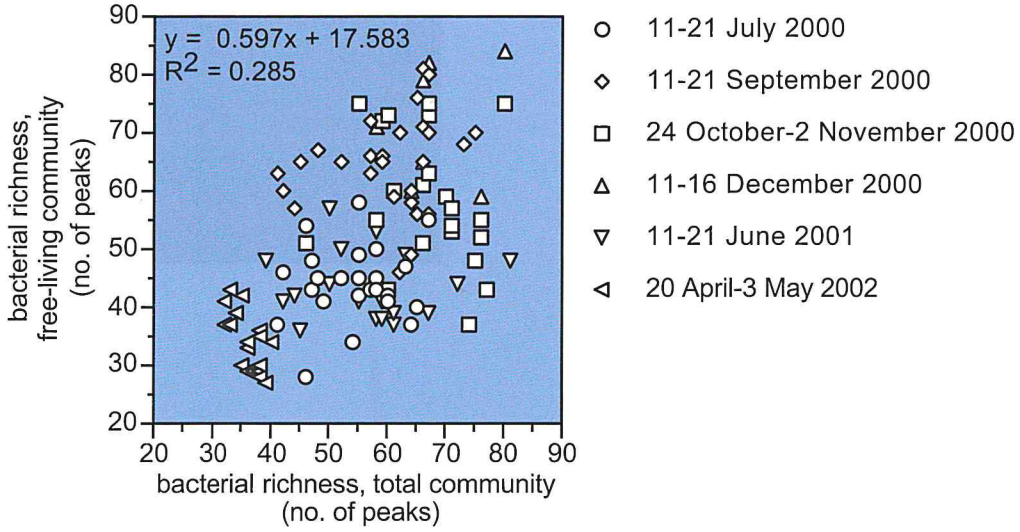


Fig. 1. Comparison of the richness of the total and free-living bacterial community as determined by T-RFLP analysis. The equation of the linear least-squares regression analysis and the coefficient of determination (R^2) are shown.

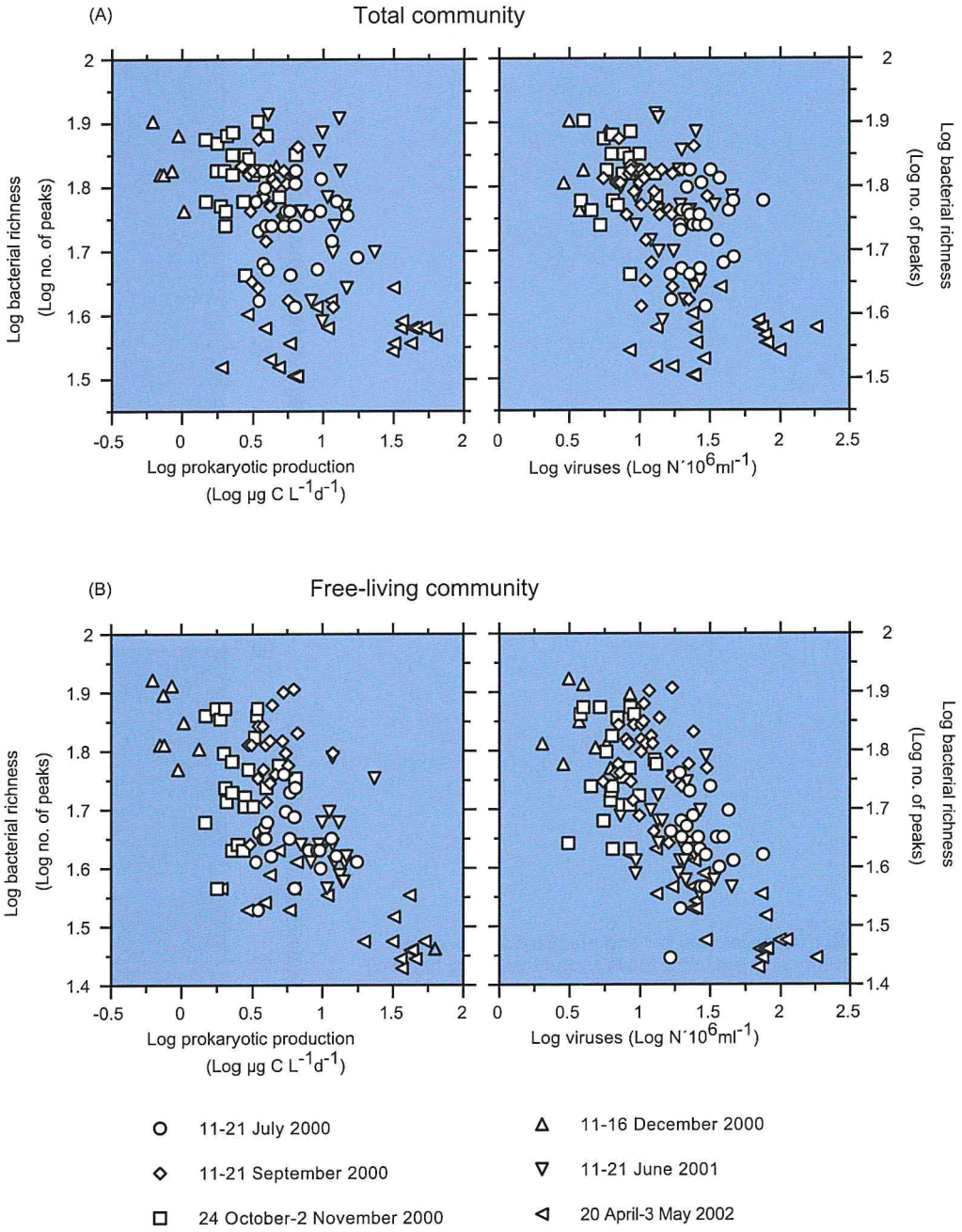


Fig. 2. Relationship of the prokaryotic production (left panels) and viral abundance (right panels) with bacterial community richness as determined by T-RFLP analysis for the total (A) and the free-living bacterial community (B).

the richness in the free-living bacterial fraction. Based on the slope (Fig. 1), bacterial richness was, on average, ca. 40% higher in unfiltered seawater than in the free-living fraction of the bacterial community. Filtration through 0.8µm pore-size filters removed particles and prokaryotic cells attached to them. Generally, free-living bacterial communities are distinctly different from particle-attached communities. Additionally, the particle load of the water column in the North Sea varied considerably during the study period. Thus, the differences in bacterial richness between unfiltered seawater (total community) and the 0.8µm fraction (free-living community, Fig. 1) reflect the exclusion of particle-attached *Bacteria* in the 0.8µm fraction.

Prokaryotic production and viral abundance in unfiltered seawater varied over two orders of magnitude between 0.6–63.1µg C $L^{-1}d^{-1}$ (mean = 9µg C $L^{-1}d^{-1}$) and 2.1–184×$10^6$$ml^{-1}$ (mean = 22.3×$10^6$$ml^{-1}$), respectively, while prokaryotic abundance varied only over one order of magnitude (0.3–4.3×$10^6$$ml^{-1}$, mean = 1×$10^6$$ml^{-1}$). Bacterial richness of the total and the free-living communities decreased with increasing prokaryotic production and viral abundance (Fig. 2). Bacterial richness of the total community decreased with viral abundance and with prokaryotic production. An even closer negative correlation was obtained for the richness of the free-living bacterial community and prokaryotic production and viral abundance. However, prokaryotic

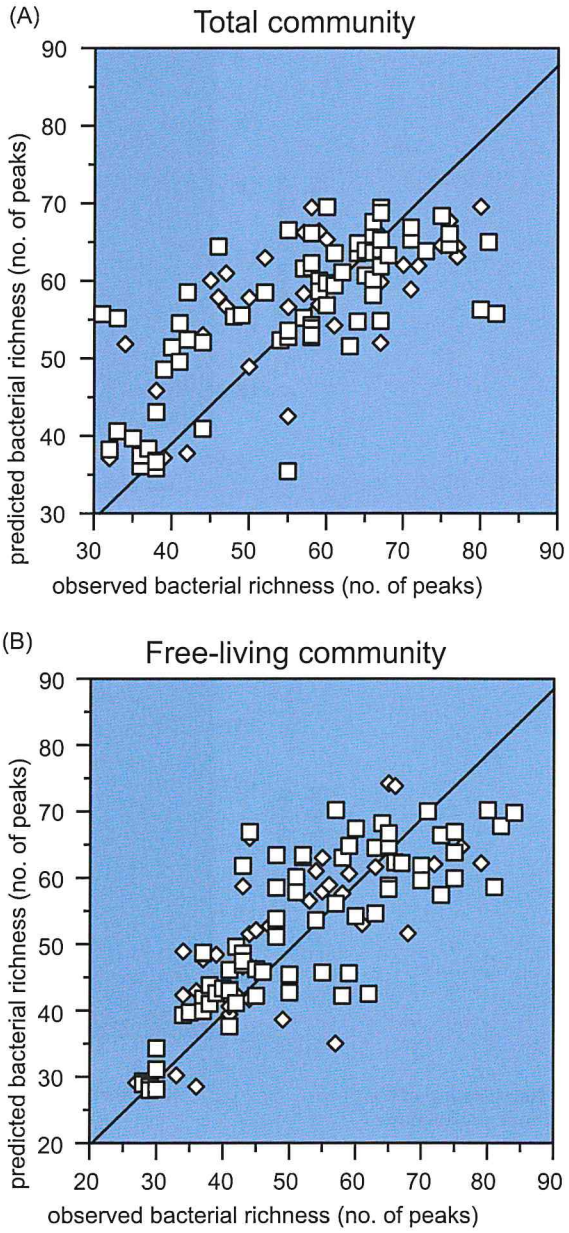


Fig. 3. Comparison between observed and predicted values of the bacterial community richness in the total (A) and free-living bacterial community (B). Bacterial community richness was determined by T-RFLP analysis and the predictions were computed using the artificial neural networks (ANNs). The formulas and the coefficients of determination (R^2) of the lines representing the linear least squares fit to the data are shown.

abundance was not correlated with bacterial richness. Additionally, we found a strong positive correlation of viral abundance and prokaryotic production.

Artificial neural network-based models of the richness of the total and the free-living communities were developed independently from each other. The data-set was divided into a training data-set used to adapt the ANNs, and a validation data-set used to test the performance of the ANNs (Fig. 3). The models mimicked the actual bacterial richness best if prokaryotic production and prokaryotic and viral abundance were used as input parameters. The high correlation coefficients calculated from the combined training and validation data sets between predicted and observed values indicate that the training strategy was successful. Additionally, the slope of linear least-squares regression analysis between observed and predicted bacterial richness was close to one for both models (Fig. 3).

The simulations based on the ANNs revealed that predicted richness of the total and the free-living bacterial community was affected differently by the input parameters (Fig. 4). This finding is not evident from Fig. 2 or the correlations between bacterial richness and prokaryotic production and viral abundance. Different types of particles (i.e., inorganic particles with organic coating versus detrital particles) might be colonized by different bacterial phylotypes. Silt plumes originating from the British coast, sediment resuspension, and decaying phytoplankton blooms constitute major sources of particles in the North Sea. Thus, changes in the particle load and the source of the particles might cause changes in the particle-attached bacter-

ial community and would explain the differences between the models for the total and the free-living bacterial consortia.

The first conclusion that can be drawn from our results is that highly active bacterial communities are characterized by low bacterial richness (Fig. 2). In the study area, prokaryotic activity was high in June-July and low in December. Thus, the high prokaryotic activity found during early summer in the North Sea might be a consequence of a small number of bacterial species capable of utilizing available substrate and out-competing less adapted species. This is further supported by the negative correlation between the richness of the free-living bacterial community and the cell-specific prokaryotic production ($r = -0.666$, $p < 0.0001$). However, bacterial richness of the total community was only weakly correlated with prokaryotic production (or cell-specific prokaryotic production: $r = -0.478$, $p < 0.0001$). This suggests that the richness of the total (particle-attached and free-living) bacterial community is related to fluctuating concentrations of inorganic particles colonized by bacteria.

The second conclusion, which can be drawn from our results is that low bacterial richness corresponds to high viral abundance (Fig. 2). The strong correlation between viral abundance and prokaryotic production suggests that high viral abundance is maintained by an active prokaryotic community. Taken together, these findings indicate that a small number of highly active, primarily free-living bacterial phylotypes maintain high viral abundance (Fig. 2B). Thus, there is a link between bacterial species richness, prokaryotic production, and viral abundance.

One of the consequences of the 'killing the winner' hypothesis is that viral lysis should sustain high bacterial richness. The finding that bacterial richness is low at high viral abundance contradicts the original 'killing the winner' hypothesis. However, a refined model proposes the existence of a reciprocal mechanism by which lytic viruses and bacterial richness are controlling each other. In this model, viruses act as balancing factor that facilitates the coexistence of bacterial species with different growth rates and viruses with fast-growing hosts should be most abundant. Thus, the inverse relationship of viral abundance and prokaryotic activity with bacterial richness found in our study is probably driven by a few phylotypes dominating at a given time and producing high numbers of viral progeny. The negative correlations of bacterial richness with prokaryotic production and viral abundance contradict our initial hypothesis that highest bacterial species richness should be found at intermediate levels of productivity and viral abundance. It might be argued that the ranges of prokaryotic production and viral abundance might not be wide enough to test this hypothesis. However, it seems unlikely that this impacts our conclusion since prokaryotic production and viral abundance ranged over two orders of magnitude (Fig. 2) covering the entire seasonal range found in the North Sea.

The strong correlation between prokaryotic production and viral abundance suggests that viral lysis of prokaryotes is the major source of viruses in the North Sea. Thus, viral abundance might serve as a measure of consumer pressure on bacterioplankton via viral lysis. Prokaryotic production measured by leucine incorporation served as a proxy for resource availability to prokaryotes. A previously published multivariate model on the influence of productivity and disturbance on diversity predicts that the effect of physical disturbance on diversity depends on productivity and *vice versa*. The predictions of this model have recently been supported by the results of an experimental study manipulating rocky shore communities of algae suggesting that the influence of disturbance and consumer pressure on diversity is similar. The study showed that consumers decrease diversity at low productivity levels but increase diversity at high productivity.

Applying the theoretical framework of this multivariate model to our study, bacterial richness should decrease with viral abundance at low prokaryotic production and increase with viral abundance at high prokaryotic production. However, our results (Fig. 2) and the ANN-

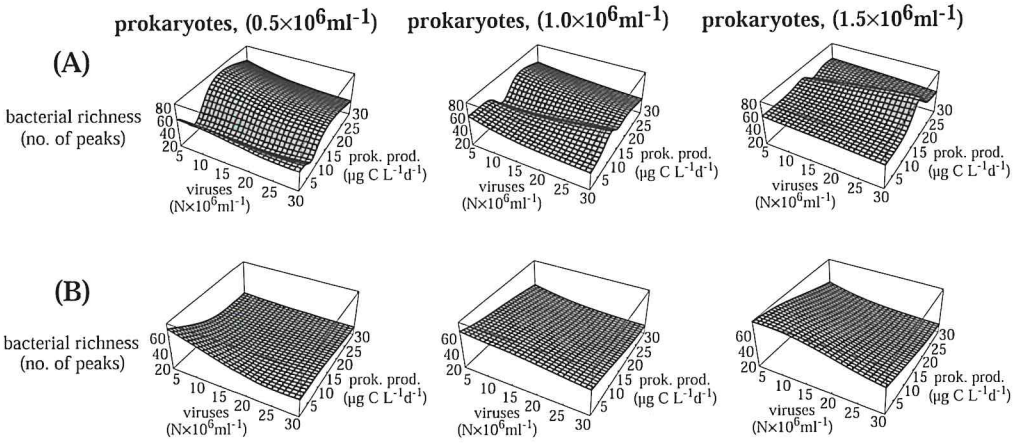


Fig. 4. Simulations of the bacterial community richness in the total (A) and the free-living bacterial community (B). The artificial neural networks (ANNs) developed in our study were used to simulate bacterial community richness at prokaryotic production ranging between 1-30µg C $L^{-1}d^{-1}$, prokaryotic abundance between 0.5-1.5´$10^6$$ml^{-1}$, and viral abundance between 5-30´$10^6$$ml^{-1}$. The results of the simulations for 3 different values of prokaryotic abundance are shown.

based model of bacterial richness of free-living *Bacteria* (Fig. 4B) show that bacterial richness decreases with increasing prokaryotic production and viral abundance. Prokaryotes have the ability to quickly acquire resistance to co-occurring viruses, especially under favorable growth conditions. The phenomenon of resistance to viral infection at high prokaryotic production could explain the differences between the multivariate model and our results. However, since viral abundance was significantly correlated to prokaryotic production in the North Sea, this seems rather unlikely. Viruses can influence the ratio of sensitive to resistant clones of prokaryotic populations. Thus, if viruses influence the clonal composition rather than the community composition of prokaryotes, the effect of viruses might not be detectable by T-RFLP analysis, especially at high prokaryotic production when the community appears to be dominated by a small number of phylotypes (Fig. 4). Furthermore, as viruses depend entirely on the metabolism of their hosts for viral replication it is unlikely to find high consumer control of bacterial richness in the form of viral lysis at low prokaryotic production.

Our results show that bacterial richness is negatively correlated with prokaryotic production and viral abundance. Thus, we conclude that a small number of highly active bacterial phylotypes maintain high viral abundance. Additionally, ANN-based models indicate differences in the relationship of bacterial richness with prokaryotic production, and prokaryotic and viral abundance between the particle-attached and free-living bacterial communities. This is probably due to differences in the composition of the bacterial communities colonizing different types of particles. In the North Sea, low prokaryotic production and viral abundance coincide with high bacterial richness. Thus, the results are in contrast to our initial hypothesis that bacterial richness should be highest at intermediate levels of viral abundance and prokaryotic production.

BIOLOGICAL CONTROL OF HARMFUL ALGAL BLOOMS; THE PHAEOCYSTIS CASE STUDY.

Contributors; M. Veldhuis, C. Brussaard, P. Ruardy, A. Noordeloos, B. Kuipers, G. van Noort, W. Klein Breteler, J. Dutz, M. Koski.

Massive blooms of *Phaeocystis* are annual events in European coastal waters and belong to the so-called non-toxic Harmful Algal Blooms (HAB). The species is polymorphic, including single cells (4 to 7 μm in diameter) and larger colonies, with numerous cells embedded in mucus. The single cells belong to the 'normal' phytoplankton community and are as such subject to biomass controlling factors like grazing by micro- and mesozooplankton. In contrast the size of the colonies, which can be up to several mm in the case of *P. globosa*, colonies of *P. pouchetii* are much smaller, do not 'fit' in the grazer controlled size range of the phytoplankton community. In particular the colony form can produce massive blooms in spring and early summer in just a few days. The foam on the beaches of the southern North Sea and its implications for tourism-related activities is the most visible aspect of the fate of the colonial matrix of *Phaeocystis*. Slime on fishing gear is another reported negative aspect of this HAB. Occasionally, during the degradation of the organic matter local anoxia in the water column occurs, killing massively shellfish like mussels and oysters.

The species not only blooms in just a few days but also disappears completely in a few day's. Biocontrollers (natural enemies), and in particular viruses, are thought to be responsible for the sudden termination of *Phaeocystis* blooms.

In order to have more insight in the bloom controlling factors and the role of colony formation in this process large-scale indoor mesocosm experiments were conducted as part of a large EU-sponsored program studying biological control of HABs. The aim of this experiment was to study the dynamics of the *Phaeocystis* blooms in relation to different environmentally realistic N/P ratios and the potential role of viruses and zooplankton grazing as bloom controlling factors. In two mesocosms nutrients were added in a balanced nutrient requirement for phytoplankton (N:P=16). In the other two mesocoms either a surplus of orthophosphate (N:P =4) or of nitrate (N:P=44) was added.

Before realising such a detailed study new tools and techniques were developed. Firstly, the detection and enumeration of viruses was improved using flow cytometry. Secondly, cell specific assays were adopted to detect the general viability of the different cell types of *Phaeocystis* (single cells and colonies). It was shown that virus infected algal cells rapidly loose their viability and thus can be distinguished easily from healthy cells. Finally, we succeeded in obtaining independent estimates of the gross growth rate of single and colony cells when co-occurring using the DNA replication rate as a tool. Because of the larger size of the colonies, up to mm's, this has for long been considered impossible. This last aspect is crucial in determining the whole set of growth and loss parameters of both cell types.

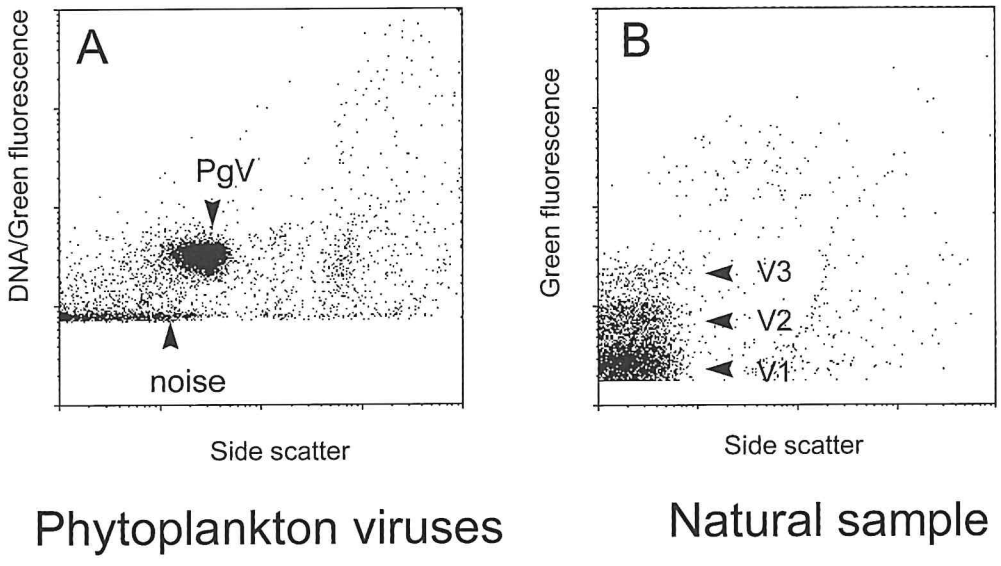
During the large-scale mesocosm experiments it was for the first time shown that viruses have an effect on the mitigation of a HAB-species but could not prevent the bloom formation of it. Blooms that developed in one week were terminated in the subsequent week with little or no

differences between the different nutrient regimes. Enhanced rates of total phytoplankton cell lysis were recorded during the decline of the *P. globosa* blooms resulting in massive cell mortality. Only single cells were susceptible to viral induced mortality or zooplankton grazing, whereas colonies escaped from this process as long as they remained intact.

The colonial derived mucus formation resulted in large aggregates in the nutrient limited mesocosms. The colony structure not only prevented the cells inside the colony from being infected by viruses, as long as the colony was intact, but the large aggregates could trap free viruses as well. This last process will therefore also reduce viral infection of single cells.
The different experiments conducted to estimate the grazing upon the two morphotypes of *Phaeocystis* showed also some interesting results. Grazing by large mesozooplankton like copepods was low and when present other food sources were preferred above *Phaeocystis*. Moreover, the development of copepod nauplii (young copepods) was hindered in the presence of *Phaeocystis*. In contrast single cells were a major food source for the smaller sized zooplankton (microzooplankton). At time of massive production of the mucus also a succession in the microzooplankton species composition was observed.

The whole set of available data was used to construct an ecosystem model where a differentiation was made between the growth and mortality dynamics of single cells and colonies of *Phaeocystis*. The model included totally new scenarios so far unknown. Of crucial importance was the polymorphic appearance of *Phaeocystis* (as colonies and single cells). This did not only affect the mortality caused by grazing and viruses but could also explain the differences in gross growth rates of both cell types. Measurements indicated that the gross growth rate of colony cells was on average 2 times higher than that of the single cells. Combined with the reduced mortality rates this explained the massive blooming of in particular colonies. Furthermore, trapping of viruses by the mucus remnants of the colonies (Transparent Exopolymeric Particles) reduced the chances of infection through a general reduction of the viral abundance. The role of different nutrient ratios appeared of minor importance, except for the fact that the colonies tended to disintegrate when nutrients were depleted.

Despite some remaining uncertainties with respect to the parameterisation of the virus module the exercise to include the virus dynamics in the model was successful and should be considered as a major improvement of complex ecosystem models.



Flow cytometric signatures of particle size and DNA content. Picture A shows a typical virus found in cultures of *P. globosa*, picture B shows three different groups of viruses in a natural sample.

EXTERNAL PROJECTS OF THE DEPARTMENT OF BIOLOGICAL OCEANOGRAPHY

- Mortality of marine phytoplankton in ecosystems with contrasting trophic status (oligotrophic vs eutrophic) (ALW-NWO).
  C.P.D. Brussaard
- The chemical composition and reactivity of bacterially derived dissolved organic carbon (DOC) and its contribution to the bulk oceanic DOC pool (ALW-NWO).
  G.J. Herndl
- Ecological role and diversity of planktonic bacteriophages in the North Sea and the Wadden Sea (ALW- NWO).
  G.J. Herndl
- Transformation of dissolved organic matter (DOM) in the North Atlantic Deep Water and intermediate waters: assessing the functional and phylogenetic variability of marine bacterioplankton communities in relation to the quality of DOM (TRANSAT) (ALW- NWO).
  G.J. Herndl
- Bacterioplankton cell death: competition between flagellate grazing and viral lysis and the role of bacterioplankton cell wall-derived dissolved organic matter in the ocean (BADE) (ALW- NWO).
  G.J. Herndl
- Composition of dissolved organic matter and its interaction with metals and ultraviolet radiation in river-ocean systems: impact on the microbial food web (COMET, 5^{th} FWP of the EU).
  G.J. Herndl
- Structure and role of biological communities involved in the transport and transformation of persistent pollutants at the marine AIR-Water Interface (AIRWIN, 5^{th} FWP of the EU).
  G.J. Herndl
- Bacterial single-cell approaches to the relationship between diversity and function in the sea (BASICS, 5^{th} FWP of the EU).
  G.J. Herndl
- Application of capillary electrophoresis for isolating bacteria and assessing ectoenzyme diversity and kinetics (ACE, Marie Curie Training Site Fellowship).
  G.J. Herndl
- Bacterial-derived organic matter production and transformation in the North Atlantic Deep Water. (Marie Curie Individual Fellowship)
  E. Teira, G.J. Herndl
- The linkage between nano/picoplankton production and reef cryptic fauna: a key process in coral reef trophodynamics (NWO-WOTRO)?
  F.C. van Duyl, R.P.M. Bak
- Dissolved organic matter cycling on coral reefs: Are coral cavities sinks of DOM (NWO-WOTRO)?
  F.C. van Duyl
- Removal of pico-and nanoplankton by coral reef benthos along the east coast of Kalimantan (Indonesia): coupling pelagic benthic heterotrophy to coral reef status (NWO-WOTRO).
  F.C. van Duyl
- Biological control of harmful algal blooms in European coastal waters: role of eutrophication (BIOHAB, 5^{th} FWP of the EU).
  M. Veldhuis
- Iron Resources and Oceanic nutrients-Advancement of Global Environment Simulations (IRONAGES, 5^{th} FWP of the EU).
  M. Veldhuis

The department aims to obtain a mechanistic understanding of the structure and dynamical behaviour of marine macrobenthos populations, ranging from the shelf margin to the intertidal. The department focuses both on the role of bottom-up (food input and competition for food and other resources) and top-down (predation) processes in structuring benthic communities. Research methods include (1) field observations, along with long-term (and wide range) surveys; (2) manipulative field experiments, e.g. using new lander technology; (3) laboratory experiments, e.g. using the experimental large-scale tidal facilities; and (4) modelling.

Within the department three different types of benthic communities are studied intensively: the tidal flats in the Wadden Sea and some tropical systems, notably in north-west Australia and West Africa; the soft-sediments of the North Sea and continental shelf margin; and the coral reefs in the Caribbean and Indonesia. On the species-poor tidal flats of the Wadden Sea, easily accessed from the institute, only four species (three bivalves and one polychaete) account for 80% of the total biomass of the intertidal infauna. Detailed studies focus on these four most abundant species, and their predators. The studies on tropical flats emphasize insightful latitudinal contrasts in ecological processes. Recent developments in the employment of landers that can be installed at the seafloor for longer periods, enables advanced manipulative experiments. Hence, the experimental approach, so far only possible on the tidal flats, can now also be followed in our second area of interest, the shallow parts of the North Sea. In contrast to Wadden Sea and North Sea, coral reefs carry the most species rich marine communities and strong competition for space appears to be a major characteristic of these systems.

In addition to detailed individual-oriented studies, long-term population and community studies are being performed in all three types of systems. In the Wadden Sea twice-annual surveys started in the late 1960s. These long-term studies focus on the population dynamics of the benthic fauna and their predators, the food conditions for the benthic fauna, and on environmental conditions, such as water temperature. They provide an important mean for generating and validating hypotheses on the structuring processes in marine ecosystems. Mollusc shells and coral skeletons accommodate an archive for studying environmental and climatic changes over much longer periods.

Most of our studies are embedded in national or European programmes. Although emphasis is put on benthic communities, studies on seabirds and marine mammals are also performed, yet mainly externally (national government, EU) funded.

Research Themes

The present and future work within the department can be divided in three themes that are closely connected:

1. The structuring role of top-predators in marine ecosystems
2. Competition, life-history strategies and dynamic energy budgets
3. Recruitment and dispersal in relation to spatial and genetic structure of benthic invertebrate populations

2.1 The structuring role of top-predators in marine ecosystems

One of our main hypotheses is that predation and other "top-down" processes have cascading effects through the benthic foodweb. This may work directly, that is predators exhibit a serious impact on the mortality patterns of their prey and on the dynamics of the prey populations. The effect of predators may also work indirectly through the occurrence of predator-avoidance mechanisms. There is ample evidence of a widespread occurrence of such mechanisms in the marine environment, e.g. toxic algae (physiological response), gelatinous plankton (morphological response), deep-burying bivalves (behavioural response), early-maturing fish (life-history response), etc. This work is mainly performed in intertidal areas (Wadden Sea), with the red knot Calidris canutus as the most important model organism.

2.2 Competition, life-history strategies and dynamic energy budgets

Intra- and interspecific competition for food and other resources may also play a major role in determining community processes. Our particular interest is directed towards the performance of benthic organisms in terms of e.g. growth rate, age and size at maturity, and fecundity, in response to food availability and other environmental conditions. The consequences of choosing a specific energetic strategy for competitive interactions and fitness are studied. One hypothesis that deserves further testing is that larger organisms with better energy storage capacities are more adapted to fluctuating food supplies, whereas smaller organisms are more able to cope with constant low food supply. Another point of interest is the phenotypic flexibility, that is the reversible within-individual variation, in both benthic

whether this match/mismatch of larvae and the phytoplankton bloom could be mechanistically understood, we went into the laboratory again.

We conducted a laboratory experiment in which we reared batches of larvae during the anticipated wax and wane of the phytoplankton spring bloom (April-May 2002). One group of larvae was reared in seawater with the natural phytoplankton assemblage, while the other group served as a control, and was reared in 1µm-filtered seawater enriched with cultured algae (*Isochrysis*). The results strongly suggest that larvae are indeed food limited under natural food circumstances, since there was a clear increase in larval growth and development rates from April till May in the experimental group and not in the control group. However, the phytoplankton densities in the seawater did not show the expected large increase.

Larvae and energy budgets

In the final stage of the project we are focussed on the integration of our laboratory results in a Dynamic Energy Budget (DEB) model. The model will allow us to estimate under which conditions bivalve larvae are food limited considering their size and temperature.

Finally we will use the model outcomes to predict whether bivalve larvae could be food limited under natural circumstances. To do so, we will compare bivalve densities, which were monitored throughout the year 2000 at locations in the Wadden Sea, Schelde estuary, Sylt (Germany) and Limfjorden (Denmark), to the phytoplankton densities at the same locations.

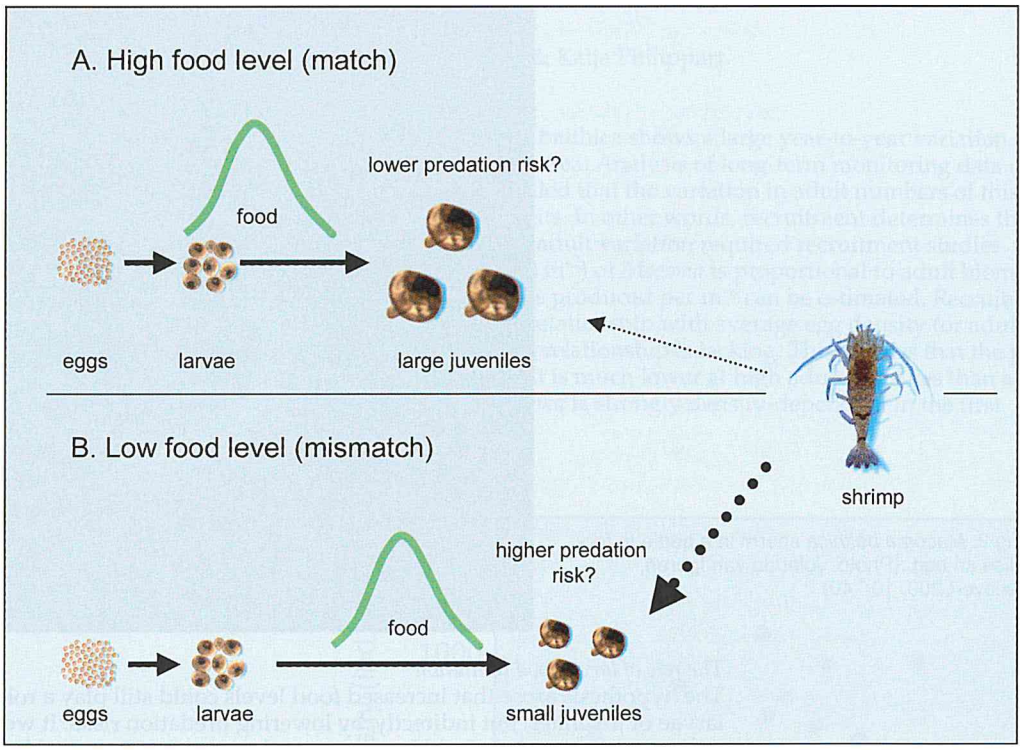


Fig. 3. Possible mechanisms behind the statistically observed dependence of recruitment success on the match/mismatch of the spring phytoplankton peak and the larval peak. A match of the phytoplankton peak and the larval peak results in a better recruitment success than a mismatch, since well-fed juveniles are better able to escape predators.

CORAL STABLE ISOTOPES. PROXIES FOR CLIMATE, ECOLOGICAL PLASTICITY AND CORAL FUNCTIONING

Contributors: C. Maier & R.P.M. Bak

This project generally questioned causes of variation of the stable oxygen and carbon isotopes in coral skeletons. Scleractinian corals construct extremely durable and well conserved aragonite skeletons. Corals, which can live for centuries, therefore provide a powerful and high resolution tool for the reconstruction of climate variations and crucial ecological parameters. Time-series profiles of skeletal $\delta^{18}O$ and $\delta^{13}C$, for example, allow for reconstruction of sea surface temperature (SST) and global (climate) change. However, several biological and environmental factors have been shown to affect the reading of coral skeletal $\delta^{13}C$ and $\delta^{18}O$ paleorecords. These sources of variation are caused by factors covering a range of scales. Consequently, the interpretation of proxies from the coral skeleton is less straightforward than previously assumed. The research comprised general questions of how stable isotope fractionation in the coral skeleton varies with skeletal growth rate, coral morphology, colony topography, coral physiology and taxonomy.

Basic questions on the magnitude of variation between replicate $\delta^{18}O$ time series from coral skeleton and whether there are colony or species specific effects on skeletal isotope fractionation had still to be answered. We thus compared a total of twelve short $\delta^{18}O$ time-series of skeletal depth profiles taken from six colonies of three species of the coral *Porites* spp (Fig. 1). The massive coral *Porites* is one of the most common species used in paleoclimate reconstruc-

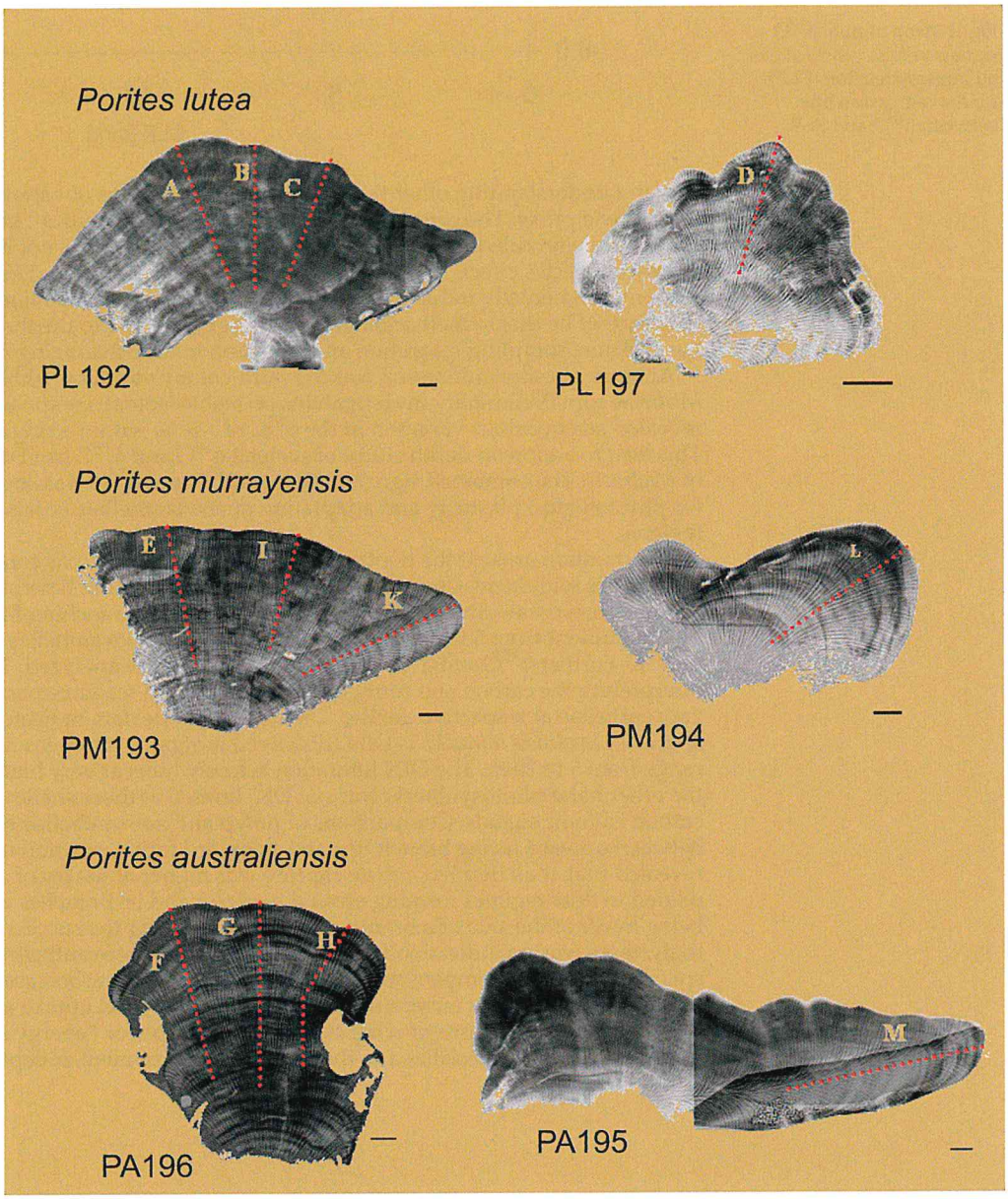


Fig. 1 X-ray photographs of ± 5 mm thick coral slabs of *Porites lutea, murrayensis* and *australiensis*. Dotted red lines indicate trajectories for drilling $\delta^{18}O$ time-series. Scale bars = 1 cm.

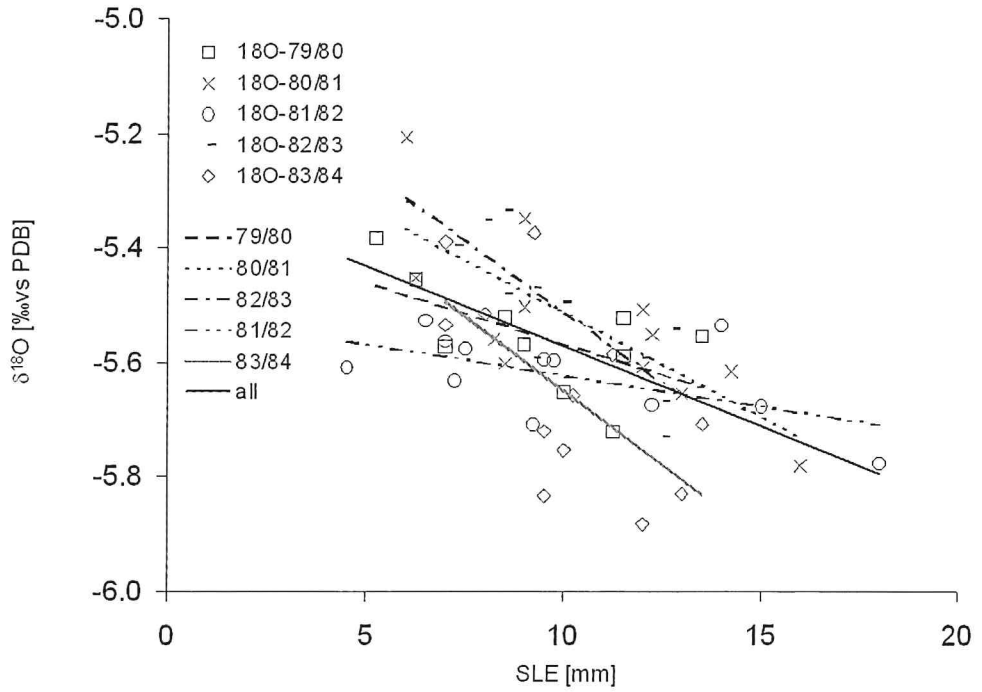


Fig. 2 Mean annual $\delta^{18}O$ signals versus yearly skeletal linear extension (SLE). Linear regression line between $\delta^{18}O$ and SLE.

tion and understanding other than environmental sources of variation is pivotal to interpreting this climate proxy. The comparison of replicate profiles on intra-, intercolony and between species scale revealed that the skeletal $\delta^{18}O$ signal of *Porites* is not influenced by between colony or species effects as has been assumed in earlier studies. Results rather showed that non-environmentally induced variation is a function of skeletal linear extension (Fig. 2) and may further be due to methodological constraints related to the three-dimensional structure of the skeleton, sampling resolution and variation in time-averaging between samples.

Another question addressed was the intra-colony variation within the Caribbean coral *Madracis* spp. Preliminary investigations on stable isotope composition over the colony surface revealed an enormous variation in the $\delta^{13}C$ of > 6 ‰ within a single colony of *Madracis formosa*. This lead to a more in depth study of skeletal $\delta^{18}O$ and $\delta^{18}C$ from different species and depths of *Madracis*. The combined signal of skeletal $\delta^{13}C$ and $\delta^{18}O$ was shown to be a good indicator for physiological plasticity and adaptation of zooxanthellate corals to distinct depth and light regimes.

The question arose if the depth-specialist species of *Madracis* compensate a decrease in photosynthesis with increasing water depth by shifting to more heterotrophic feeding as suggested for other reef corals. To address this, tissue samples of branching *Madracis* were sampled over a depth gradient from 5 to 50 m, and polyp tissue and zooxanthellae were separated for analyses of $\delta^{13}C$. Further $\delta^{13}C$ and $\delta^{15}N$ of holobiont tissue were analyzed. This set of data allowed for interpreting the carbon and nitrogen assimilation and resource partitioning between polyp and zooxanthellae at respective depths. The stable isotope data indicated, that the shallow water specialist *Madracis mirabilis* is DIN (dissolved inorganic nitrogen) restricted over its entire depth range from 5 to 20 m. The DIN limitation actually hints at very high rates of photosynthesis. On the other hand photosynthesis was not DIC limited at these shallow depths as indicated by the carbon isotopic signals. Comparisons of polyp and zooxanthellae $\delta^{13}C$ on intra-colony scale, between upward facing branch tips and sideward facing position further down at a branch, revealed that at all depths particle capture was higher at the tip of a colony. This must be related to flow regimes forming around a colony and its branches with particle encounter rates being lower at the side of a branch and thus decreasing the success of prey capture. Most strikingly, there was no indication from $\delta^{13}C$ of polyp and zooxanthellae, that the depth specialist species of *Madracis* compensate for the inevitable loss of carbon assimilation due to a reduced photosynthetic rate by increasing their heterotrophic food uptake at increasing water depth. This raises new questions of what other energy supply or "energy saving mechanisms" apply in these reef corals specialized to the low-light environment at depths of 50 m or more.

Contributors: Pieternella Luttikhuizen, Pieter Honkoop and Jan Drent

A basic assumption in evolutionary biology and population dynamics is that eggs are always fertilized. The reproductive success of males is supposedly limited by the availability of females, while resources limit the reproductive success of females.

This is not necessarily true in the marine environment, where many species reproduce by external fertilization and eggs run the risk of never meeting a sperm in their lifetime. Important factors for successful fertilization are being in the vicinity of individuals of the opposite sex (population density), simultaneous spawning, male fecundity and sufficient diffusion or mixing.

Aspects of fertilization kinetics in *Macoma balthica* (L.) were studied by means of field observations, laboratory experiments and mathematical modeling. Our results suggest that fertilization is not always guaranteed for eggs and that females tune the size of their eggs to anticipated sperm concentrations. This is beneficial to the individual females, and they thereby lower their egg numbers at low sperm concentrations. Population dynamics could thus not only be directly affected by fertilization rate, but also indirectly by egg size adjustments.

Spawning induces spawning.
In the laboratory, spawning females inspire males as well as other females to also start to spawn. This effect will greatly enhance realized fertilization rates in the field. It is probably a pheromone released by the females or the eggs themselves that triggers spawning. Intriguingly, though, we also found that spawning in the field is spread out over a period of two months.

Not all males perform similarly.
Among 209 males induced to spawn by a temperature shock, the average number of spermatozoa released per male was 3.4.108, but the variation between males was enormous (Fig. 1). Size differences between the males partly cause this, but cannot explain all variation.

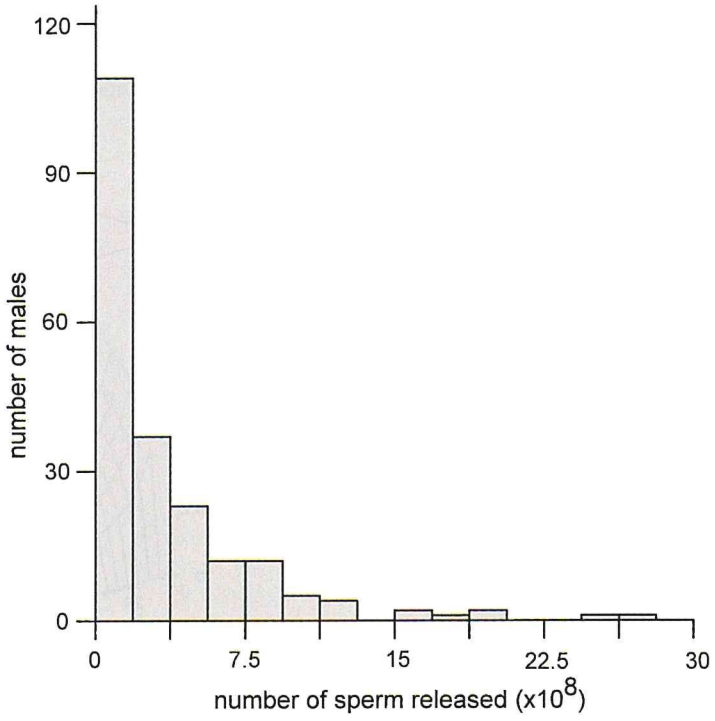


Fig. 1 – Some males spawn many sperm, but most very little.

Are all eggs fertilized?
In *Macoma balthica*, they are probably not. *Macoma balthica* occurs in a range of population densities: the majority of individuals live in densities below 100 per m^2 (Fig. 2). At high densities, more males will be spawning at the same time and so sperm limitation will be less severe than at low population densities. We estimated the relationship between sperm density and fertilization probability in lab experiments, and when we then assume that sperm is well mixed in

the water column in the field, we can make a rough prediction of fertilization probability for eggs in the field (Fig. 3). Because this prediction still contains many uncertainties, these probabilities must be interpreted with caution. Nevertheless, it is clear that fertilization depends very strongly on population density and is probably less (possibly much less) than 100%, given the conditions under which most *Macoma balthica* live.

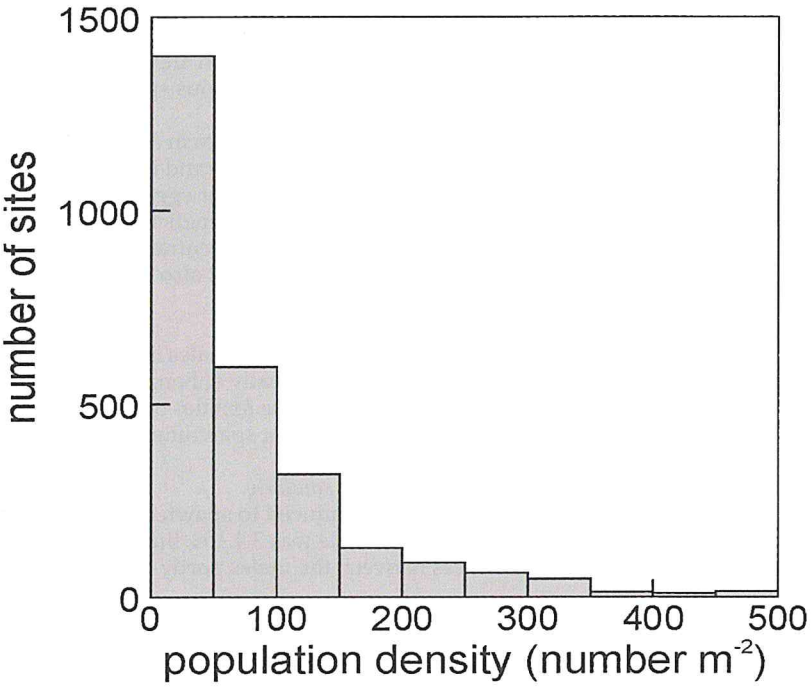


Fig. 2 – Variation in population density of *Macoma balthica* (>10 mm) in the western Dutch Wadden Sea among 2724 sites in 2000 (data: Jan van Gils, NIOZ).

Egg size: females anticipate and adjust.

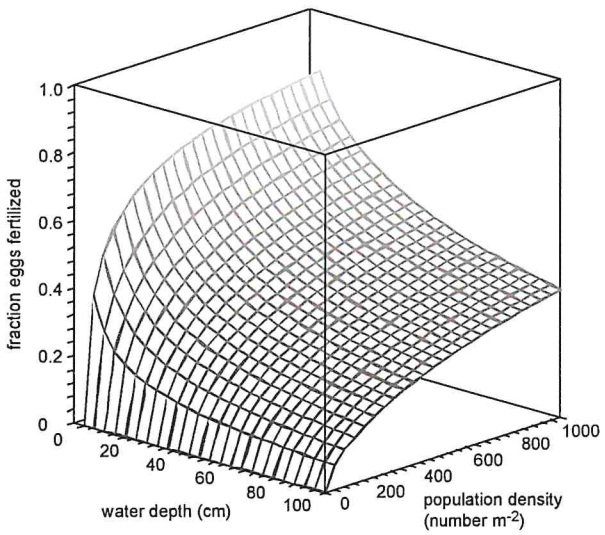


Fig. 3 – Predicted probability for eggs to be fertilized at different population densities and different water depths, under the assumptions that gametes are well-mixed through the water column and spawning is fully synchronized.

Could it be useful to females to increase the size of their eggs when sperm are in short supply, so that the eggs become a larger target for sperm? This has been suggested earlier, and our analysis of a generalized model shows that it is true under a wide range of possible circumstances. And indeed, data on *Macoma balthica* suggest that it really happens in the field (Fig. 4).

The correlation with population density is so strong (a 10% increase in egg diameter means a 25% increase in egg volume and thus about 25% fewer eggs) that it might be expected to impact recruitment success.

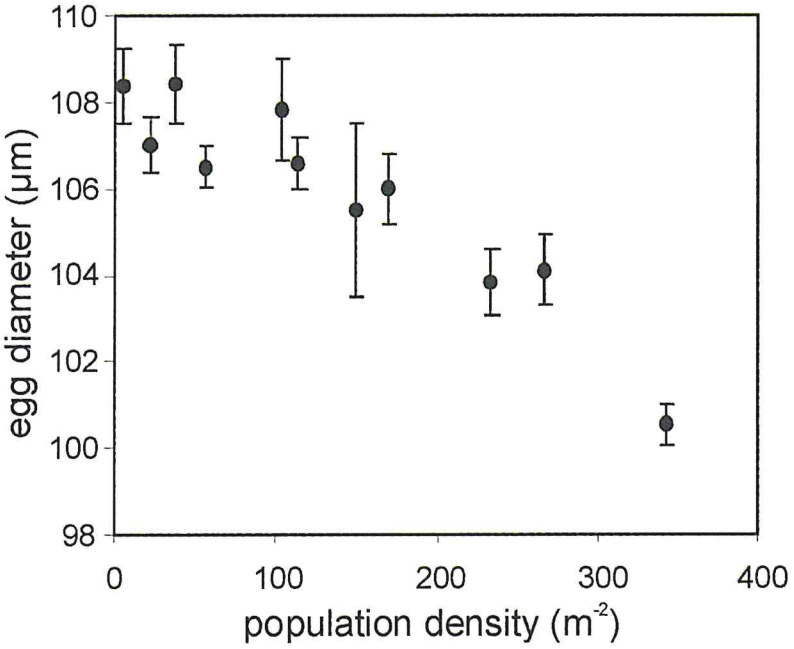
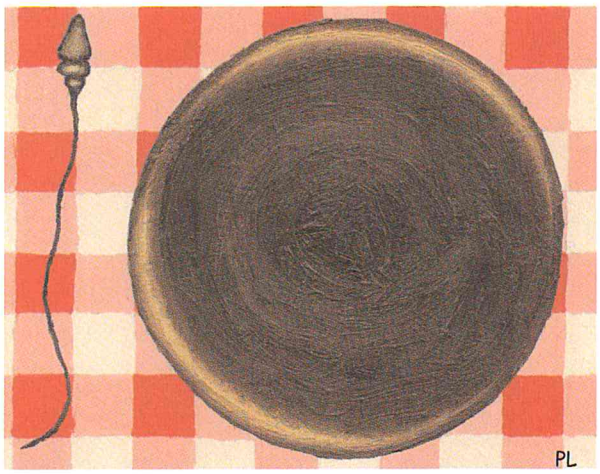


Fig. 4 – Egg size of *Macoma balthica* in the western Dutch Wadden Sea correlates well with population density (egg size data: partly from P. Honkoop and J. van der Meer, 1997, Mar. Ecol. Progr. Ser. 149; density data: partly from J. Beukema and R. Dekker).

The future.

The large variation in recruitment success of benthic marine invertebrates is still for the most part unexplained. To quantitatively investigate the influence of the factor fertilization, several parts of our models and empirical relationships will require more consideration. It will be essential to establish whether the egg size — population density correlation is causal. Also, the effect of egg size on fertilization probability and embryo survival will need to be quantified. The fact that spawning is stretched out over a time span of two months is still a mystery, because one would expect the animals to synchronize their spawning efforts to avoid eggs remaining unfertilized. Could bet-hedging on unpredictable pelagic conditions play a role, and could this increase sperm limitation even further?

A combination between analytical optimization models, mechanistic models of larval growth and of diffusion and dispersal of gametes in moving water, laboratory experiments with spawning populations and transplantation experiments in the field should bring us closer to quantitative answers. And, ideally, methods should be designed to study fertilization in the field that can cope with the turbulent, turbid and unpredictable nature of the soft-sediment tidal environment.



Egg ans sperm cell of *Macoma balthica*

EXTERNAL PROJECTS OF THE DEPARTMENT OF MARINE ECOLOGY AND EVOLUTION

- Biological monitoring programme North Sea and Outer Delta (RWS)
  R. Daan, M. Mulder
- Biological monitoring programme macrobenthos Wadden Sea, Balgzand and Ems-Dollard (RWS)
  R. Dekker, D. Waasdorp
- Decadal variability in marine ecosystems and climate history in corals (NEBROC)
  J. van der Meer, H.J. Lindeboom, C.J.M. Philippart, R.P.M. Bak, C. Maier
- Sustainable use and management of marine ecosystems (ALW)
  J. van der Meer, C.J.M. Philippart, O. Bos
- Interactions between the marine environment, predators and prey, IMPRESS (EU)
  J. van der Meer, C.J. Camphuijsen
- Interference and the spatial distribution of shorecrabs (ALW)
  J. van der Meer, I. Smallegange
- Functional ecology of preen-gland waxes (ALW)
  T. Piersma, J. Reneerkens
- Interference in waders (RUG)
  J. van der Meer, T. Piersma, W. Vahl
- East Kalimantan project (coral reefs) (WOTRO)
  R. Bak
- Towards standardized seabirds at sea census techniques in the UK (Crown Estate)
  C.J. Camphuijsen
- Atlantic coral ecosystem studies (EU)
  G. Duineveld
- Regime shifts at the Frisian Front (FCT, Lisboa, Portugal)
  T. Amaro, G. Duineveld
- Recruitment landers (NWO)
  G. Duineveld, M.J.N. Bergman
- BENDEX expedition Antarctica (AWI)
  M. Lavaleye
- Parasites in birds (Univ. Lisboa)
  J. van der Meer, T. Piersma
- Comparison of tropical and temperate bivalves on mud flats (RUG)
  T. Compton, T. Piersma
- Automatic radio tracking systems (ESF)
  T. Piersma
- Analysis of benthos sampling data western Wadden Sea (Natuurmonumenten)
  T. Piersma
- Structure of coral-algal overgrowth hierarchies (EU)
  M. Nugues, R. Bak
- Survival of waders wintering in Africa (RUG)
  T. Piersma, B. Spaans
- Dynamic energy budgets in Atlantic bivalves, 'Van Gogh' (NWO)
  H. van der Veer
- Energy budgets in bivalves (EU)
  J. Cardoso, H. van der Veer
- Role of shrimps in the ecosystem (EU)
  H. van der Veer

THE NETHERLANDS MARINE RESEARCH FACILITIES (MRF)

Contributor: Marieke J. Rietveld

MRF advises the Earth and Life Sciences Board (GB-ALW) of NWO on the technical, logistic and financial aspects of the execution of the National Programme for sea research. When sea-going projects have been approved and granted by GB-ALW, MRF helps the chief scientists in the planning, preparation and execution of the cruises. MRF also advises GB-ALW on long-term investments, in consultation with the financial department and technical services of NIOZ and advisory committees on CTD systems, auto-analyser systems, moored instrumentation systems, bottom sampling and seismic systems and biological sampling systems. Scientists and technicians from all Dutch scientific groups involved in sea-going research participate in these advisory committees

The updated Long Term Plan on seagoing Marine Facilities 2003 — 2007 was submitted to the NWO advisory Committee for Marine Facilities (CMF) in August 2003 . Every year the Long Term Plan will be updated.

Cruises for the National Facilities Programme in 2003:

In 2003 the National Programme consisted of:

1. PASS-2/BIODEEP, Palaeoceanographic, Palaeoclimatic, Palaeo-environmental and diagenetic Aspects of Sapropel formation in the Eastern Mediterranean with emphasis on the most recent S1 (PASS-2). Project manager and cruise leader Dr. G.J. de Lange, Institute of Earth Sciences, Utrecht University. The project is the sea-going contribution to the EU-programme Sapropels and Paleoceanography (SAP) in combination with the EU-project BIODEEP. The overall aim is a better understanding of the (paleo)functioning of the Eastern Mediterranean and to determine the role in the global environment by studying the characteristic biogeochemical processes in black sediment layers which are extremely rich in organic matter (sapropels). The Project is a co-operation with Italian research groups. This year field work was planned to take place on board the new Italian research vessel UNIVERSITATIS for 12 days, but because of serious technical problems most of the work was taken over by the Italian RV MAREOCEANO. Due to time constraints this cruise was limited to recovery and redeployment of the sediment trap moorings.

   Therefore the opportunity offered in the framework of the Tripartite Agreement to do CTD-work and gravity coring on board the RV L'ATALANTE of IFREMER, during transit from Iraklion to Toulon, was gratefully accepted.

Fig. 1 deployment of sediment trap

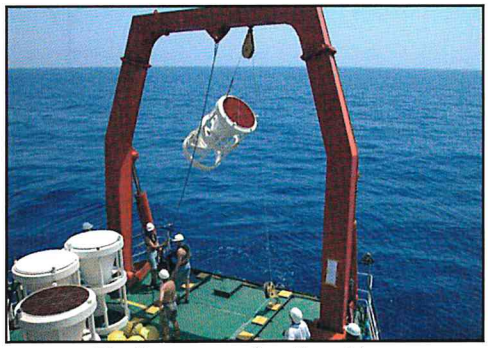
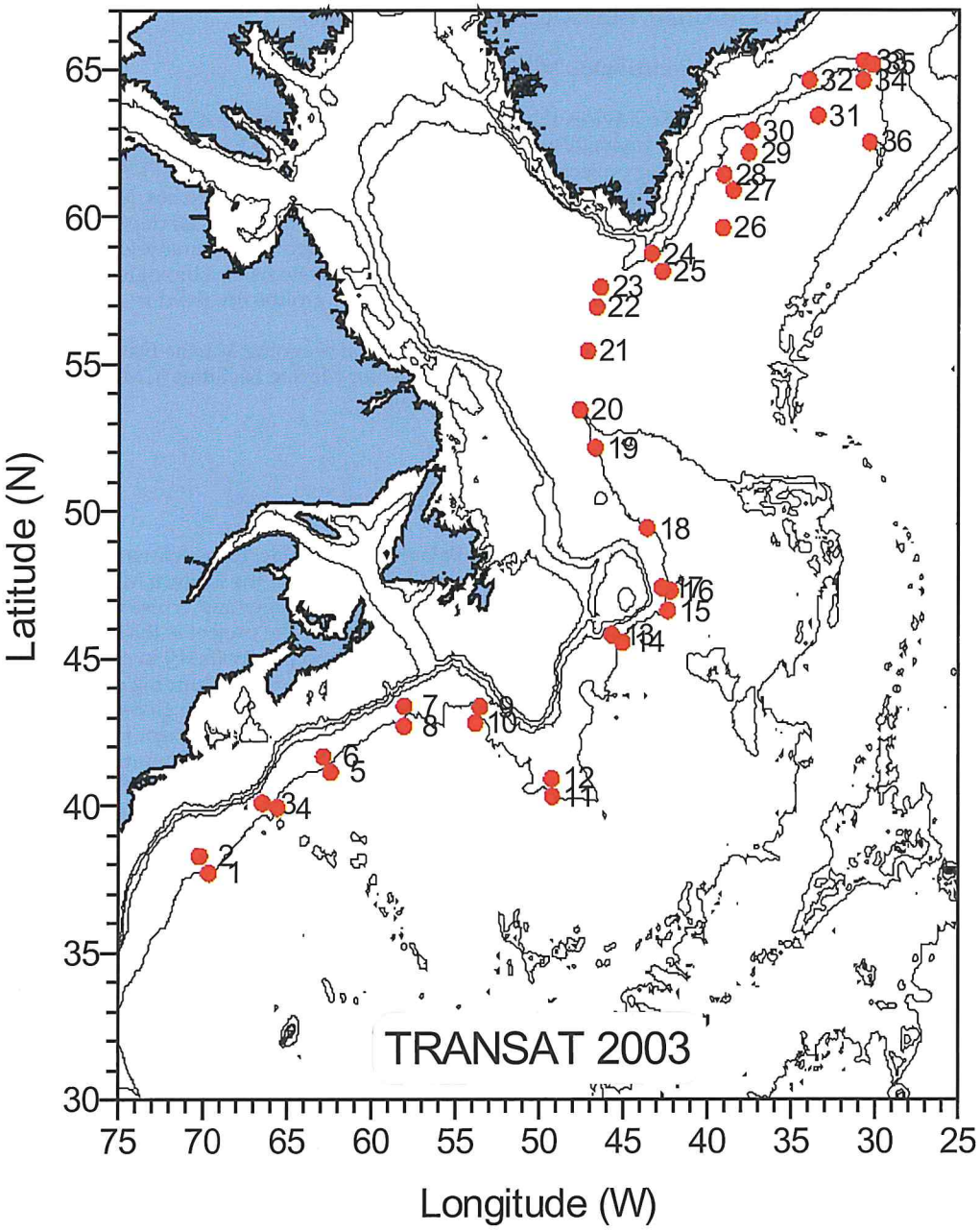


Fig. 2 recovery of sediment trap

2. TRANSAT (Transformation of dissolved organic matter (DOM) in the North Atlantic Deep Water and intermediate waters). Project manager Prof. dr. G. Herndl (NIOZ). This project aims to determine the structural changes in the bacterioplankton community and the DOM in the North Atlantic Deep Water over a time span of around 50 years. A cruise was held in the North Atlantic Ocean from Bermuda along the South tip of Greenland towards the Greenland Iceland Norwegian sea during 28 science days on board R/V PELAGIA, covering a distance of approximately 5000 km.
3. MOMAP (Mortality of marine phytoplankton in ecosystems with contrasting trophic status (oligotrophic vs eutrophic)). Project manager Dr. Corina Brussaard (NIOZ). This project has three main goals: first to elucidate the ecological role of phytoplankton cell lysis in systems along a large trophic gradient. Secondly, to identify and understand the mechanisms controlling phytoplankton mortality. Thirdly, to comprehend the effects of environmentally relevant variables on the different algal mortality processes. A 14 day cruise on board RV PELAGIA was done in the Central North Sea in July 2003.



Transect TRANSAT-2 cruise 8 May – 5 June 2003

4. BADE-1 (Bacterioplankton cell death: the diel variations in microbial activity in the surface layers of the Western Mediterranean Sea gyre as influenced by ultraviolet radiation; project manager Prof. Dr. G. Herndl, NIOZ) a cruise of 21 science days was performed in the Western Mediterranean on board RV PELAGIA. All measurements were done following a drifting buoy within the gyre system.
5. For the EUROCORES project MOUNDFORCE 2003 (The distribution, morphology and sedimentology of mud mounds in the Faeroe Shetland Channel and carbonate mounds at the South West Rockall Trough Margin; project leader Prof. Dr. T.C.E. van Weering, NIOZ, chief scientist Dr. H. de Haas, NIOZ) a 27 day cruise was performed on RV PELAGIA in both areas.
6. For the EUROCORES project MEDIFLUX/NAUTINIL 2003 (An integrated study of seepage through the seabed of the Nile deep-sea fan; chief scientist Dr. J.P. Foucher, IFREMER, co-chiefs Dr. J. Woodside, VUA and Dr. G. de Lange, UU), a 30 day cruise was performed on the French RV L'ATALANTE with the submersible NAUTIL of IFREMER in the Eastern Mediterranean and Nile Delta.

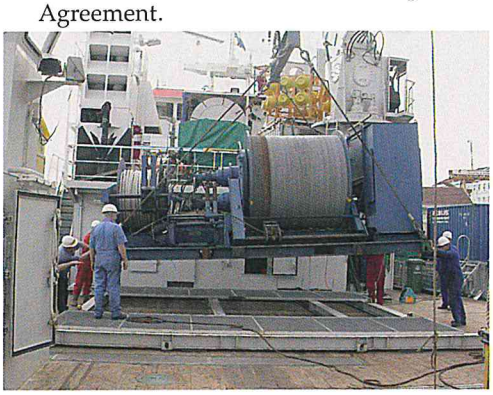
Three cruises for the NWO large-investment grant for the LOCO project (Long-Term Ocean Climate Observations) were performed.

7. LOCO/IW (Long-Term Ocean Climate Observations — Internal Waves; project managers Dr. H. van Haren and Dr. L. Maas, NIOZ) a 29 day cruise comprising 12 science days was performed in February/March in the Canary Basin on board RV PELAGIA.
8. LOCO/North Atlantic (Long-Term Ocean Climate Observations — North Atlantic; project manager Dr. H. van Haren, NIOZ) moorings were deployed during 4 science days in August in the Irminger Sea, in combination with the NIOZ CLIVAR cruise CAMP in the North Atlantic on board RV PELAGIA
9. LOCO/Mozambique (Long-Term Ocean Climate Observations — Mozambique Strait; project manager Dr. Ir. H. Ridderinkhof, NIOZ) a 16 day cruise, comprising 6 station days was performed on board the UK research vessel RRS CHARLES DARWIN in the Mozambique Strait. This cruise was part of the tripartite ship-time exchange agreement.

Proposed cruises for the National Facilitation Programme in 2004:

For next year, NIOZ has proposed the following cruises to GB-ALW of NWO

1. BADE project (Bacterioplankton cell death); project manager Prof. Dr. G. Herndl, NIOZ, a 21 day cruise was advised in the Atlantic Ocean off Mauritania on board RV PELAGIA.
2. As for the ODP proposal 549-Full2 (project manager Dr. J.W. Zachariasse, UU) the preparative cruise on board the UK research vessel RRS CHARLES DARWIN had to be cancelled because of the war situation in Iraq, the cruise had to be postponed till 2004, and is planned to be sailed on the RV MARION DUFRESNE of Institut Polaire Emile Victor (IPEV) France.
3. For ongoing EUROCORES projects MOUNDFORCE and MEDIFLUX cruises were advised on RV PELAGIA for 30 days in the Gulf of Cadiz and in the Rockall/Porcupine area and in the Faeroe Shetland Channel for MOUNDFORCE and 28 days on RV PELAGIA in the Eastern Mediterranean in the Anaximander and Nile Delta areas for MEDIFLUX.
4. For the NWO large-investment grant for the LOCO project (Long-Term Ocean Climate Observations) two ongoing cruises were advised. One cruise for LOCO/North Atlantic (project manager Dr. H. van Aken, NIOZ) for 6 days in the Irminger Sea in the North Atlantic on board RRS CHARLES DARWIN and for LOCO/Mozambique (project manager Dr. Ir. H. Ridderinkhof, NIOZ) in March 2005 for 6 days on board the UK research vessel RRS DISCOVERY in the Mozambique Strait. Both cruises as part of the ship time Tripartite Agreement.



Loading the Towed Ocean Bottom Instrument winch on RV PELAGIA. (photo courtesy SOC)

Deploying TOBI from RV PELAGIA (photo courtesy SOC)

Tripartite Agreement o the Ocean Facilities Exchange Group)

In the framework of the Tripartite Agreement, the Ocean Facilities Exchange Group (OFEG, the former MFTG), met in April at IFREMER in Toulon, and in November at NIOZ.

Participants are: NERC and SOC (UK), IFREMER (Fr), BMBF (De) and NIOZ. UTM-CMIMA (Sp) attended the meetings as an observer.

In this framework three cruises were performed.

1. The above cruise number 9
2. The additional work of cruise number 1.
3. On RV PELAGIA a cruise of 18 science days was performed in November 2003 for the EUROSTRATAFORM project; project manager Dr. P.P.E. Weaver, SOC, chief scientist Dr. D.G. Masson, SOC) for the work with the Towed Ocean Bottom Instrument (TOBI) in the North Atlantic off the Portuguese margin and on the Galicia Bank in the area where the Oil Tanker Prestige sank early 2003.

DATA MANAGEMENT GROUP

Contributors: T.F. de Bruin, R.X de Koster, M.A. Hiehle, J. Nieuwenhuis, H. Ridderinkhof

The Data Management Group (DMG) is a separate group within the department of Physical Oceanography, funded by ALW and NIOZ.
It has a national role as data centre for the academic oceanographic community. It also acts as National Antarctic Data Centre (NADC).

The main tasks of the DMG are to:
* assist scientists during all phases of a project with data handling
* archive and keep available and accessible all relevant data of ALW and NIOZ cruises.

The DMG maintains a series of databases and project web sites. Part of these are dynamically linked.

The emphasis of the DMG activities in 2003 has been on adding new CTD profiles to the central CODIS information system. The CODIS system now contains over 4200 temperature and salinity profiles, with more than 3 million data records and is accessible by Internet. As a result, the areal and temporal densities of the data holdings in the database make data mining feasible for certain regions. As shown in figs. 1 and 2 the density of data in both the Southern Bight of the North Sea and in the Bay of Biscay opens up possibilities for new research.

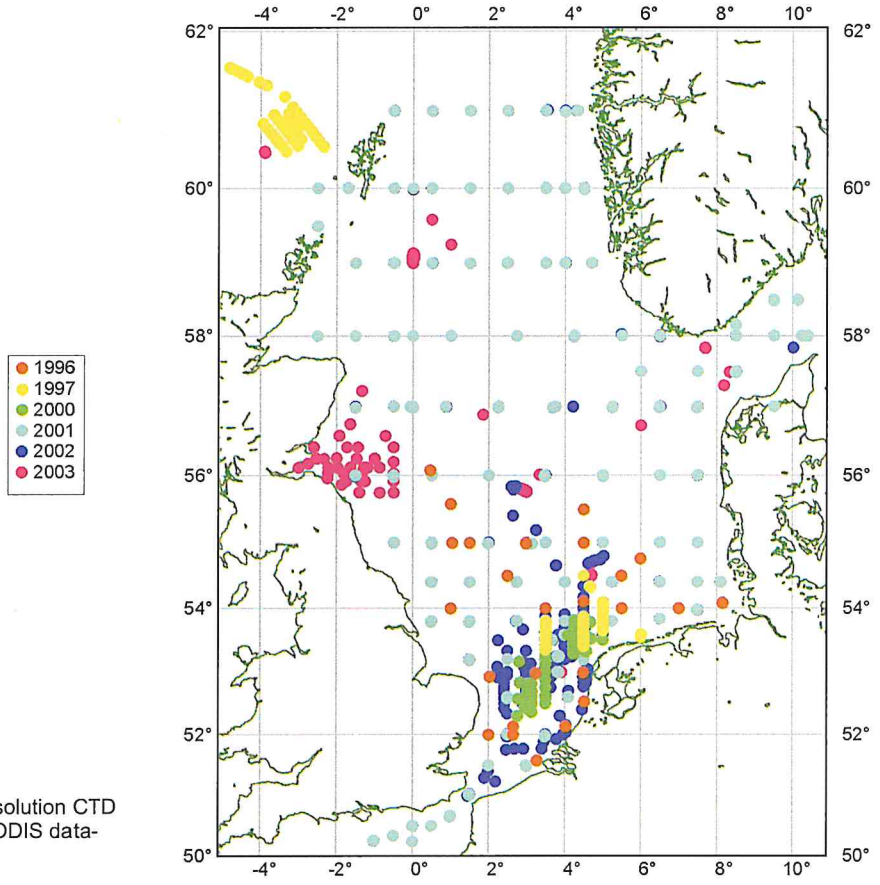


Fig. 1. Areal and temporal density of high-resolution CTD casts in the North Sea, as available in the CODIS data- and information system.

Another ongoing activity is assistance of scientists with data handling questions. Many requests for data, both from within the institute as from outside, were answered. These request are very diverse and range from questions on support for a new research vessel for Peru to supplying all available NIOZ data to the final JGOFS data DVD. Answering these requests fits perfectly in the end-to-end data management philosophy, adopted by the DMG since its inception. During the TRANSAT-2, IMPRESS, MOMAP and BADE-1 cruises, the DMG assisted the scientists onboard with the delivery and interpretation of remote sensing data and other information, in cooperation with M. Wernand.

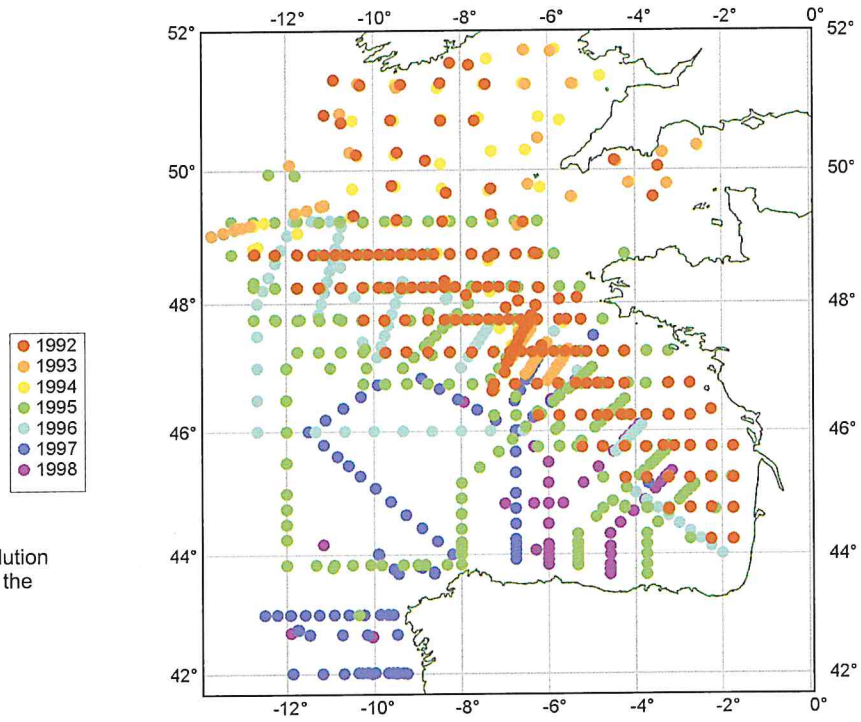


Fig. 2. Areal and temporal density of high-resolution CTD casts in the Bay of Biscay, as available in the CODIS data- and information system.

Staff of the DMG participated in 2 cruises, notably in the LOCO-IW and the CAMP/LOCO-cruises, as well as in several 24-hours cruises within the Marsdiep-project. Part of the post processing of the CTD data for these and other cruises, was carried out by the DMG.
All relevant digital data, collected during the Pelagia cruises, have been archived on CD-ROM or DVD and are stored in a safe, for use in case of permanent loss of data by the scientist. Following technical developments and due to the increased size of the collected datasets, the DMG acquired DVD-writers and has started the migration of the CD-ROM archive to DVD.

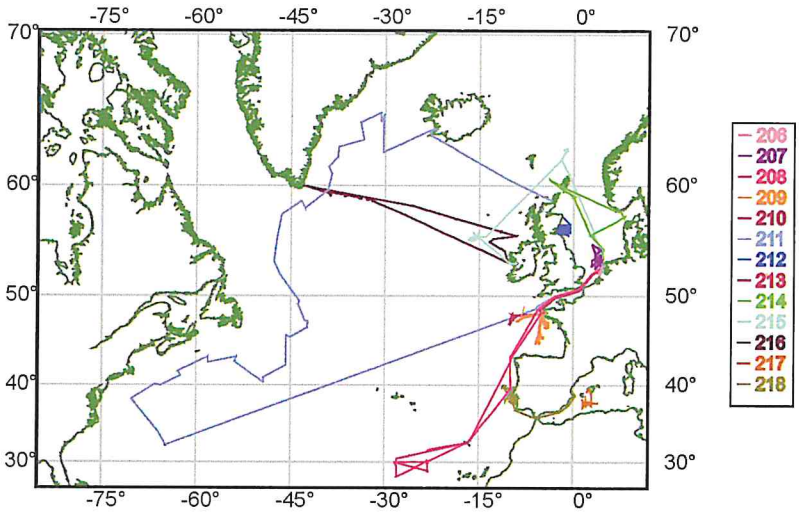
Besides this archive on CD-ROM/DVD the DMG also maintains a series of databases, most of these in connection with project web sites.

In 2003 the MOVE web pages were added to the project websites, which are built and maintained by the DMG (see also annual reports 2001 and 2002). The DMG also developed new web-enabled request forms for the Experimental Seawater Facilities. Besides, the DMG overhauled the IRONAGES web pages and contributed to the development of the NIOZ web site.

The DMG represents NIOZ and the Dutch academic oceanographic community within the National Oceanographic Data Committee (NODC). T. F. de Bruin was elected as NODC Chairman in 2003.
As participant in the NODC, NIOZ actively participates in international projects and organisations like the EU-SeaSearch project, the IOC Committee on International Oceanographic Data and Information Exchange (IODE) and the ICES-Working Group on Marine Data Management.

Furthermore, web sites for the secretariats of the NODC and the International Research Ship Operators' Meeting (ISOM) are maintained by the DMG.

An additional task of the DMG is the development and maintenance of the Netherlands Antarctic Data Inventory (NADI, http://www.nioz.nl/projects/antarctica) for the Antarctic research projects in the Netherlands. One member of the staff represents the Netherlands in the Joint Committee on Antarctic Data Management (JCADM), for which he is currently the Deputy Chief Officer. The activities of the DMG concentrated on the (successful) recruitment of 10 new nation-members in JCDAM, which now has representation from 26 countries.



R.V. Pelagia cruises 2003

Cruise number	Project	Departure	Arrival	Specific area	Chief scientist
64PE206	BIVALFF	Feb. 10, Texel	Feb. 14, Texel	Frisian Front	Drs. G. Duineveld
64PE207	CRENS	Feb. 17, Texel	Feb. 21 Texel	North Sea/Skagerrak	Dr. J. Sinninghe-Damste
64PE208	LOCO	Feb. 27, Texel	Mar. 24, Brest	Canary Basin	Dr. H. van Haren
64PE209	Charter Thales	Mar. 26, Brest	Apr. 15, Brest	NW Atl. Oc	Mar. Res. Facilities
64PE210	Test seismics	Apr. 16, Brest	Apr. 19, Texel	English Channel S. North Sea	Dr. T. van Weering
64PE211	TRANSAT-2	Apr. 24, Texel	Jun. 5, Peterhead	Bermuda - GIN Sea	Prof. Dr. G. Herndl
64PE212	IMPRESS	Jun. 8, Peterhead	Jun. 19, Texel	Firth of Forth	Dr. J. van der Meer
64PE213	BIVALFF	Jun. 23, Texel	Jun. 27, Texel	Frisian Front	Drs. G. Duineveld
64PE214	MOMAP	Jul. 9, Texel	Jul. 20, Texel	North Sea	Dr. C. Brussaard
64PE215	MOUNTFORCE 2003	Jul. 23, Texel	Aug. 20, Galway	Rockall/Porcupine	Dr. H. de Haas
64PE216	CAMP/LOCO	Aug. 22, Galway	Sep. 11, Galway	Iceland Basin	Dr. H. van Aken
64PE217	BADE-1	Sep. 13, Galway	Oct. 9, Valencia	West Mediterranean	Prof. Dr. G. Herndl
64PE218	CANYONS-2	Oct. 11, Valencia	Nov. 2, Lisbon	Off Portugal	Dr. H. de Stigter
64PE219	Charter-EuroStrataForm	Nov. 5, Lisbon	Nov. 27, Texel	n.a.	SOC, Dr. P. Weaver
64PE220	BIVALFF	Dec. 1, Texel	Dec. 5, Texel	Frisian Front	Drs. G. Duineveld
64PE221	Charter-CORDAH	Dec. 8, Texel	Dec. 15, Texel	Off Aberdeen	MRF

Contributors: C.J.M. Philippart, B. Bak-Gade, J.J. Beukema, G.C. Cadée and H.G. Epping

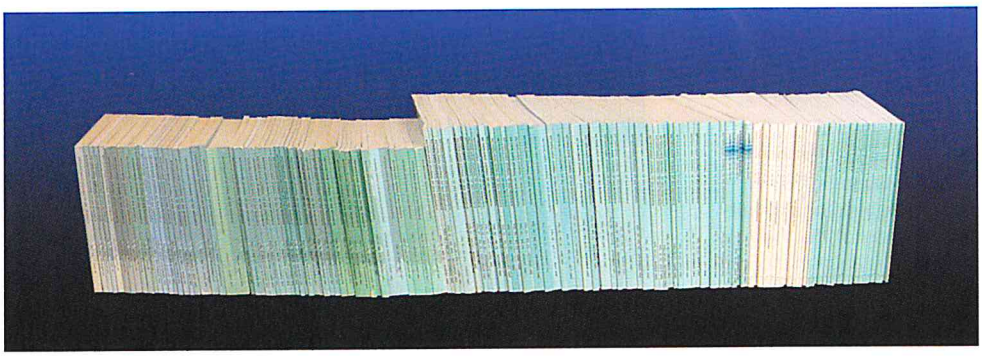
Short History
In April 1961, the greatly expanding activities of the Netherlands Institute for Sea Research (NIOZ) induced the Netherlands Zoological Society to issue a new periodical, the Netherlands Journal of Sea Research (NJSR). In 1996, the journal's name was changed into the Journal of Sea Research to reflect the broadening of the geographical origin of the authors. Since 1997, the journal is published by Elsevier Science, whereas scientific responsibilities stayed within NIOZ. From 2002 onwards, ScienceDirect® offers full electronic access to the Journal, listing back to volume one, issue one.

Editorial Office
During its entire history, the Editorial Office of the Journal has been situated at the Netherlands Institute for Sea Research. For a long period (1985-1999) the Journal was guided by benthic ecologist Jan Beukema. Birthe Bak-Gade became the assistant editor of the Journal in 1989. They were joined by NIOZ-colleagues Gerhard Cadée in 1990 (phytoplankton dynamics), Katja Philippart (benthic ecology) in 1996 and Wim van Raaphorst (marine chemistry) in 1999. In 2000, C.J.M. Philippart was made responsible for the Journal. Tragically, Wim van Raaphorst died in a car accident in November 2002, and is still sorely missed by all. Eric Epping (Department of Marine Chemistry and Geology) joined as an editor in 2003. He will be mainly responsible for manuscripts relating to pelagic and benthic microbiology and chemistry.

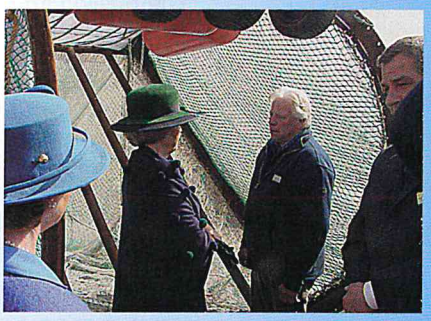
Publications in 2003
In 2003, the Journal published volumes 49 and 50, each consisting of four issues and together comprising 50 research papers and 5 short communications. Part II of the Proceedings of the international scientific symposium on "Structuring Factors of Shallow Marine Coastal Ecosystems" was published as the first Special Issue of this year, viz. 49(2). The second Special Issue, viz. 49(4), was dedicated to the Proceedings of the 22nd Conference of the Baltic Oceanographers, held in Stockholm in November 2001. The third Special Issue, viz. 50 (2-3) comprised Part I of the Proceedings of the Fifth International Symposium on Flatfish Ecology, which was held in November 2002 on the Isle of Man.

Historical and Future Scope
Over the past 40 years, the scope of the journal has remained largely unaltered, covering multi-disciplinary marine research in seas and oceans. During the past decade, we have observed a gradual shift towards a preponderance of papers dealing with benthic ecology of shallow marine coastal waters. From the first volume of 2004 onwards, the scope of the Journal of Sea Research will emphasize the functioning of marine ecosystems in coastal and shelf seas, including intertidal, estuarine and brackish environments. As several subdisciplines add to this aim, the JSR will publish papers from the fields of marine biology, marine chemistry, marine sedimentology and physical oceanography, provided they add to the understanding of marine ecosystem processes.

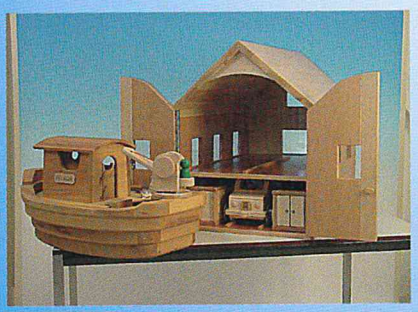
Co-editorial Board
From 1985 onwards, the journal has benefited from the help of an outstanding board of co-editors. In principle, every manuscript that is sent out for in-depth peer review is refereed by at least one of the co-editors. The efforts of the co-editors over the years are keenly appreciated. With regard to the trends and plans in scientific scope, the JSR recently updated the expertise within their Editorial Board. With the help of its continuing and new co-editors, JSR hopes to serve readers and authors in communicating on the structuring factors of shallow marine coastal ecosystems in the years to come.



QUEEN BEATRIX OPENS OUR NEW BUILDINGS



First the Queen officially opens the buildings by setting a model of the thermohaline circulation in motion. After that she visits the departments.



The ceremony ends with a reception in our new canteen. Ruud Daalder presents the NIOZ gift, which he constructed, to the Queen for her grandchildren.

Pictures:
Bert Aggenbach, NIOZ

2. Publications and Presentations

PUBLICATIONS

Dissertations

Diekmann, O.E. The coral genus Madracis: Speciation in corals and their symbionts. University of Amsterdam, 136 pp.

Luttikhuizen, P.C. Spatial arrangement of genetic variation in the marine bivalve *Macoma balthica* (L.). University of Groningen, 183 pp.

Manders, A.M.M. Internal wave patterns in enclosed density-stratified and rotating fluids, University of Utrecht, 144 pp.

Schefuß, E. Paleo-environmental effects of the Mid-Pleistocene Transition in the tropical Atlantic and equatorial Africa. University of Utrecht, Geologica Ultraiectina 223: 187 pp.

Smittenberg, R.H. Holocene environmental changes disclosed from anoxic fjord sediments by biomarkers and their radiocarbon content. University of Utrecht, 143 pp.

Van Dongen, B.E. Natural sulfurization of carbohydrates in marine sediments: Consequences for the chemical and stable carbon isotopic composition of sedimentary organic matter. University of Utrecht, 149 pp.

Zemmelink, H.J. Dimethylsulphide, measuring emissions from the ocean to the atmosphere. University of Groningen, 165 pp.

Refereed papers and books

1. Akhmetzanov, A.M., N.H. Kenyon, M. Ivanov, A. Wheeler, P.V. Shaskin & T.C.E. Van Weering. Giant carbonate mounds and current swept seafloors on the slopes of the southern Rockall Trough. In: Mienert, J. & Ph. Weaver (eds.). European Margin Sediment Dynamics, Springer Publishers: 203-211.
2. Amaro, T., G. Duineveld, M. Bergman & R. Witbaard. Growth variations in the bivalve *Mya truncata*: a tool to trace changes in the Frisian Front macrofauna (southern North Sea)? Helgol. Mar. Res. 57: 132-138.
3. Antia, A.N., P. Burkill, W. Balzer, H.J.W. De Baar, R.F.C. Mantoura, R. Simó & D. Wallace. Coupled biogeochemical cycling and controling factors. In: Wefer, G., F. Lamy & F. Mantoura (eds.). Marine Science Frontiers for Europe, Springer-Verlag, Berlin: 147-162.
4. Bak, R.P.M. & E.H. Meesters. Acclimatization/adaptation of coral reefs in a marginal environment. Proc. 9th Int. Coral Reef Symposium Vol 1: 265-272.
5. Battley, P.F., D.I. Rogers, T. Piersma & A. Koolhaas. Behavioural evidence for heat-load problems in great knots in tropical Australia fuelling for long-distance flight. Emu 103: 97-103.
6. Battley, P.F., M. Poot, P. Wiersma, C. Gordon, Y. Ntiamoa-Baidu & T. Piersma. Social foraging by waterbirds in shallow coastal lagoons in Ghana. Waterbirds 26: 26-34.
7. Battley, P.F., W.K. Vahl & B. Spaans. Ruddy Turnstone retains egg in oviduct for five months. Wader Study Group Bull. 101/102: 67-69.
8. Bayne, B.L. & P.J.C. Honkoop. Phenotypic flexibility. Trends Ecol. Evol. 18: 554-555.
9. Beukema, J.J. & R. Dekker. Redistribution of spat-sized *Macoma balthica* in the Wadden Sea in cold and mild winters. Mar. Ecol. Prog. Ser. 265: 117-122.
10. Bianchi, A., O. Tholosan, J. Garcin, T. Polychronaki, A. Tselepides, R. Buscail & G. Duineveld. Microbial activities in the benthic boundary layer in the Aegean Sea. Prog. Oceanogr. 57: 219-236.
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12. Booij, K., C.V. Fischer, H.E. Hofmans & E.M. Van Weerlee. Temperature-dependent uptake rates of nonpolar organic compounds by semipermeable membrane devices and low-density polyethylene membranes. Environ. Sci. Technol. 37: 361-366.
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24. De Vooys, C.G.N. Effect of a tripeptide on the aggregational behaviour of the blue mussel, *Mytilus edulis*. Mar. Biol. 142: 1119-1123.
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64PE196-EMIR	M.A.Hiehle
64PE204-CANYONS	M.A.Hiehle
64PE207-CRENS	M.A.Hiehle
64PE208-LOCO	M.A.Hiehle
64PE213-BIVALFF	M.A.Hiehle
64PE214-MOMAP	M.A.Hiehle
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White, M., H. De Stigter, H. De Haas & T.C.E. Van Weering. The influence of benthic dynamics on the carbonate mound ecosystem. Ocean Margin Research Conference, Paris, France, 15-17 August.

Oral presentations

Amaro, T., G. Duineveld, M. Bergman & R. Witbaard. Growth variations in the bivalve *Mya truncata*: a tool to trace changes in the Frisian Front macrofauna (southern North Sea)? BEM 2003, Connecticut, USA, 27-30 March.

Arrieta, J.M. & G.J. Herndl. Bacterial beta-glucosidase diversity in two marine systems. Enzymes in the Environment: Activity, Ecology and Applications, 7-12 July.

Baars, M.A. & S.S. Oosterhuis. Secondary production measured with the *in situ* chitobiase method in different water masses of the southern North Sea. 3rd International Zooplankton Production Symposium, Gijón, Spain, 22 May.

Bak, R.P.M. Tropical Aquatic Ecology (Tropical Marine Biology) Lectures series, University of Amsterdam, January/February.

Bak, R.P.M. Coral Reefs (Master Course Limnology and Oceanography)) Lectures series, University of Amsterdam, November/December.

Bak, R.P.M. What is the status of coral reefs in East Kalimantan in terms of coral health and environmental stress? Samarinda EKP Meeting 20 October.

Bergman, M.J.N. & G. Duineveld. Monitoring- en Evaluatie Programma Near Shore Windpark (MEP-NSW). Bodemfauna. NOVEM-meeting, Utrecht, 6 March.

Blamart, D., T.C. Rollion-Bard, J.-P. Cuif, A. Juillet-Leclerc, A. Lutringer, T.C.E. Van Weering & J.-P. Henriet. C and O isotopes in deep-sea corals (*Lophelia pertusa*) measured by ion microprobe. Second International Symposium on Deep-Sea Corals, Erlangen, Germany, 8-13 September.

Bombardiere, L., P. Farrimond, R. Tyson, A. Forster & J.S. Sinninghe Damsté. High resolution biogeochemistry in the Upper Cenomanian Black Shales of the Umbria Marche Basin (Central Italy). Abstract EGS-AGU-EUG Joint Assembly, Nice, France, 6-11 April.

Bonnin, J. Cycling of silica in the Faeroe-Shetland Channel. Geochemie Actie, Utrecht, 19 June.

Booij, K. Assessing danger and damage of chemicals in the marine environment. Symposium "Black Tide", West-Terschelling, 14 March.

Booij, K. The basic environmental chemistry and ecotoxicology behind the MARPOL treaty. Marine Environmental Awareness Course, NIOZ, 5 March, 9 October, 12 November.

Boon, J.P. & C.C. Ten Hallers-Tjabbes. Environmental impact of TBT anti-fouling. Policy and the future. Marine Environmental Awareness Course, NIOZ, 4 March.

Boon, J.P. Is Brittania ruling Dutch waves? Rotary clubs of Texel and West-Malling (UK), NIOZ, 24 May.

Boon, J.P., B.N. Zegers & A. Mets. Brominated Flame Retardants: Analysis, Occurrence in the European Environment, and Biotransformation. 5th Agilent Technologies Environmental MS meeting, Chester, UK, 19-20 June.

Boon, J.P., B.N. Zegers, W.E. Lewis, M. Tjoen-A-Choy, A. Mets, R.H. Smittenberg & W. Boer. Brominated Flame Retardants: Friend or Foe ? NIOZ colloquium, 9 January.

Boon, J.P., M.H. Bik & P. Bonnet. The Marine Environmental Awareness (MarEnA) Course. Introduction and Goals. MarEnA Courses, 3 March, 6 October and 10 November.

Boon, J.P., M.J. Veldhuis & C.C. Ten Hallers-Tjabbes. Environmental research on shipping-related issues at the Royal NIOZ. Guest lecture at the institute of Environmental Research and Engineering (IESE) at the Nanyang Technological University. Singapore, 22 July.

Boon, J.P., M.J. Veldhuis, C.C. Ten Hallers-Tjabbes, H. Van Niekerk, H. Schilperoord & S. Vlaski. Biological hazards of modern shipping. Unwanted transport of sediment and biota; how to react? A challenge for 'the Netherlands Ltd'. Symposium on methods for ballast water treatment methods, VOPAK Shipping Company, Dordrecht, 26 September.

Boon, J.P. The Marine Environmental Awareness Course for Seafarers and Students of the Dutch Maritime Academies, programme and goals. Lecture for a delegation of politicians from Northern Ireland, the Texel Academy, and the Municipality of Texel, NIOZ, 28 May.

Bos, O.G. Recruitment variation of *Macoma balthica*: the role larval food limitation. TNO seminar series, Den Helder, 10 September, NIOZ seminar series, 11 September and RIVO seminar series, Yerseke, 20 October.

Bos, O.G. Recruitment variation of *Macoma balthica*: Testing the Match-Mismatch hypothesis. Benthic Ecology Meeting, Groton, USA, 27 March- 2 April.

Bozec, Y., H. Thomas, K. Elkalay & H.J.W. De Baar. Inorganic carbon characteristics in the North Sea. EGS-AGU-EUG Joint Assembly, Nice, France, 6-11 April.

Brummer, G.-J.A. Top-down, sideways and up: particulate fluxes between upper ocean and buried sediment. University Utrecht seminar, 20 February.

Brummer, G.-J.A., S. Schouten & J. Ossebaar. Stable carbon and nitrogen characterisation of the Somali margin. 6C Annual Meeting, Southampton Oceanography Center, U.K. 1-2 October.

Brussaard, C. P. D. Role of viruses in controlling phytoplankton blooms. CIESM Workshop on Ecology of Marine Viruses, Banyuls-sur-Mer, France, 19-22 March.

Brussaard, C. P. D. Viral Control of Phytoplankton. Joint meeting of the Society of Protozoologists and the Phycological Society of America on "Microbial Controls of Planktonic Microalgae", Gleneden Beach, Oregon, 15-20 June.

Buijsman, M.C. ADCP Observations of Secondary Flow in the Marsdiep Inlet. Netherlands Centre for Coastal Research, 3 March.

Buijsman, M.C. Lateral Structure of Flow in Marsdiep Tidal Inlet. Buys Ballot Research School, Garderen, 5-7 November.

Cadée, G.C. Fragmented shells are more interesting than entire shells. Dutch Malacological Society, Texel, 13 September.

Cadée, G.C. Drift seeds, Nationaal Herbarium Leiden, 23 January.

Cadée, G.C. Origin and importance of nature reserve 'de Slufter' on Texel. Milieufederatie N-Holland, Texel, 14 August.

Camphuysen, C.J. Chronic oil pollution and the value of beached bird surveys as an independent monitoring tool. Key note address 7th International Conference Effects of Oil on Wildlife, Hamburg, Germany, 14-16 October.

Camphuysen, C.J. Natural variability issues: predicting abundances from insufficient data. COWRIE workshop, University of Aberdeen, UK, 24 November.

Camphuysen, C.J. Onderzoek aan zeezoogdieren in Nederland. ZON workshop, TNO, Den Haag, 4 September.

Camphuysen, C.J. World fisheries, deep trouble. Cursus Global Ecology, Royal NIOZ, 10 September.

Coolen, M.J.L., G. Muyzer, S. Schouten, J.K. Volkman & J. S. Sinninghe Damsté. Lipid and fossil rDNA stratigraphy reveals impact of environmental changes on the ancient microbial community of meromictic, euxinic Ace Lake (Antarctica). NATO Advanced Research Workshop on Past and Present Water Column Anoxia, Sevastopol 2003, Crimea, Ukraine, 4-8 October.

Coolen, M.J.L., G. Muyzer, S. Schouten, J.K. Volkman & J.S. Sinninghe Damsté. Impact of Holocene climate change on the ancient species composition of Ace Lake (Antarctica) as revealed by stratigraphic analysis of lipids and fossil rRNA genes. Special Seminar Series on the Deep Biosphere, Woods Hole Oceanographic Institution, USA, 6 September.

Coolen, M.J.L., G. Muyzer, S. Schouten, J.K. Volkman & J.S. Sinninghe Damsté. Impact of Holocene climate change on the ancient species composition of Ace Lake (Antarctica) as revealed by stratigraphic analysis of lipids and fossil rRNA genes. CSIRO Australia, Division of Oceanography Marine Laboratories, Hobart, Tasmania, Australia, 4 November.

Costello, M.J., M. McCrea, A. Freiwald, T. Lundalv, L. Jonsson, B.J. Bett, T.C.E. Van Weering, H. De Haas, M.J. Roberts & D. Allen. Function of deep-sea cold-water *Lophelia* coral reefs as fish habitat in the eastern Atlantic. Second International Symposium on Deep-Sea Corals, Erlangen, Germany, 8-13 September.

De Baar, H.J.W. Emissions by ships into the atmosphere; Marine Environmental Awareness Course for the Maritime Schools; Texel, 5 March, 7 October, 11 November.

De Baar, H.J.W. IJs, Lucht, Zee en Klimaat (Ice, Air, Sea and Climate); (i) Royal NIOZ Open House for the Public, Texel, 5 April; (ii) Van ReenenPark Society, Bergen, 22 May; (iii) invited lecture Intercity-meeting Rotary district, Texel, 13 November.

De Baar, H.J.W. Interaction between trace element cycles and marine ecosystems; (i) invited keynote lecture, First workshop international GEOTRACES (GEOSECS II) initiative, Toulouse, France, 14 April; (ii) invited colloquium series Department of Earth Sciences, University of Cambridge, Cambridge, U.K., 4 November.

De Baar, H.J.W. Lecture Series Oceanography, University of Groningen, 10-19 February.

De Baar, H.J.W. Natural and human-induced iron and nitrogen additions to the ocean. Invited lecture and chair of IGBP Working Group A4 session, Third IGBP Congress, Banff, Canada, 20 June.

De Baar, H.J.W. Southern Ocean Fertilization Experiment, presentation for support departments Royal NIOZ, 20 February.

De Baar, H.J.W., K.R. Timmermans, L.J.A. Gerringa, E. Buitenhuis, P. Laan, C. Lancelot, O. Aumont, G. Sarthou, A. Bowie, S. Blain & P. Worsfold. Co-limitation by light and multiple nutrients; (i) invited keynote lecture, JGOFS Final Open Science Conference, U.S. National Academy of Sciences, Washington D.C., USA, 6 May; (ii) invited guest lecture, Woods Hole Oceanographic Institution, Woods Hole, USA, 12 May; (iii) Marine Global Ecology Course of University of Amsterdam site visit at Royal NIOZ, 10 September; (iv) colloquium series Royal NIOZ, 2 October.

De Bruin, T.F. The Netherlands national report to the ICES Working Group on Marine Data Management. ICES-WGMDM annual meeting, Gothenburg, Sweden, 28-30 May

De Bruin, T.F. Antarctic datamanagement in The Netherlands. Annual meeting of the Joint Committee on Antarctic Data Management (JCADM), Brussels, Belgium. 30 June — 4 July

Dekker, R. Life-history strategies in marine invertebrates. Marine Ecology Course, University of Amsterdam, NIOZ, 18 December.

De Stigter, H.C. Near-bottom hydrodynamics and suspended matter on carbonate mounds of the Rockall Trough margins. Final ACES Workshop, Erlangen, Germany, 19-22 February.

Duineveld, G. & M. Bergman. Settlement en recruitment van de bodemfauna in de Nederlandse kustzone m.b.v. autonome bodemlanders. Workshop Coastal Research, NITG, Utrecht, 11 April.

Duineveld, G. & M. Lavaleye. The abiotic environment of the deep-sea coral community and the particle flux at the Galicia Bank (NW Spain). Final Workshop ACES project, Erlangen, Germany, 19-23 February.

Epping, H.G. New technologies for *in situ* seafloor experiments and observations. Symposium on Methods and Techniques in Aquatic Sciences, Helsinki, Finland, 5-8 February.

Epping, H.G. Photosynthesis, respiration and nutrient dynamics in benthic phototrophic communities. Workshop 'Intertidal Microphytobenthos', Amsterdam, 22 April.

Estrada, M., M.M. Sala, K. Van Lenning, M. Alcaraz, J. Felipe, M.J.W. Veldhuis. Biological interactions in enclosed phytoplankton communities including the paralytic shellfish toxin producer *Alexandrium catenella*. EUROHAB meeting, Amsterdam, 17/18 March.

Frank, N., M. Paterne, L. Ayliffe, A. Lutringer, D. Blamart, J.P. Henriet & T.C.E. Van Weering. Cold-water corals of the northeast Atlantic margin: archives of intermediate water circulation during the Holocene. Second International Symposium on Deep-Sea Corals, Erlangen, Germany, 8-13 September.

Gerkema, T., F.P.A. Lam, & L.R.M. Maas. Scattering of internal-tide beams in the Bay of Biscay. EGS-AGU-EUG Joint Assembly, Nice, France, 6-11 April.

Goldring, R., G.C. Cadée, A. D'Alessandro, J.M. De Gibert, R. Jenkins, & J.E. Pollard. Climatic control of trace fossil distribution in the marine realm. Lyell meeting, London, UK, 24 February.

Grice, K., S. Schouten, S. Chin Wong, H. Stuart Williams, G. Farquhar. Compound specific D/H isotopes of lipids and carbohydrates. 21st Intern. Meeting on Organic Geochemistry, Kraków, Poland, 8-12 September.

Herndl, G.J. UV radiation and its potential impact on bacterial activity measurements: is there a need to care about it? Workshop on Methods in Aquatic Microbial Ecology, 16-21 February.

Hibiya, T., M. Nagasawa, Y. Niwa, M. Watanabe, N. Furuichi, Y. Kitade, Y. Kawamura, H. Van Haren & H. Van Aken. Global mapping of diapycnal diffusivity in the deep ocean based on fine-scale vertical shear observed by expendable current profilers. EGS-AGU-EUG Joint Assembly, Nice, France, 6-11 April.

Holmes, S.P. Modes of reproduction, population genetics and dispersal: can one be used to predict the other? 38th European Marine Biology Symposium, Aveiro, Portugal, 8-12 September.

Hosegood, P., H. Van Haren & J. Bonnin. Observations of high-frequency internal waves impinging on the slope at depth in the Faeroe-Shetland Channel. EGS-AGU-EUG Joint Assembly, Nice, France, 6-11 April.

Hosegood, P. Observations of mixing processes over the continental slope in the Faeroe-Shetland Channel. Southampton Oceanography Centre, Physical Oceanography and Climate Seminar, Southampton, UK, 12 February.

Hosegood, P. Turbulent mixing in the Faeroe-Shetland Channel. Global Environmental and Ocean Sciences, Swindon, UK, 3 March.

Hosegood, P. Turbulent mixing over slopes. NIOZ, 27 February.

Huvenne, V.A.I., H. De Haas, J.P. Henriet & A.J. Wheeler. TOBI sidescan sonar mapping of deep-water coral banks and their sedimentary environment in the Porcupine Seabight, W of Ireland. Second International Symposium on Deep-Sea Corals, Erlangen, Germany, 8-13 September.

Jansen, J.H.F. Paleoceanography, general circulation. Introductory Course in Marine Sciences, Bremen, Germany, 12 November.

Jansen, J.H.F. Why ice ages, and what does the ocean floor tell about them? Volkssterrenwacht "de Jager", Texel, 7 November.

Koning, E. Preservation mechanisms for biogenic silica. Utrecht University, 4 November.

Kuypers, M.M.M., A.O. Sliekers, G. Lavik, M. Schmid, B.B. Jørgensen, J.G. Kuenen, M. Strous, S. Schouten, J.S. Sinninghe Damsté & M.S.M. Jetten. Anaerobic ammonium oxidation by anammox bacteria in the Black Sea. NATO Workshop on Past and Present Water Column Anoxia, Sebastopol, Oekraine, 4-8 October.

Kuypers, M.M.M., A.O. Sliekers, G. Lavik, M. Schmid, B.B. Jørgensen, J.G. Kuenen, M. Strous, J.S. Sinninghe Damsté & M.S.M. Jetten. Anaerobic ammonium oxidation by anammox bacteria in the Black Sea. Institut für Genetik und Mikrobiologie, Ludwig-Maximilians-Universität München , Germany, 17 June.

Kuypers, M.M.M., S. Schouten, A.O. Sliekers, G. Lavik, M. Schmid, M. Strous, & J.S. Sinninghe Damsté. Anaerobic ammonium oxidation, a new sink in the oceanic nitrogen cycle, as revealed by biomarker lipids. 21st Intern. Meeting on Organic Geochemistry, Kraków, Poland, 8-12 September.

Lavaleye, M & G. Duineveld. A long term settlement experiment near *Lophelia* thickets at the Galicia Bank. 2nd International Symposium on Deep Sea corals, Erlangen, Germany, 8-13 September.

Lavaleye, M.S.S. & J.IJ Witte. Veertien programma's over diverse onderwerpen over het natuurleven in zee, uitgezonden tijdens Natuurwijzer, een radioprogramma over de natuur en het milieu op Texel, Radio Texel, Den Burg, The Netherlands.

Lavaleye, M.S.S. Fauna van de diepzee. Wetenschappelijke vergadering van de Strandwerkgemeenschap, Haarlem, 19 January.

Lavaleye, M.S.S. & G.C.A. Duineveld. The deep-sea coral community at the Galicia Bank (NW Spain) and the settlement experiment. ACES Final Workshop, Erlangen, Gemany, 21 February.

Lavaleye, M.S.S. & G.C.A. Duineveld The deep-sea coral community at the Galicia Bank (NW Spain), it abiotic environment, and the settlement experiment. 6th Underwater Science Symposium, Aberdeen, Scotland, 4 April

Lavaleye, M.S.S. Kwallen in Nederland. Vroege Vogels. VARA radioprogramma, Radio 1, Hilversum, 3 August

Lavaleye, M.S.S. & G.C.A. Duineveld. A long-term settlement experiment near *Lophelia* thickets at the Galicia Bank (NW Spain). Second Deep Sea Coral Symposium, Erlangen, Gemany, 11 September

Lavaleye, M.S.S. NIOZ benthos onderzoek in de Noordzee. VARA Vroege Vogels Happening, Apeldoorn, 28 Sept.

Lok, T. & W.K. Vahl. Interference competition in a foraging wader, the ruddy turnstone (*Arenaria interpres*); the mechanisms revealed. The 2003 EGI Student and BOU conference: Long term studies of birds, Oxford, U.K., 11-16 April.

Loncaric, N., G.-J.A. Brummer, J.M. Van Iperen, F. Peeters & D. Kroon. Ecology of planktic foraminifera: tales from the SE Atlantic. Faculty of Life and Earth Sciences, Free University Amsterdam, 28 October.

Maas, L.R.M. Can internal waves be trapped in a wedge? EGS-AGU-EUG Joint Assembly, Nice, France, 6-11 April.

Maas, L.R.M. De zee in beweging: van chaos tot golfaantrekkers. Kaleidoscoop Lezing Natuurkunde, Universiteit Utrecht, 18 March.

Maas, L.R.M. & A.M.M. Manders. Inertial wave propagation, focusing and mean flow generation. Large-scale facilities user meeting, Budapest, Hungary, 21 May.

Maas, L.R.M. Internal wave focusing. EC-INTAS meeting, Nizhny Novgorod, Russia, 4 October.

Maas, L.R.M., U. Harlander, A.M.M. Manders & A. Swart. Stratified fluid experiments in an annulus with sloping inner wall under slight modulation of the rotation speed. Large-scale facilities user meeting, Budapest, Hungary, 22 May.

Maier, C., J. Pätzold, S. Schouten & R.P.M. Bak. Link between variation in skeletal isotopes (C,O) and tissue stable isotopes (C,N) of holobiont, polyp and zooxanthellae from coral colonies of *Madracis* spp. Abstract. EGS-AGU-EUG Joint Assembly, Nice, France, 7-11 April.

Manders A.M.M. & L.R.M. Maas. Observations of gyroscopic waves in a rectangular tank with a sloping boundary: horizontal structure. European Fluid Mechanics Conference, Toulouse, France, 25 August.

Manders A.M.M., L.R.M. Maas & T. Gerkema. Internal tides in Mozambique Channel. Buys Ballot meeting, Garderen, 5-7 November.

Merckelbach, L. A semi-analytic model for fluid mud flows in estuaries. International conference on cohesive sediments. Virginia Institute for Marines Sciences, Gloucerpoint, VA, USA. 2 October.

Merckelbach, L. Gesuspendeerd sediment-concentratiemetingen met een ADCP. Rijksinstituut voor Kust en Zee, Den Haag, 24 November.

Merckelbach, L. Towards measuring suspended sediment transport through Marsdiep. Nederlands Centrum voor Kustonderzoek, NIOZ, 27 Maart.

Nodder, S., G. Duineveld, R. Witbaard, M. Lavaleye, C. Pilditch, K. Probert, J. Hall, K. Richardson & H. Chang. First direct observation of a phytodetritus deposition event in the deep ocean, east of New Zealand. Joint Conference of the New Zealand Marine Sciences Society and the Australasian Society for Phycology and Aquatic Botany, Auckland, New Zealand, 1-3 September.

Nodder, S., P. Boyd, S. Chiswell, G. Duineveld, M. Greig, J. Hall, M. Lavaleye, C. Pilditch, K. Probert, K. Richardson & R. Witbaard. Ocean observatories: new biophysical time-series data from pelagic and benthic environments in subtropical and subantarctic waters, east of New Zealand. Joint Conference of the New Zealand Marine Sciences Society and the Australasian Society for Phycology and Aquatic Botany, Auckland, New Zealand, 1-3 September.

Otto, L. & A.J. Van Bennekom. Marin Henri Jansen, his activities in connection with the 1853 Brussels Maritime Conference and his ideas with respect to marine research. 7th International Congress on the History of Oceanography, Kaliningrad, 8-12 September.

Philippart, C.J.M. & J. Van Iperen. Food ecology of bivalve larvae. Meimaand Natuurmaand, Texel, 22 May.

Philippart, C.J.M. & J. Van Iperen. Life in the waters of the Wadden Sea. Public day, NIOZ, 5 April.

Philippart, C.J.M. & J. Van Iperen. Wadden Sea phytoplankton. VARA's Vroege Vogels Festival, Apeldoorn, 28 September.

Philippart, C.J.M., H. Andersen, O. Bos, P. Honkoop & J. Van Iperen. Marine Ecology. Opening new and renovated departments, NIOZ, 4 April.

Philippart, C.J.M. Effects of climate change on coastal communities: The Wadden Sea example. Global ecology course of the University of Amsterdam, NIOZ, 10 September.

Philippart, C.J.M. Historical and recent developments in the Wadden Sea ecosystem. Marine Ecology Course of the University of Amsterdam, NIOZ, 18 December.

Philippart, C.J.M. The color of the Wadden Sea. Visit ECN, NIOZ, 4 September.

Piersma, T. 'Disease and parasitism', 'Dispersal and migration' and 'The knot story'.. Three lectures in course Experimental Ecology, University of Groningen, 27 March.

Piersma, T. 'Global ecologists' par excellence: the migratory shorebird story. MSc course 'Marine global ecology' of the University of Amsterdam, NIOZ, 10 September.

Piersma, T. From foraging and energetics to population biology of red knots: progress report on 15 years of research. Symposium on Long term studies of birds, Oxford University, UK, 15 April.

Piersma, T. Imagination and field biology. Symposium 'Beta boeiend in beeld', University of Groningen, 2 April.

Piersma, T. Integrative and comparative studies of migrant birds: keeping an eye on different levels of biological explanation. Symposium on Long term studies of birds, Oxford University, UK, 13 April.

Piersma, T. Seven lectures in Topmaster course 'Adaptation, biocomplexity and conservation', University of Groningen, November-December.

Piersma, T. The secrets of knots: migratory birds and their evolutionary 'motives'. Natuurwetenschappelijk Genootschap Wageningen, 4 February.

Piersma, T. Wader studies at Zackenberg, NE Greenland, during the summer of 2003. Biologysk Wurkferbân, Fryske Akademy, Leeuwarden, 18 October.

Piersma, T., B. Koks & B. Spaans. Towards an ecological underpinning of changes in abundance of red knots in the Dutch Wadden Sea (and elsewhere along the east Atlantic flyway). Wader Study Group Conference, Cadiz, Spain, 26 September.

Poole, I., P.F. Van Bergen, S. Schouten & D.J. Cantrill. Molecular isotopic heterogeneity of fossil organic matter and the implications for δ13Cbiomass and δ13Cpalaeoatmosphere signatures. 21st Intern. Meeting on Organic Geochemistry, Kraków, Poland, 8-12 September.

Reinthaler, T. & G.J. Herndl. Seasonal dynamics of organic carbon remineralization by heterotrophic bacteria in the southern North Sea. EGS meeting, Nice, France, 7-12 April.

Reneerkens, J. Fysiologische aanpassingen aan broeden in de Arctis. De kanoetstrandloper. Arctisch Weekend 2003, Lunteren, 21-23 November.

Reneerkens, J. Why shellfisheries in the Wadden Sea are not sustainable. EPCEM course, Ameland, 9-11 November.

Ridderinkhof, H. Observations on the flow in the Mozambique Channel: Invited presentation at the IUGG, Sapporo, Japan, 30 June.

Ridderinkhof, H. Ocean research with the Pelagia. NIOZ, Texel, 22 May.

Ruardij, P., C. Brussaard & M.W. Veldhuis. Modelling *Phaeocystis* dynamics in a mesocosm experiment: mucus and TEP formation as a defence against virus infection. EUROHAB 2003, Cluster Workshop, Amsterdam, 17/18 March.

Sarthou, G., K. Timmermans, S. Blain, E. Bucciarelli & P. Tréguer. Growth physiology and fate of diatoms in the Ocean: a review. EGS-AGU-EUG, Nice, France, 6-11 April.

Schefuß, E., J.H.F. Jansen, J.S. Sinninghe Damsté & R.R. Schneider. Tropical environmental changes at the mid-Pleistocene transition: a lipid biomarker perspective. INQUA Nederland meeting, Amsterdam, 24 October.

Schefuß, E., J.H.F. Jansen, J.S. Sinninghe Damsté & R.R. Schneider. Tropical environmental changes at the mid-Pleistocene transition: a lipid biomarker perspective. INQUA meeting: Early/Middle Pleistocene Transitions: The Land-Ocean Evidence, Cambridge, UK., 4 April.

Schefuß, E., J.H.F. Jansen, S. Schouten & J.S. Sinninghe Damsté. African vegetation controlled by tropical sea surface temperatures in the mid-Pleistocene. EGS-AGU-EUG Joint Assembly, Nice, France, 6-11 April.

Schouten, S. & M. Kienhuis. Isotopic measurements of carbonates and dissolved inorganic carbon. CESOP Meeting, Amsterdam, 6-7 March.

Schouten, S., An idiot's guide to continous flow mass spectrometry. Benelux IRMS Users meeting, Geel, Belgium, 13-14 March.

Schouten, S., E.C. Hopmans, C. Wuchter & J.S. Sinninghe Damsté. Ecology of marine archaea: Insights from lipid and RNA analysis. NIOO-CEM, Yerseke, 8 October.

Schouten, S., J. Ossebaar & G-J. Brummer. Isotopic analysis of alkenones. 6C-meeting, Southampton, UK, 1-3 October.

Servais, T., E. Raevskaya & G.J.M. Versteegh. The biological affinities of the acritarchs and the relation to the dinoflagellates: morphological and biogeochemical data. 7th International Conference on Modern and Fossil Dinoflagellates, Nagasaki, Japan, 21-25 September.

Simons, D-J., F. Kenig, M. Gonzalez-Meler & J.S. Sinninghe Damsté. Differential latitudinal response of land plant ecosystems to the Cenomanian/Turonian Oceanic Anoxic Event. Annual Meeting of the Geological Society of America, Seattle, US, 3 November.

Sinninghe Damsté, J.S. Biogeochemical cycling in a greenhouse world. Global Ecology Symposium, Wageningen, 17 April.

Sinninghe Damsté, J.S. Biomarker evidence for anoxia in shelf seas and oceans during deposition of organic-rich sediments. NATO Workshop on Past and Present Water Column Anoxia, Sebastopol, Oekraine, 4-8 October.

Sinninghe Damsté, J.S. Biosignatures, biomarkers. Lecture in the graduate course Geomicrobiology, University of Utrecht, 19 September.

Sinninghe Damsté, J.S. Tetraether lipid analysis as a tool in the study of the microbial ecology of non-thermophilic archaea in marine and terrestrial settings. NIOO Centre for Limnology, 27 October.

Sinninghe Damsté, J.S. Membrane lipids of non-hyperthermophilic archaea in the ocean: implications for biogeochemical cycling and palaeothermometry. Southhampton Oceanography Centre, Southhampton, UK, 14 November.

Smallegange, I.M. & J. Van Der Meer. Density- and Size-dependent Interference Competition in Shore Crabs. Benthic Ecology Meeting 2003, Groton, CT, USA, 27-30 March.

Smallegange, I.M. & J. Van Der Meer. Density- and Size-dependent Interference Competition in Shore Crabs. Population Ecology of Individuals — interference competition as a case study, NIOZ, 25-26 September.

Smallegange, I.M. & J. Van Der Meer. Interference competition in shore crabs. Annual meeting of the Netherlands Society of Behavioural Biology, Dalfsen, 26-28 November.

Smittenberg, R.H. Radiocarbon dating of isolated biomarkers: a promising new tool in (paleo)oceanography. Symposium on biogeochemistry. Research Centre of Ocean Margins, Bremen, Germany, 15-16 January.

Stadnitskaia, A. Lipid composition and microbial diversity of carbonate crusts and mud volcanic deposits in the Sorokin Trough, NE-Back Sea. Kluyver Laboratory for Biotechnology, Dept. of Microbiology, Delft University of Technology, Delft, 22 May.

Stadnitskaia, A., M. Baas, M.K. Ivanov, T.C. Van Weering & J.S. Sinninghe Damsté. Novel archaeal macrocyclic diether core membrane lipids in methane-induced carbonates associated with active fluid venting in the Sorokin Trough, NE Black Sea. ASLO meeting, Salt Lake City, Utah, USA, 8-14 February.

Stoderegger, K.E. & G. J. Herndl. Ecological implications and determination of bacterial cell surface charge in a natural bacterial community in the coastal North Sea. EGS meeting, Nice, France, 7-12 April.

Stoker, M. & STRATAGEM partners.(NIOZ medewerkers in "STRATAGEM partners": T. Van Weering, H. De Haas, T. Richter). Shaping the glaciated European margin. Ocean Margin Research Conference, Paris, France, 15-17 August.

Stratified fluid experiments in an annulus with sloping inner wall under slight modulation of the rotation speed. Large-scale facilities user meeting, Budapest, Hungary, 22 May.

Stuut, J.-B.W., F. Lamy, M.A. Prins, L.J. Lourens & J.H.F. Jansen. On the relation between Antarctic sea ice and South-Western African climate during the Late Quaternary. INQUA Nederland meeting, Amsterdam, 24 October.

Ten Hallers—Tjabbes, C.C., W. Van Raaphorst, M.J.W. Veldhuis, C. Brussaard & J.P. Boon. Ballast water - Testing for Risk, an exploration to identify and evaluate prerequisites for testing protocols. Paper presented at SGBOSV Meeting (Study Group on Ballast and Other Ship Vectors), Vancouver, Canada, 24 March.

Ten Hallers-Tjabbes, C.C. & C.M. Ree. Interactive case study in scientific activities in a societal process. Course "Water Systems", Department of Biology, University of Groningen, 14 May.

Ten Hallers-Tjabbes, C.C. "Imposex and organotin concentrations in *Buccinum undatum* (common whelk) and *Neptunea antiqua* (red whelk) from the North Sea: relationship to shipping density and hydrographical conditions". Introduction to document LC/SG 26/INF.6 (IUCN), London Convention Scientific Group - 26th Meeting, IMO, London, UK, 23 April.

Ten Hallers-Tjabbes, C.C. Antifouling, TBT and the marine environment. Lecture Marine Environmental Awareness course, NIOZ, 8 October, & 13 November.

Ten Hallers-Tjabbes, C.C. Elements of Microcontaminants, Ecotoxicology and Case-studies, Course "Water Systems", Department of Biology, University of Groningen, 14 May.

Ten Hallers-Tjabbes, C.C. Evaluation of Ballast Water Treatment Strategies and Techniques. Introduction to Document MEPC-IBWWG 2/2/9 (IUCN). Intersessional Meeting of the MEPC Ballast Water Working Group, 2nd session, IMO, London, UK, 5 March.

Ten Hallers-Tjabbes, C.C. Maritime shipping and the environment; the potential of science and scientists to assist in policy planning for the environment and in raising public awareness. Paper presented at Conference on Interfaces between Science and Society, Milan, Italy, 27—28 November.

Ten Hallers-Tjabbes, C.C., J.P. Boon, M.J. Veldhuis, J.L. Brouwer & J.R Van Niekerk. Ballast water treatment R&D in the Netherlands. Paper presented at 2nd International Ballast Water Treatment R&D Symposium, IMO, London, UK, 23 July.

Terra, G.M. Nonlinear response of a cooscillating tidal basin; theory and laboratory experiments. Nonlinearity in Amsterdam, Amsterdam, 21 May.

Terra, G.M. Nonlinear response of a cooscillating tidal basin; theory and laboratory experiments. SIAM Conference on Applications of Dynamical Systems, DS03, Snowbird, Utah, USA, 27-31 May.

Thatje, S., M.S.S. Lavaleye, W. Arntz & G. Duineveld. Reproductive strategies of high latitude invertebrates. BENDEX-expedition, ANTXXI/2, on board RV. Polarstern, Antarctica, 25 November.

Thomas, H. Carbon cycling in marginal seas. Dalhousie University, Halifax, Canada, 18-19 August.

Thomas, H. Carbon cycling in marginal seas. Woods Hole Oceanographic Institution, Woods Hole, USA, 27-28 October.

Thomas, H. Climate and the ocean carbon cycle. Dalhousie University, Halifax, Canada, 18-19 August.

Thomas, H. The role of coastal seas/margins in the global carbon cycle and the importance of interacting with terrestrial and atmospheric communities. SCOR-IOC/WCP IOCCP workshop, Paris, France, 13-15 January.

Thomas, H., J. Pempkowiak, F. Wulff & K. Nagel. Autotrophy, nitrogen accumulation and nitrogen limitation in the Baltic Sea: a paradox or a buffer for eutrophication? EGS-AGU-EGU Joint Assembly, Nice, France, 6-11 April.

Thomas, H., Y. Bozec, K. Elkalay & H.J.W. De Baar. Seasonality of air/sea CO2 exchange of the North Sea. Gas Exchange: on Land, at Sea and in the Air, Symposium in context of SOLAS of IGBP/SCOR, Amsterdam, 13 March.

Timmermans, K., B. Van Der Wagt, M. Veldhuis, A. Maatman & H. De Baar. Physiological responses of pico-phytoplankton to nitrogen, phosphorus, iron and light limitation. EGS-AGU-EUG Joint Assembly, Nice, France, 6-11 April.

Timmermans, K.R. Diatoms for ever. Centre d' Océanologie de Marseille, U. of Marseille, France, 14 April.

Van Aken, H.M. Collecting and analyzing oceanographic observations. CKO Summer School on Physical Oceanography, Les Diablerets, Switzerland, 21 September-1 October.

Van Aken, H.M. Turbulent mixing in the Banda Sea system, the driving force of the flushing of the deep waters in the East Indonesian seas. INSTANT workshop "Oceanography of Indonesian Seas", Bali, Indonesia, 20-21 October.

Van Aken, H.M. Wind-driven circulation. Thermohaline circulation. Physical observation methods. Contribution to the NEBROC-ECOLMAS introductory course in marine sciences, Bremen, Germany, 3-14 November.

Van Bennekom, A.J. & L. Otto. Oceanography in the Netherlands and the Dutch Navy. 7th International Congress on the History of Oceanography, Kaliningrad, 8-12 September.

Van Breugel, Y., S. Schouten, E. Erba, G.D. Price & J.S. Sinninghe Damsté. Molecular examination of the global negative carbon isotope spike in Aptian sediments. 21st Intern. Meeting on Organic Geochemistry, Kraków, Poland, 8-12 September.

Van Breugel, Y., S. Schouten, M. Paetzel, S. Rampen & J.S. Sinninghe Damsté. The consequences of CO2 recycling in stratified marine systems for the stable carbon isotope ratios of biolipids in the water column and in sediment records. Benelux IRMS User Group Meeting, Geel, Belgium, 13—14 March.

Van Der Meer, J. Early models on interference competition. Symposium Population Ecology of Individuals: interference competition as a case study, Texel, 25 September.

Van Der Meer, J. Foraging games between prey and predators: Shoaling behaviour of prey as an anti-predation strategy. EU-IMPRESS meeting, Texel, 10 October.

Van Der Meer, J. Linking the temporal variability in population abundance to the variability of community attributes. CIESM Workshop on Mediterranean biological time series, Split, Croatia, 11-14 June.

Van Der Meer, J. Linking the temporal variability in population abundance to the variability of community and ecosystem attributes. 38th European Marine Biology Symposium, Aveiro, Portugal, 8 September.

Van Der Meer, J. Long-term variability in secondary production of an intertidal bivalve is primarily a matter of recruitment variability. NIOO/CL Lecture Series, Nieuwersluis, 20 January.

Van Der Meer, J. The power of environmental monitoring programmes. University of Stockholm, Sweden, 3 June.

Van Dongen, B.E., S. Schouten & J.S. Sinninghe Damsté. Carbohydrates through sulfurization: the primary cause of the accumulation of organic matter in a Jurassic shelf sea. 21st Intern. Meeting on Organic Geochemistry, Kraków, Poland, 8-12 September.

Van Duyl, F.C. Coral Reefs: Functioning and threats. MARPOL Course, NIOZ, 5 March.

Van Duyl, F.C. Microbial Ecology of Coral Reefs. University of Amsterdam, Amsterdam, 30 January.

Van Duyl, F.C. Removal of pico-and nanoplankton by coral reef benthos: coupling pelagic-benthic heterotrophy to coral reef condition. WOTRO-EKP meeting, Den Haag, 22 January.

Van Haren, H. Biological implications of properties of vertical shear across stratification in shelf seas. Tokyo University of Marine Science and Technology, Department of Ocean Sciences, Tokyo, Japan, 23 October.

Van Haren, H. Deep-ocean internal wave spectra. The University of Tokyo, Department of Earth and Planetary Science, Tokyo, Japan, 24 October.

Van Haren, H. Motions above sloping bottoms. Geophysical Institute, University of Bergen, Norway, 10 June.

Van Haren, H. Motions above sloping bottoms. Univ. Kyoto, Dept. of Geophysics, Kyoto, Japan, 17 October.

Van Haren, H. Properties of vertical shear across stratification in shelf seas. National Institute of Advanced Industrial Science and Technology, Chugoku Center, Kure, Hiroshima, Japan, 20 October.

Van Veldhoven, A.K. & H. Van Aken. Observed decay of an anti-cyclonic Agulhas ring. Autumn Symposium of the Buys Ballot Research School, Garderen, 6-7 November.

Veldhuis, M., K. Timmermans, P. Laan & H. De Baar. Iron limitation in natural populations of phytoplankton in the eastern North Atlantic Ocean: (IRONAGES III). EGS-AGU-EUG Joint Assembly, Nice, France, 6-11 April.

Veldhuis, M.J.W., K. Timmermans, P. Laan & H.J.W. De Baar. Iron limitation in natural populations in the eastern North Atlantic Ocean. EGS-AGU, Nice, France, 6-11 April.

Versteegh, G.J.M., E. Schefuß, L. Dupont, F. Marret, J.S. Sinninghe Damsté & J.H.F. Jansen. Taraxerol and *Rhizophora* pollen as proxies for tracking past mangrove ecosystems. 21st Intern. Meeting on Organic Geochemistry, Kraków, Poland, 8-12 September.

Versteegh, G.J.M., S. Torricelli, M.E. Collinson, K.A.F. Zonneveld & H. Brinkhuis. On the chemical structure of dinoflagellate cyst walls. 7th International Conference on Modern and Fossil Dinoflagellates, Nagasaki, Japan, 21-25 September.

Veth, C. Turbulence, air-sea interaction, and mixed-layer dynamics. Tides and waves. Contribution to the NEBROC-ECOLMAS introductory course in marine sciences, Bremen, Germany, 3-14 November.

Volkov, D.L. Eddy field and its interannual variability in the North Atlantic Ocean as observed with satellite altimetry. EGS-AGU-EUG Joint Assembly Nice, France, 6-11 April.

Volkov, D.L., The variability os sea level and surface circulation in the North Atlantic Ocean from 1992 to 2002 as observed with satellite altimetry, NIOZ, 4 September.

Wakeham, S.G., E.C. Hopmans, S. Schouten, J.S. Sinninghe Damsté & R.I. Amann. Organic biomarkers for anaerobic oxidation of methane in the anoxic water column of the Black Sea. NATO Workshop on Past and Present Water Column Anoxia, Sebastopol, Oekraine, 4-8 October.

Waldmann, C. & E. Epping. MOVE!-A deep ocean mobile vehicle for biogeochemical research. EGU, Nice, France, 6-11 April.

Wernand, M.R. Presentation at the "BEL-COLOUR" scientific symposium on optical remote sensing of coastal and inland waters. Management Unit of the North Sea Mathematical Models and the Scheldt estuary (MUMM), department of the Royal Belgian Institute of Natural Sciences (RBINS). Who is afraid of blue, yellow and red? Dealing with Marine Optics and Remote Sensing, Brussels, 1 December.

Wheeler, A.J., H. De Haas, V.A.I. Huvenne, F.X. Monteys & J. Thiede. Hydrodynamic and anthropogenic influences on deep-water corals on the Porcupine Bank, Irish margin: recent ROV results from ARK-XIX/3a. Second International Symposium on Deep-Sea Corals, Erlangen, Germany, 8-13 September.

Wheeler, A.J., H. De Haas, V.A.I. Huvenne, M. Kozachenko, K. Olu-Le Roy & D.G. Masson. Coral mound morphology and growth: evidence for environmental controls. Second International Symposium on Deep-Sea Corals, Erlangen, Germany, 8-13 September.

Winter, C., G.J. Herndl & M.G. Weinbauer. Seasonal dynamics in viral control of bacterioplankton diversity. EGS meeting, 7-12 April.

Witbaard, R., E. Jansma & U. Sass-Klaassen. Malacochronology, the application of dendrochronological methods on marine bivalve (shell) growth. Trace 2003, Tree rings in archeology, climatology and ecology. Utrecht, 1-3 May.

Wuchter, C., S. Schouten, E.C. Hopmans, M. Coolen, S.G. Wakeham & J.S. Sinninghe Damsté. Genetic and environmental controls on the distribution and abundance of archaeal tetraether lipids: Implication for the new paleothermometer, the TEX 86. 21st Intern. Meeting on Organic Geochemistry, Kraków, Poland, 8-12 September.

Zonneveld, C.A.F. & G.J.M. Versteegh. Use of selective degradation of organic-walled dinoflagellate cysts to separate preservation from productivity. 7th International Conference on Modern and Fossil Dinoflagellates, Nagasaki, Japan, 21-25 September.

EXTERNAL PROFESSIONAL FUNCTIONS

M.A. Baars

- member JGOFS Indian Ocean Synthesis and Modelling Group (SCOR)
- member Working Group JGOFS Nederland
- member Working Group GLOBEC Nederland
- member discussion group 'Tracers and mineralogy North Sea sediments' (RIKZ/NITG/NIOZ)

R.P.M. Bak
- professor Tropical Marine Biology, University of Amsterdam
- Editorial Advisor Marine Ecology Progress Series
- member Netherlands SCOR Committee (KNAW)
- member Board Foundation for Scientific Research Surinam and the Netherlands Antilles

M.J.N. Bergman
- member ICES Working Group on Ecosystem Effects of Fishing Activities
- member Raad van Overleg voor het Fysisch-oceanografisch onderzoek Noordzee -
- Overleggroep Bodem
- member ICES Benthos Ecology working group

W. Boer
- Member of inter-laboratory validation group for normalisation of "Methoden voor de radiochemische bepaling van polonium-210 en lood-210 (NNI-NVN 5694)
- Member of the Nederlandse Werkgroep Deeltjeskarakterisering

J.P. Boon
- member ICES Marine Chemistry Working Group
- Member "commissie voor de milieu-effect rapportage (CMER)".
- Member of the advisory board of the Institute for Risk Assessment Sciences (IRAS), University Utrecht

T.F. de Bruin
- Chairman - National Oceanographic Data Committee (NODC)
- Deputy Chief Officer - Joint Committee on Antarctic Data Management (JCADM)
- Member - ICES Working Group Marine Data Management

G.C. Cadée
- editor Journal Sea Research
- associate editor ICHNOS
- board member 'Nederlands Vlaamse Kring van Diatomisten'
- associate editor Senckenbergiana Maritima
- member Commissie voor de geschiedenis van de aardwetenschappen, KNAW
- Editorial board Natura (Kon. Ned. Natuurhist. Ver.)

C.J. Camphuysen
- Editor Atlantic Seabirds (scient. journal The Seabird Group and Nederlandse Zeevogelgroep) (1999-present)
- Member editorial board Marine Ornithology (scient. journal South African Seabird Group en Pacific Seabird Group) (elected 2000)
- Editor and technical editor Ardea (scient. journal Netherlands Ornithologists Union) (1995-present)
- Co-ordinator Dutch beached bird survey
- Chairman European Seabirds at Sea database
- Consultant CSR Consultancy

H.J.W. De Baar
- Professor of oceanography, University of Groningen
- Associate editor Marine Chemistry
- Guest editor special issue Marine Chemistry 'Southern Ocean fertilization'
- Life member Clare Hall College, Cambridge
- Chairman, Netherlands SCOR Committee of Royal Academy of Sciences (KNAW)
- Chairman, Iron Resources and Oceanic Nutrients - Advancement of Global Environment Simulations (IRONAGES, EU FP 5 Climate key action)
- Chairman Netherlands Task Group on international SOLAS program
- Chairman, Users Advisory Group, Nutrients, national Marine Research Facilities
- Convener Gas Exchange workshop. Royal Academy (KNAW), Amsterdam, 13 March
- Convener Ironages sessions at Joint EUGS-AGU-EUG, Nice, 7-8 April
- Convener working group A4 at IGBP Congress and SOLAS SSC, Banff, Canada, 19-24 June
- Deputy coordinator, CarboOcean Integrated Project submitted (7 October) to European Union Framework Program VI
- Member IGBP/WCRP Committee of Royal Netherlands Academy of Sciences (KNAW)
- Member Users Advisory Group, CTD systems, national Marine Research Facilities
- External adviser BELCANTO (Belgian research Carbon uptake in the ANTarctic Ocean)

J.W. De Leeuw
- board member Hanse Wissenschaftskollege
- board member EMaPS
- professor Organic Geochemistry University of Utrecht, Earth Sciences faculty
- member Koninklijke Nederlandse Akademie van Wetenschappen' (KNAW)
- board member LPP, University of Utrecht, Biology faculty
- board member Inst. für Chemie und Biologie des Meeres, Univ. Oldenburg, Germany
- board member working group Mol. Mech. and Anal. Chem. NIOZ-TUD
- professor Geochemistry, Univ. Barcelona, Spain

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- member ICES Benthos Ecology working group

H.G. Epping
- Editor Journal of Sea Research

G.J. Herndl
- Professor of Biological Oceanography, RUG
- Associate Editor of Aquatic Microbial Ecology
- Associate Editor of Limnology & Oceanography: Methods
- Associate Editor of Marine Ecology
- Member of the scientific committee of NEBROC
- Coordinator of the EU project COMET
- Appointed reviewer for the Norwegian Science Foundation for Aquatic and Terrestrial Microbiology and Biotechnology
- Member of the Nominating Committee of ASLO
- Chair of the Microbial Ecology Section of CIESM
- Member of the College of Reviewers for NERC

J.H.F. Jansen
- member Working Group INQUA Nederland
- Member NOC (Nederlandse Ocean Drilling Program Committee)

W.C.M. Klein Breteler
- member users group Quantimet (Image Analysis)

H.J. Lindeboom
- chairman Scientific Steering Committee LOICZ
- member Scientific Committee for the IGBP
- member Board of the Sir Allistair Hardy Foundation of Ocean Sciences
- member ICES working Group 'Effects of Fisheries'
- member 'Commissie voor Milieueffectrapportage'
- board member 'Onderzoekschool Functionele Ecology'
- member Steering Committee WOTRO project 'Rivers and coastal zones'
- member Steering Committee and working group Indonesian-Dutch Cooperative Research on Integrated Coastal Zone Management, Teluk Banten
- SYKON Advisory Committee, Hamburg, Germany
- member 'MER workinggroup 'Winning van beton- en metselzand op de Noordzee'
- member Scientific Committee 'North Sea 2000', 13th International Senckenberg conference
- member organizing committee IGBP-science conference, Amsterdam 2001
- member Editorial Board 'Archive of Fishery and Marine Research'
- member International Steering Committee International Advanced School 'Leonardo da Vinci', Bologna

L.R.M. Maas
- External examiner at thesis defences of L. van Veen, UU 9 April and F. Moulin, Universite Joseph Fourier, Grenoble, France 24 October

S. Ober
- member 'overleg-groep 'waarnemen en interpreteren', Raad van overleg fysisch-oceanografisch onderzoek Noordzee'

C.J.M. Philippart
- editor-in-chief Journal of Sea Research

T. Piersma
- Professor in Animal Ecology at the Centre for Ecological and Evolutionary Studies (CEES) at the University of Groningen
- vice-chairperson of the International Wader Study Group (IWSG)
- Chairman of the Biologysk Wurkferbân of Fryske Akademy, Ljouwert
- editor of Ardea
- member Editorial Board Current Ornithology
- member Editorial Board Zoology
- member of the Scientific Steering Committee of the International Ornithological Committee
- Editor of Journal of Avian Biology
- Editorial Board Current Ornithology, Plenum Press, New York
- Editorial Board Zoology, Urban & Fischer, Frankfurt
- Member Management Board of the Centre for African Wetlands, University of Ghana, Accra, Ghana

J. Reneerkens
- Editor Limosa

H. Ridderinkhof
- Member Committee 'Milieueffectrapportage'
- Member 'Beleidsadviescommissie Aardwetenschappen ALW - NWO'
- Member EUROGOOS-NL
- Member 'Programma commissie NCK'
- Member 'Programme committee NAC 7'
- Member 'NWO committee Marine Research Facilities'

M.J. Rietveld
- member and secretary 'International research Ship Operators Meeting' (ISOM)
- member Ocean Facilities Exchange Group/Marine Facilities Tripartite Group (OFEG/MFTG)
- member European Research vessel Operators (ERVO)
- member ESF Marine Board Ocean Research Fleets Working Group (OFWG)

J.S. Sinninghe Damsté
- Part time professor University of Utrecht, Faculty of Geosciences
- Associate editor Organic Geochemistry
- Associate editor Geology
- Member of the Klankadviesgroep Euromargins
- Co-ordinator of EC Network C/T-Net
- Member of the Science Comm. of the NIOO

C.C. Ten Hallers-Tjabbers
- Advisor to IUCN for the London Convention 1972
- Advisor to IUCN for the Marine Environment Protection Committee of the International Maritime Organization, London
- Lady Chairman Animal Navigation Group, Royal Institute of Navigation, London, U.K.

H.M. Van Aken
- Member ICES Oceanography Committee
- Member ICES Working Group on Oceanic Hydrography
- Chairman "ALW gebruikersadviesgroep CTD-systemen"
- Member "ALW apparatuurcommissie"
- Member Editorial Advisory Board of the Archive of Fishery and Marine Research

M.A. Van Arkel
- member Working group 'Monitoring rond Mijnbouwinstallaties'

A.J. Van Bennekom
- Member "Deutsche Arbeits Kreis Geschichte des Meeresforschung"

S.J. Van Der Gaast
- member editorial board of Applied Clay Science
- member of the XRPD group of the NKV (Ned. Kristallografische Ver.)

H. van Haren
- Convenor EGS-AGU-EUG Joint Assembly session OS3. Small and meso-scale processes and their impact on the large scale', 6-11 April, Nice, France
- Chairman"ALW gebruiksadviesgroup verankerde instrumentatie".

J. Van Der Meer
- Member of the Science Advisory Board SOVON (Co-operative Ornithological Field Research in the Netherlands)
- Member of the ICES Working Group on the Statistical Aspects of Environmental Monitoring
- Honorary Research Fellow of the School of Biological Sciences, University of Aberdeen

H.W. Van Der Veer
- Member organizing committee 6th International Symposium on Flatfish Ecology, Isle of Man
- Guest editor Proceedings 5th International Symposium on Flatfish Ecology
- Member Working Group on Recruitment Processes (ICES)
- Associate professor of Zoology, North Carolina state University, Raleigh, USA
- Adjunct associate professor of Marine science, University of South Carolina, Columbia, USA

F.C. Van Duyl
- board member Treub-Mij
- advisor Studiekring Suriname en de Nederlandse Antillen
- member European Scientific Diving Committee
- Lecturer University of Amsterdam

T.C.E. Van Weering
- member Scientific Steering Committee EU-MAST Program OMEX
- member Scientific Steering Committee EU-MAST Program ENAM
- member Editorial Board Geologie en Mijnbouw/Netherlands Journal Geo Sciences
- member Editorial Board Marine Geology
- member Editorial Board Boreas
- member Scientific Committee IMAGES
- special guest editor Progress in Oceanography Volume OMEX-II Benthic Processes
- member Editorial Board Marine Geology
- member Editorial Board Boreas
- member Editorial Board International Journal of Earth Sciences/Geol.Rundschau
- member Editorial Board Netherlands Journal of Geosciences/Geologie en Mijnbouw
- guest editor Progress in Oceanography Special Volume OMEX II Benthic Processes
- guest editor Marine Geology Special Volume Geosphere-Biosphere coupling
- guest editor Special issue of JASES Red River Delta
- member commissie advisering IODP drilling (NWO)

M.J.W. Veldhuis
- Member advisory board SARSIA
- Member flow cytometer working group NL
- Associate member SCOR working group 120: Phaeocystis
- Co-organiser 2nd International Conference & Exhibition on Ballast Water Management (19-21 May 2004; Singapore)

G.J.M. Versteegh
- Board Member International Graduate College "Proxies in Earth History" EUROPROX
- Member Scientific Staff, Dept. of Geochemistry, Faculty of Geosciences, Utrecht University
- Guest Scientist Dept. Palaeontology and Historical Geology, Faculty of Geosciences, Bremen University

C. Veth
- member Working group Joint Ocean Global Flux Study NWO/GOA
- membr Editorial Board of Oceanologica Acta

J.T.F. Zimmerman
- Professor, Physical Oceanography, UU
- member editorial board Continental Shelf Research

Meetings, courses and colloquia held at NIOZ

- Coordination meeting of the EU project 'Biological Effects of Pollutants on different populations of Small Cretaceans from European waters' (BIOCET) 25-29 August.
- De Baar, H.J.W. Surface Ocean Lower Atmosphere Study (SOLAS of IGBP) one day symposium organized at central location of Royal Academy (KNAW), Amsterdam, 13 March.
- De Baar, H.J.W. Planning workshop CarboOcean Integrated Project of the EU Framework program VI, held at central location of Royal Academy (KNAW), Amsterdam, 17 and 18 June.
- Brummer, G.-J.A. Coordination meeting/workshop within Bilateral Cooperation Programme NWO-DFG "Divalent cations: development and validation of proxies", Utrecht, 24-25 February.

- Brummer, G.-J.A. EU-"CESOP" annual meeting at VU, Amsterdam, 6-7 March.
- Brummer, G.-J.A. EU-"6C" annual meeting, at SOC, Southampton, 1-3 October.
- Brummer, G.-J.A. EU-STREP preparatory meeting "Trefoil", at AWI, Bremerhaven, 19-21 September.
- Brummer, G.-J.A. Preparatory meeting EU-STREP "SOFCAL" and ESF-EuroClimate "Focus" at VU, Amsterdam, 28-29 October.
- Symposium Population Ecology of Individuals: interference competition as a case study. Texel, 25-26 September - contact persons Drs. W. Vahl, Ir. I.M. Smallegange & Dr. J. Van Der Meer.
- Coordination meeting EU-IMPRESS project, 9-11 October - contact persons C. Camphuysen & Dr. J. Van Der Meer.
- EUROHAB Cluster Workshop, Amsterdam 17-18 October.
- MFSTEP (Mediterranean ocean Forecasting System) Kick-off meeting.13-19 March, Bologna, Italy. (EU-MAS-project).
- MFSTEP-WorkPackage "Ecological modelling" meeting 10/11 June, Bologna, Italy.
- MFSTEP-WorkPackage "Ecological modelling" meeting 6/8 October, NIOZ.
- Workshop on the treatment of ballastwater on ships. 18 and 19 December. Contact persons J.P. Boon, M.J. Veldhuis and C. ten Hallers-Tjabbes.

Annual Courses

- Course 'Introduction to Oceanography' (RUG). Contact person Prof. Dr. Ir. H.J.W. De Baar.
  The course Introduction to Oceanography is part of the Marine Biology curriculum at the University of Groningen and was attended by a record number of 32 students marine biology. Upon the introductory lectures held at Groningen in February, the students took part in the practial part at Royal NIOZ from 24 March through 3 April. For the first time the course was set up into three distinct Themes each integrating a suite of subtopics. Theme 1 'Open Wadden Sea' was pivoting around estuarine mixing processes which need to be unraveled before one is able to observe the biological and chemical impact of the spring bloom of phytoplankton. This was done by a combination of shipboard transect work aboard RV Navicula as well as time series stations both on the NIOZ jetty and on shipboard in the Marsdiep. Theme 2 'Mokbaai' was focusing on establishing a biogeochemical carbon budget of this shallow tidal inlet where processes range from photosynthesis to vigorous mixing of the bottom sediments. Theme 3 'Carbon Moieties' combined an investigation of the carbondioxide system in seawater with an assessment of synthetic organic carbon entities (PCB's and PAH's) in the marine ecosystem. The students very much enjoyed the integration approach in Themes and all efforts came together very nicely in concerted powerpoint presentations by the students at the final day. Several NIOZ technicians, shipcrews and scientists were actively involved during this stimulating two weeks course.
- Course Marine Biology for geology students. Vrije Universiteit Amsterdam, Faculty Biology and Earth Sciences. Course organised by Dr. R. Thijssen & Dr. J. van Minnen. 6-7 October.
- Course marine ecosystems (RUG); contact persons Prof. Dr. G.J. Herndl & Dr. J. Van Der Meer.
  Course marine ecosystems (RUG), 10-28 June. During the first week lectures were given at RUG on the ecological provinces of the world's oceans in general and the North Sea in particular. The second and the third week were devoted to practical work at NIOZ, particularly in the BIO and MEE. The program comprised research on the metabolism of selected benthic organisms and pelagic communities. Sampling was performed in the North and Wadden Sea with the R/V Navicula.
- Introductory course in Marine Biology for Utrecht University- contact person Prof. dr. G.J. Herndl.
  In this course, organized by BIO and MEE from 3-7 November, the students were introduced to the fauna and flora of the intertidal and subtidal sediments and the water column. Simple experiments on the metabolic activity of selected organisms were performed also. At the end of the course the students presented their work in brief lectures followed by a general discussion.
- Marine Environmental Awareness (MarEnA) courses for students of the higher maritime universities.
  The goal of the MarEnA course series is to provide the students with a sound basic knowledge of the most important physical, chemical, biological and geological processes and their interactions in the marine environment. This should result in a better understanding of the basis for the large number of existing rules with respect to environmental affairs in the shipping industry, such as the ISM code and the MARPOL treaty. Our philosophy is that a better understanding of these rules leads to a better compliance in everyday practice on board. In this framework, the concept of sustainable shipping is introduced and the implications for current and future practice and ship design are discussed in workshops. This course series is organized in cooperation with EcoMare.
- Three courses were given in 2003, one from 3-6 March for students of the schools of Amsterdam (HvA-IMT) and Rotterdam (HRO) combined, and two courses in the autumn for the 'Hogeschool Zeeland' from Vlissingen (6-9 October) and the 'Institute Willem Barentsz' from Terschelling (10-13 November). All courses were commissioned by the ProSea foundation. The first course was funded by the Directorate General of Goods Transport (DGG) of the Ministry of Transport, Public Works and Water Management, the second one by the EU project 'Save the North Sea', while the last course was the first one given under the umbrella of the newly erected 'Texel Academy'. The course coordinators at NIOZ were Jan Boon and Margot Bik (first two courses only).

Irregular Courses

- Ruardij, P. Ecosystem modelling in coastal perspective. Summer School 2003 on Ecological Coastal perspectives, 13/19 september, Helgoland , Germany
- Training course in Molecular Palaeontology for C/T Net. Course organised by J.S. Sinninghe Damsté, S. Schouten & M. Baas. 27-31 January.

Colloquia

9 Januari	Jan Boon (MBT) Brominated flame retardants
16 Januari	Gert de Lange (UU, Earth Sciences) Mud vulcanos
23 Januari	Jerome Bonin (MCG) Silica stuff
6 Februari	Johan van de Koppel (NIOO-CEMO)Mussels in space!: emergent properties of self-organisation in mussel beds
13 Februari	Gerrit Burgers (KNMI) On the role of the Central Pacific in maintaining el Niño.
20 Februari	Bruno Ens (Alterra) Evaluating the Dutch policy on shellfish fisheries in the Wadden Sea
27 Februari	Phil Hosegood (FYS) Turbulent mixing over slopes
27 Februari	Albert Oost (RIKZ, Haren) Reconstruction of the "Calendar of Texel" with Quartz OSL dating
03 April	Huib de Swart (IMAU) Morphodynamics of the Waddenzee.
10 April	Marco Coolen (MBT) Reconstruction of the impact of environmental changes on ancient biodiversity using DNA stratigraphy
17 April	Christian Winter (BIO) Bacteriophages and their role in controlling bacterioplankton abundance and diversity
24 April	Farooq Azam (Scripps Institution of Oceanography, USA) Microbial control of oceanic carbon cycle and implications for ecosystem response to human-induced stresses
29 May	Helmut Thomas (MCG) Carbon and nutrient cycling in coastal seas
28 August	Kees Camphuysen (Royal NIOZ - MEE) - The impact of oceanography on the foraging dynamics of seabirds and marine mammals in the North Sea
4 September	Denis Volkov (Royal NIOZ - PHYS) -The variability of sea level and surface circulation in the North Atlantic Ocean from 1992 to 2002 as observed by satellite altimetry
11 September	Oscar Bos (Royal NIOZ - MEE) - Explaining recruitment variation of the bivalve *Macoma balthica*: the role of larval food limitation
19 September	Thomas Richter (Royal NIOZ - MCG) - Terrigenous input patterns in the Faeroe-Shetland area: Implications for Norwegian Sea Overflow Water (NSOW) variability
25 September	Adam Lomnicki (Jagiellonian University, Kraków, Poland) - The individual-based approach to population ecology
2 October	Romke Kats (Alterra) - Common Eiders and food supply in the Wadden Sea
16 October	Neven Loncaric (Royal NIOZ - MCG) - Ecology of planktonic foraminifera: tales from the SE Atlantic
23 October	Geraldine Kramer (Royal NIOZ - BIO) - Bacterial derived dissolved organic matter (DOM) in the ocean
30 October	Alina Stadnitskaia (Royal NIOZ - MBT) - Mud volcanoes and associated diagenetic alterations in the Black Sea
6 November	Luisa Mendes (Royal NIOZ - MEE) - Parasites and immune response in shorebirds with contrasting habitat choices
20 November	Conny Maier (Royal NIOZ - MEE) - Stable isotopes of tissue and skeleton in tropical reef corals
27 November	Eva Teira-Gonzalez (Royal NIOZ - BIO) - Uptake of D- vs. L- amino acids by the main prokaryotes in the meso- en bathypelagic waters of the North Atlantic
4 December	Henko de Stigter (Royal NIOZ - MCG) - Sediment dynamics of submarine canyons on the Portuguese Atlantic margin
11 December	Astrid Forster (Royal NIOZ - MBT) - Black shale deposition through the Cenomanian/ Turonian oceanic anoxic event: compound specific delta 13C-records from different key-locations
18 December	Uwe Harlander (Royal NIOZ - PHYS) On Rossby waves, caught by currents and coasts

3. Guest scientists, visitors and students

The NIOZ Guest house. Photo: B. Aggenbach

GUEST SCIENTISTS

- Bocher, Dr. P., Université de La Rochelle, France, 15 July-10 August, 24 November-10 December.
- Estrada, M.,K. Van Lenning, M. Alcaraz, J. Felipe, Institut de Ciències del Mar-CMIMA (CSIC), P. Marítim de la Barceloneta, 37-49, 08003 Barcelona, Spain, January.
- Fago, F., Stanford University, USA, March 3-21.
- Gbogbo, F., Department of Zoology, University of Ghana, Accra, Ghana, 1 September-10 October.
- Gibson, J., CSIRO, Hobart, Australia, March 4-13.
- Gontikaki, E., University of Thessaloniki, Greece, 3 November 2003 - 1 February 2004.
- Hornak, K.,Center of Limnology and Inland Waters, Ceske Budejovice, Czech Republic, 24 March-5 April.
- Mendes, L., Department of Zoology, University of Lisboa, Portugal, 1 January - 31 December.
- Menzel, D., Utrecht University, several periods.
- Montesinos, E., University of Barcelona, June.
- Ostertag-Henning, C., September
- Peeters, F.J.C., Vrije Universiteit, Amsterdam, 16-19 June.
- Perez, M., Centre de Recherche en Ecologie Marine et Aquaculture (CREMA-CNRS), L'Houmeau, France, 15 July- 3 August, 17-31 July.
- Sala, M., Institut de Ciències del Mar-CMIMA (CSIC), Barcelona, Spain, January.
- Schiettecatte, L.-S., University de Liège, Belgium, 1-30 November.
- Tsikos, H., University of Oxford, UK.
- Turich, C., Penn. State University, USA, 6-19 March.
- Wang, Dr. B., Department of Marine Environment Protection, State Oceanic Administration, P.R. China, 17 January-27 October.
- Wilhartitz, I.,University of Vienna, Austria, 1 August-31 December.
- Wilke, I., Universität Bremen, 16-19 June.
- Zegers, B.N., University of Amsterdam, 1 January-31 December.

VISITORS

- Sommeria, J., Coriolis Laboratory, LEGI, Univ. Joseph Fourier, Grenoble.
- Lohse, D., Dept. Physics, Twente University.
- Duineveld, P., Philips Natlab, Eindhoven.
- Doelman, A., KdV-Institute, Univ. of Amsterdam.
- Hibiya, Prof. T., Univ. Tokyo, Japan.
- Bombardiere, L., University of Newcastle, UK.
- Brassell, S., Indiana University, USA, 11-13 October.
- Delegation from Damen shipyards and the Institute of Marine Geology at the University of Bandang, Indonesia, 4 September.
- Division of Maintenance and Engineering, Royal Dutch Navy, 1 October.
- Eglinton, T., Woods Hole, USA, 15-17 January.
- Geenevasen, J.A.J., UvA.
- Gross, S., University of Bayreuth, Germany.
- Gustafsson M., Christian-Albrechts-University of Kiel, Germany.
- Kuypers, M.M.M., MPI for Marine Microbiology Bremen, Germany.
- Stam, F., University of Wageningen.
- Turgeon, S., University of Oldenburg, Germany.
- Walsworth-Bell, B., University of Milan, Italy.
- Zhang, C., Savanah River Ecology Laboratory, University of Georgia, USA.
- MacGregor, B., Max Planck Institute for Marine Microbiology, Germany, 12 August.
- Van Duin, A., California Institute of Technology, USA, 21 August.
- Van Geel, B., UvA.
- Volkman, J.K., CSIRO Australia, Division of Oceanography Marine Laboratories, Hobart, Australia, 16-18 September.
- Wakeham, S., Skideway Institute of Oceanography, USA, 28-29 July.
- Stoker, Dr. M.S., British Geological Survey, Edinburgh, Scotland.
- Baker, Prof. A.J., Royal Ontario Museum/University of Toronto, Toronto, Canada.
- Berkenbusch, Dr. K., National Institute of water and athmospheric research, New Zealand.
- Billet, Dr. D, Southampton Oceanography Center, UK.
- Gill, Dr R.E. Jr., Alaska Science Center, US Geological Survey, Anchorage, Alaska, USA.
- Day, T., Queen's University, Kingston, Canada.
- Gonzalez, Dr P.M., Fundacion Inalafquen, San Antonio Oeste, Rio Negro, Argentina.
- Lomnicki, Prof. Dr. A., Institute of Environmental Sciences, Jagiellonian University, Poland.
- Williams, Prof. J.B., Ohio State University, USA.
- Ydenberg, Prof. R.C., Simon Fraser University, Vancouver, B.C., Canada.

- Sieracki, M., Bigelow Laboratory for Ocean Sciences, Westbooth Bay Harbor, ME, USA.
- Kitazaw, Dr. D., Department Human and Society,Institute of Industrial Science, The University of • Tokyo, Japan (21-23 May).
- Crise. Dr. A., Istituto Nazionale di Oceanografia e di Geofisica Sperimentale -OGS, Segonico (TS), Italy (6-8 October).
- Solidoro, Dr. C., Istituto Nazionale di Oceanografia e di Geofisica Sperimentale -OGS, Segonico (TS), Italy (6-8 October).
- Cossarini, Dr. G., Istituto Nazionale di Oceanografia e di Geofisica Sperimentale -OGS, Segonico (TS), Italy (6-8 October).
- Zavaterelli, M., Dept. of Physics, Univ. of Bologna, Italy (6-8 October).
- Butenschön, M., Dept. of Physics, Univ. of Bologna, Italy (6-8 October).

UNDERGRADUATE UNIVERSITY STUDENTS AND STUDENTS FROM SCHOOLS OF PROFESSIONAL EDUCATION

- Andresen, H., University of Bremen, Germany
- Baudana, M., University of Torina, Italy
- Becking, L., Universiteit van Amsterdam
- Benda, M., Drenthe College
- Cleto, S.L.A., University of Porto, Portugal.
- De Boer, K., Friesland College, MBO Laboratoriumtechniek, Leeuwarden
- De Haas, S., Hogeschool Leiden
- De Jong, M.F., Utrecht University
- Dissard, D., University of Bordeaux I
- Eppenga, J., Rijksuniversiteit Groningen
- Faber, G., Friesland College, MBO Laboratoriumtechniek, Leeuwarden
- Haeberlé, M.A., Université Strasbourg
- Hamro-Drotz, D., University Helsinki, Finland
- Hidding, B., Universiteit van Amsterdam
- Hommersom, A., LUW
- Ines Seabra, M., University Lisboa, Portugal
- Kneepkens, J., Universiteit Utrecht
- Lammerts, L., Drenthe College
- Lijnse, I., Universiteit Wageningen
- Loff, J.F., University of Lisboa, Portugal
- Lok, T., Rijksuniversiteit Groningen
- Lubbe, S.K., Rijksuniversiteit Leiden
- Martins, A.S.R., University of Porto, Portugal
- Meijer, K., Rijksuniversiteit Groningen
- Minkenberg, C., Fontys Hogeschool, Eindhoven
- Reimerink, J., Rijksuniversiteit Groningen
- Rijkens, B., Van Hall Instituut, Leeuwarden
- Schulting, S., Universiteit Wageningen.
- Sjollema, S., Hogeschool van Utrecht
- Sperber, V., LUW
- Van De Berg, W.J., January-July, Utrecht University, Physical Oceanography
- Van Den Vossenberg, B., HLO, Eindhoven
- Van Der Waal, D., Van Hall Institute, Leeuwarden
- Van Der Zeijden, M., Mondriaan Onderwijsgroep
- Van Hooidonk, R., Vrije Universiteit
- Van Opstal, L., HLO, Eindhoven
- Wijngaards, E., January-July, Twente University, Physical Oceanography
- Woltering, M., Saxion Hogeschool, IJsselland
- Zwier, A.
- Verbeek, S.A. University Utrecht

4. Support Services

The vibrocorer during the ALW program 'Plume & Bloom'. Outcrops of Brown Bank Clay near East Anglia were mapped by this MRF-instrument. Photo: Martien Baars.

THE TECHNICAL SUPPORT SERVICES

Contributors: Jan van Ooyen, Marieke J. Rietveld, Marck Smit

Research Vessel PELAGIA

NIOZ owns and operates several marine research facilities, not only to accommodate its own scientific programme but also for the oceanographic community in the Netherlands. As a consequence of its position as a national institute and in relation to its mission NIOZ co-ordinates and takes care of the execution of sea-going research programmes funded by NWO in the framework of the national programme for sea-going research. A report on these MRF activities is given in Chapter 1.

The largest sea-going facility is RV PELAGIA, a 66 m multipurpose research vessel developed for oceanographic research in coastal seas, on continental shelves and in the blue ocean. R/V Pelagia (built 1991, ISM Certified) is specially designed as a multipurpose research vessel. It is a very stable platform and has most favourable nautical properties. Since 1991 she has experience in CTD-deployment, biological sampling methods, seismic surveys, coring activities (box-, multi-, piston, gravity, vibro-, CPT) as well as in deployment and recoverage of deep-sea moorings and bottom landers.

Smaller research vessels

Research Vessel NAVICULA: NIOZ has a 25 m research ship specially designed for working in the shallow Wadden Sea. She has been built in 1980, and was elongated in 1999. At the end of 2003 she went to Visser Shipyard in Den Helder for replacement of the steering house and major upgrading. After completion the ship will be state-of-the art for the coming 10 - 15 years.
Research Vessel NEREIS: A contract was given to Alnmaritec Tyne Tube Services Ltd. in Alnwick (near Newcastle), UK for the building of a 20 m fast aluminum twin hull with water jet propulsion (max speed 25 knots), shallow draught (0.8 m) for research near the coast and in the shallow waters of the Wadden Sea. The ship will be named NEREIS, and will be equipped with an A-frame and a hydraulic crane. The ship has been launched on 1 December 2003 and is expected to be ready for delivery early 2004. NEREIS is a shared ship with the Netherlands Organisation for Applied Technology (TNO).

NIOZ harbour

Plans are developed to change the lay-out of the NIOZ harbour in order to protect the smaller ships from damage by stormy easterly winds.

Ocean Facilities Exchange Group/Marine Facilities Tripartite Group

The OFEG/MFTG's primary objective is bartering shiptime and exchange of major marine equipment without the need to exchange money. This arrangement has significant advantages. It allows scientists access to a wider range of facilities and equipment than would otherwise be possible, and also it reduces wasted time, and therefore wasted costs on long transit passages. In 2003 Dutch scientists sailed on French and UK ships under this arrangement, and a British team sailed on RV Pelagia for a three week research cruise using the deep tow bathymetric instrument TOBI of SOC (Southampton Oceanography Centre). Another favourable development evolving from the partnership is the impulse to international co-operation and exchange of marine technicians for training and support on board. NIOZ marine technicians were trained for operating winches on NERC's RRS Charles Darwin, and marine technicians from SOC were trained on RV Pelagia to handle the NIOZ piston coring system. Moreover, NIOZ is proud that NIOZ/MRF techniques are widely recognized internationally. As a result SOC (UK) and the National Institute of Oceanography (NIO) in India purchased the NIOZ piston coring system for their ships.

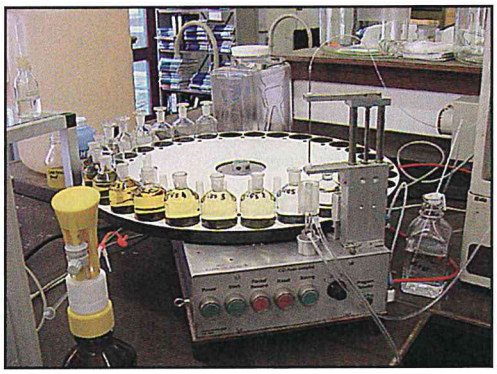
Cruise programme 2003

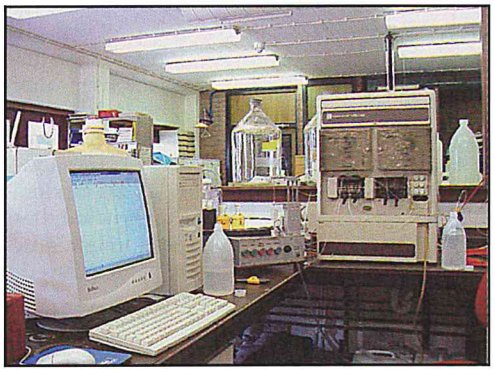
After maintenance R/V Pelagia started her cruise programme mid February and went on continuously during the year until mid December. Pelagia sailed 290 days in the North Sea, North Atlantic and the Mediterranean for the National Programmes TRANSAT, MOMAP and BADE, for the LOCO projects LOCO-IW and CAMP-LOCO, the EUROCORES programme MOUNDFORCE, for the EU programmes IMPRESS and EUROSTRATAFORM, for the LOICZ project CRENS and for the NIOZ project BIVALFF and as charters for Thales Underwatersystems, France and Cordah Ltd., UK. For the MRF equipment pool, new seismic equipment was tested. To accommodate these cruises diplomatic clearance has been obtained from UK, Ireland, Norway, Germany, Greenland/Denmark/Faeroer, Belgium, Canada, Iceland, Portugal, France,

Algeria, and Spain. Besides calling at homeport Texel, port calls for change of crew and scientific party as well as (un)loading scientific equipment took place in Funchal (Madeira - Portugal), Brest (France) (four times), St. George (Bermuda), Southampton, Peterhead and Aberdeen (UK), twice in Galway (Ireland), in Lisbon (Portugal), and in Palma de Mallorca and Valencia (Spain).

Auto Analyzer Group

In co-operation with the Ocean Engineering Division Instrumental Service and the Electronical Service, the Auto Analyser Group developed an automated method for the determination of dissolved oxygen in seawater.
The manual oxygen analysis was, although very accurate, a very time consuming and labor intensive method. The maximum number of samples that could be analyzed was around 50 on a 12 hours working day. The automated method can handle about 120 samples in the same time and with the same accuracy as the manual method.
The analysis is based on a spectrophotometrical measurement of a yellow iodine/iodide complex which is formed after adding reagents to a precipitate formed by binding the dissolved oxygen with manganese chloride to manganese oxide.
This automated method has been successfully tested in November 2003 during the LOCO-cruise on the RV Charles Darwin in the Indian Ocean.





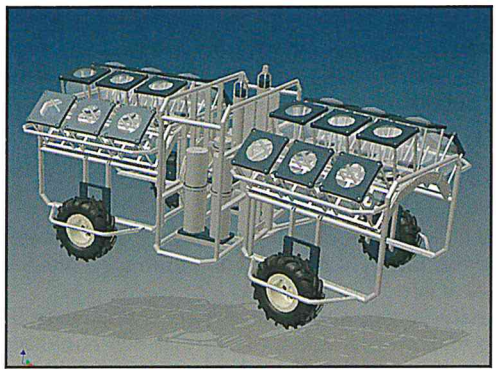
The automated oxygen analyses system

Ocean Engineering Division
A number of major projects that needed an integrated approach of the several technical skills of the Ocean Engineering Division gave the incentive to integrate the Sea Technology and Instrumentation Services. According to plan the Electronical Service will be integrated in the first half of 2004.

MOVE! (MObile VEhicle for benthic research)
A good example of an integral project is the making of the MOVE!, a bottom transecting vehicle for benthic research, designed to cover up to 30 stations down to a maximum depth of 6000 m for a maximum period of 9 months. In order to meet the scientific demands for this vehicle, several concepts with respect to propulsion, power supply, buoyancy, local intelligence, hydrostatics and hydrodynamics had to be conceived and evaluated with respect to technical feasibility, scientific applicability and overall reliability. Out of several options an articulated vehicle has been selected, composed of two outer instrument segments and a central intelligence and energy unit. The instrument segments have either an axial or a radial rotational freedom relative to the central unit, in order to deal with sediment roughness. A 4-wheel drive has been selected for propulsion, since skid steering was considered insufficiently accurate for high resolution positioning, and a 3-wheeled vehicle insufficiently stable. All wheel units are individually controlled in coordination with the steering bar between central unit and instrument segment for maneuvering.

Due to complexity of the project a wide variety of technical spin-off was experienced in the fields of: 3-dimensional parameter oriented CAD-engineering, lander development, buoyancy systems, hydrostatic and hydrodynamic engineering, battery systems and the development of local intelligence.

The first prototype of the MOVE!, has been - remotely operated - successfully tested on the Texel beach and shallow waters in December 2003. More extensive information on the MOVE-project: see http://www.nioz.nl/projects/move/index.htm



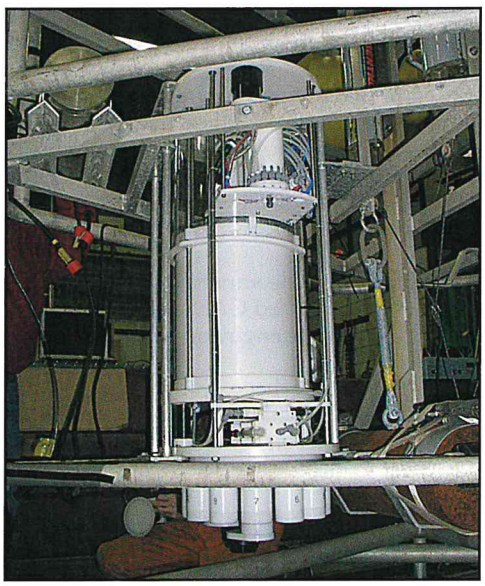
3-dimensional engineering has proven successful in developing complex instrumentation

On-shore test trials of the MOVE September 2003

LOCO-project (Long term Ocean Climate Observations)
Support was given to three LOCO-cruises where moored instrumentation was deployed for long-term observations in the North and Mid Atlantic and Indian Ocean.
Several innovating techniques were introduced: the use of large low drag buoyancy-units, specially adapted tandems of acoustic-releases, and to-order constructed titanium frames for mounting scientific equipment. Also a new more effective procedure was introduced for deployment.

Titanium frames for anchored instrumentation

Larval Collector
When water samples are required to investigate living organisms it is important to have a quickly operating water mass sampler. In such way that the sampled biomass is not influenced by the sampling-procedure itself. For this purpose the "Larval Collector" was developed. Especially for bivalve research in the North Sea this has proven to be an important innovation.



Larval Collector mounted in the Altrap Bottomlander

Scanfish Container

By the completion of the project Scanfish Container a long looked for wish was finally fulfilled. The Scanfish itself is an undulating wing which is towed by the research-vessel and which is "flying" through the water. During deployment a continuous on-line flow of data from biological and physical measurements is transmitted to the ship and monitored.

A special purpose container was constructed for the extensive accompanying equipment. The containerised package now provides for the physical storage of the fragile wing itself, the umbilical winch, computer and measuring equipment and a climatized working space and lab.

August 2003 the Scanfish container was introduced into the Marine Research Facilities equipment pool.

Sad to say that during operation on board the German RV POLARSTERN in January 2004, the Scanfish has been lost in the Southern Ocean.

5. Sociaal Jaarverslag

ALGEMEEN

In 2003 kon tenslotte helderheid worden verkregen over de financiële situatie met een substantiële financiële injectie die het mogelijk maakt om gebouwen en faciliteiten te vernieuwen dan wel aan te passen. Ook met de zekerheid dat de Regeling NIOZ gedekt is, stemde dit tot grote tevredenheid. Met het nieuwe elan dat deze toekenning van NWO genereerde, wordt nu reikhalzend uitgezien naar de aanbevelingen van de door NWO ingestelde Commissie van wijzen inzake de toekomst van het NIOZ op de lange termijn.

Feestelijk hoogtepunt van het jaar was de opening van de nieuwbouw door Hare Majesteit Koningin Beatrix op 4 april 2003. Het voltallige personeel van NIOZ en ALTERRA was daarbij aanwezig, evenals een honderdtal hoge gasten. De rondleiding langs de verschillende afdelingen en de daarbij door de medewerkers gegeven toelichting werd door de Koningin zozeer gewaardeerd, dat zij het zorgvuldig opgestelde protocol negeerde en het bezoek wel vier uur duurde. Op 5 april was er een druk bezochte Open Dag met meer dan 1000 bezoekers.

De bouwactiviteiten voor de nieuwbouw en de renovatie van het zeewaterexperimenteeraquarium, alsmede de op handen zijnde vernieuwbouw van de oude gebouwen en de bestaande installaties, de nieuwbouw voor de technische diensten, maakten organisatorische aanpassing van de dienst Gebouwen en Installaties noodzakelijk. Deze is inmiddels voltooid. Om meer geïntegreerd te kunnen werken, vooral wat betreft de grote projecten, is de samenvoeging gestart van de Technische Diensten. De Dienst Zeetechniek en Instrumentmaken zijn sinds oktober samengegaan en de Dienst Electronica zal naar verwachting in 2004 volgen.

Nu het NIOZ met de Pelagia deel uitmaakt van de internationale overeenkomst met Duitland, Frankrijk en het Verenigd Koninkrijk voor het uitwisselen van scheepstijd en grote zeegaande apparatuur, is het niet alleen mogelijk om de eigen scheepstijd beter te benutten doordat lange transittijden kunnen worden vermeden, maar ook kunnen onderzoekers gebruik maken van een breder scala aan schepen en grote apparatuur. Deze uitwisseling geeft daarnaast een stimulans aan de onderlinge uitwisseling van kennis en ervaring op technisch gebied. De Pelagia voer dit jaar gedurende 290 dagen met een druk vaarprogramma, in de Noordzee en op de Noord-Atlantische Oceaan, van Bermuda tot IJsland en van Groenland tot het Canarische Basin, en verder in de Westelijke Middellandse Zee.

Met de verjonging en vernieuwing van de vaste wetenschappelijke staf kon dankzij het Excellente Postdocprogramma een begin worden gemaakt. Daarnaast zijn de banden met universiteiten versterkt door de benoeming van drie NIOZ senior onderzoekers als deeltijdhoogleraar.
Prof.dr. Jan W. de Leeuw heeft aangekondigd dat hij zijn functie als directeur in 2004 wil neerleggen. De benoemingsadviescommissie is druk bezig met het zoeken naar een opvolger. De Science Plan Commissie is actief met de opstelling van een nieuw Science Plan voor de komende zes jaar. Er is vertrouwen in de toekomst.

BESTUUR EN WETENSCHAPCOMMISSIE

Bestuur Stichting NIOZ

Per 31 december 2003 was het bestuur als volgt samengesteld:

Prof.dr. Lous van Vloten-Doting, voorzitter	Ministerie LNV
Ir. W. Verhage	Den Haag
Prof.dr. W. van Delden	Vakgroep Genetica, faculteit Biologie, Rijksuniversiteit Groningen
Prof.dr. J.E. Meulenkamp	Vakgroep Geologie, Universiteit Utrecht

Het bestuur kwam in het verslagjaar 2003 zesmaal met de directie in vergadering bijeen, op 31 januari te Amsterdam, op 4 april te Texel voorafgaande aan de feestelijke opening door Koningin Beatrix van de NIOZ nieuwbouw, op 14 maart, 15 mei, 29 september en 21 november te Utrecht.

De vergaderingen werden namens de algemeen directeur van NWO bijgewoond door Dr. H. Weijma.

Genotuleerd werd door mevrouw C.S. Blaauboer-de Jong.

Wetenschapcommissie NIOZ

De Wetenschapcommissie NIOZ adviseert het bestuur en de directie over het algemene wetenschappelijk beleid van de Stichting en het Instituut, zij evalueert periodiek het wetenschappelijk programma en zorgt voor de wetenschappelijke beoordelingsprocedure van de voorstellen voor eigen NIOZ-oio's.

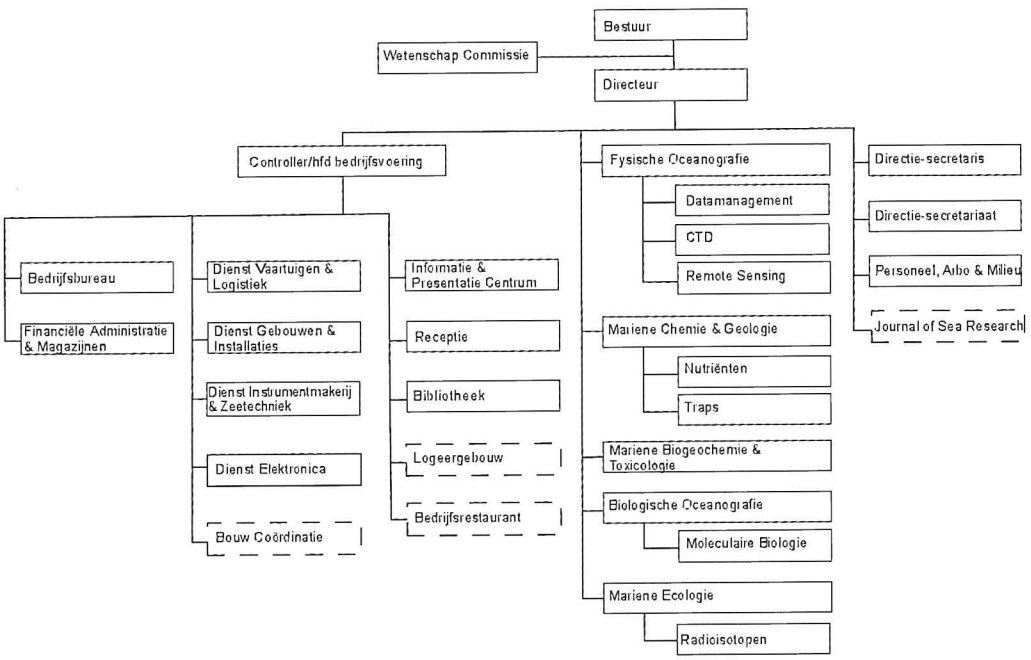
De Wetenschapcommissie was per 31 december 2003 als volgt samengesteld:

Prof.dr. W. van Delden, voorzitter	Vakgroep Genetica, faculteit Biologie Rijksuniversiteit Groningen
Prof. dr. J.-P. Henriët	RCMG/Mariene Geologie, Universiteit Gent, België
Prof. dr. J. Simpson	School of Ocean Sciences/UCNW, Bangor, UK
Prof. dr. R.J. Law	Centre for Environment Fisheries and Aquaculture Science (CEFAS), Burnham on Crouch, UK
Prof. dr. Karin Lochte	Institut für Meereskunde (IfM), Universität Kiel, Duitsland
Prof. dr. P. Herman	Afdeling Spatial Ecology, NIOO-CEME, Yerseke

Op 21 november 2003 werd Prof. dr. Laurent Labeyrie van het Laboratoire des Sciences du Climat et de l'Environnement in Gif sur Yvette van de Université Paris Sud-Orsay, Frankrijk, formeel benoemd als lid van de Wetenschapcommissie.

De Wetenschapcommissie kwam in 2003 bijeen op 5-6 juni te Texel. Op 5 juni vond een site-visit plaats aan de afdeling Fysische Oceanografie. Genotuleerd werd door mevrouw C.S. Blaauboer-de Jong.

ORGANOGRAM



PERSONEELSLIJST 31-12-03

DIRECTIE

Leeuw J.W. de Prof. dr.	34.2 uur	directeur
Rietveld M.J. Drs.		directie-secretaris

Directiesecretariaat

Blaauboer-de Jong C.S.	30.4 uur	dir. secretaresse
Markesteijn A.M.		secretaresse

STAFEENHEDEN

Mens en Mariene Milieu

Lindeboom H.J. Dr.	11.4 uur	senior onderzoeker
Weijerman M.	24 uur	m.i.v. 13-01 tot 13-07

Personeels-, Arbo en Milieuzaken

Vooys P.C.		hoofd
Mulder-Starreveld J.P.	28.5 uur	medewerker
Bredewold J.J.H.		personeelsfunctionaris
Kuip T.	22.8 uur	arbocoördinator
Reurink S.A.		medewerker m.i.v.01-07 tot 11-08

Bedrijfsbureau

Haas R.G. Drs. ir.		hoofd bedrijfsvoering/controller
Kralingen P. van Ing.		plv. hoofd bedrijfsvoering
Alkema P.R.	35.15 uur	medewerker
Jourdan M.T.	16.0 uur	administratief medewerkster

Financiën en control

Heerwaarde van C.W.		hoofd fin. administratie
Biersteker P.C.B.		projectmedew. fin. administratie tot 01-05
Arkel M.A. van Drs.		projectcontroller
Gootjes J.A.		ass. controller m.i.v. 01-01
Wernand-Godee I.	30.4 uur	medew. project-administratie
Keijser A.	24 uur	medew. financiële administratie
Tuinen H.A. van		medew. financiële administratie
Kooijman-Biermans M.H.M.	30.4 uur	medew. financiële administratie
Poleacov-Maraiala C.	32.3 uur	medew. financiële administratie
Brand J.A.	26.6 uur	medewerker m.i.v. 01-09
Nieuwenhuizen J.M.		medewerker Inventarisbeheer
Kalf J.		medewerker Inventarisbeheer

CORE PROJECT OFFICE (LOICZ/IGBP)

Kremer H.H. Dr.		executive officer
Whyte H.A.Y.		office-administrator

WETENSCHAPPELIJKE AFDELINGEN

AFDELING FYSISCHE OCEANOGRAFIE

Ridderinkhof H. Dr.		hoofd
Veth C. Drs.		senior onderzoeker
Zimmerman J.T.F. Prof. dr.	26.6 uur	senior onderzoeker
Aken H.M. van Dr.		senior onderzoeker
Maas L.R.M. Dr.		senior onderzoeker
Haren J.J.M. van Dr.		senior onderzoeker
Bruin T.F. de Drs.		datamanager MRF
Harlander U. Dr.		postdoc
Merckelbach L.M. Dr.		postdoc m.i.v. 19-08
Manders A.M.M. Dr.	30.4 uur	postdoc m.i.v. 01-05
Hosegood P.J.		OIO
Volkov D.		OIO

Veldhoven A.K. van		OIO
Terra G.		OIO FOM
Buijsman M.C		projectmedewerker
Eijgenraam F.		automatiseringsdeskundige
Nieuwenhuis J.		middelbaar electronicus
Wernand M.R.	32.3 uur	senior onderzoekmedewerker
Ober S. Ing.		senior onderzoekmedewerker
Hillebrand M.T.J.		senior onderzoekmedewerker
Hiehle M.A.		senior laboratoriummedewerker
Koster R.X. de		systeemanalist

AFDELING MARIENE CHEMIE EN GEOLOGIE

Baar H.J.W. de Prof. dr. ir.	32 uur	wnd hoofd	
Weering T.C.E. van Dr.		senior onderzoeker	
Jansen J.H.F. Dr.		senior onderzoeker	
Brummer G.J.A. Dr.		onderzoeker	
Timmermans K.R. Dr.		onderzoeker	
Stigter H.C. de Drs.	30.0 uur	projectonderzoeker	tot 07-12
Haas H. de Dr.		projectmedewerker	m.i.v. 01-05
Epping H.G. Dr.		onderzoeker	
Koning F.A. Dr.		onderzoeker	
Thomas H. Dr.		onderzoeker	
Richter T.O. Dr.		onderzoeker	
Gerringa A.L. Dr.	19.0 uur	postdoc	
Kramer J. Dr.		postdoc	
Bergh van den G. Dr.		postdoc NWO	tot 01-10
Karpen V.A. Dr.		onderzoeker	m.i.v. 08-09
Loncaric N.		OIO	tot 01-11
Bonnin J.		OIO	tot 01-10
Bozec Y.		OIO	
Mienis F.		OIO	m.i.v. 01-07
Gaast S.J. van der		senior onderzoekmedewerker	
Ooijen J.C. van		senior onderzoekmedewerker	
Bakker K.M.J.		onderzoekmedewerker	
Boer W. Ing.		onderzoekmedewerker	
Iperen J. van	8.0 uur	senior laboratoriummedewerker	
Gonzalez S.R.		senior laboratoriummedewerker	
Schogt N.	25.5 uur	laboratoriummedewerker	
Witte A.J.M.	19.0 uur	laboratoriummedewerker	
Laan P.		laboratoriummedewerker	
Weerlee E.M. van		laboratoriummedewerker	
Maatman A.		laboratoriummedewerker	tot 01-04
Crayford S.J.		laboratoriummedewerker	m.i.v. 15-01

AFDELING MARIENE BIOGEOCHEMIE EN TOXICOLOGIE

Sinninghe Damsté J.S. Dr. ir.	34.2 uur	hoofd	
Boon J.P. Dr.		senior onderzoeker	
Booy K. Dr.	30.4 uur	onderzoeker	
Schouten S. Dr. ir.		projectonderzoeker	
Versteegh G.J.M. Dr.		onderzoeker	
Hopmans E.C. Dr.	30.4 uur	postdoc	
Coolen M.J.L. Dr.		postdoc	tot 15-11
Forster A. Drs.		postdoc	
Herfort L.M.C.C. Dr.		postdoc	
Stadnitskaia A. Drs.		Postdoc	m.i.v. 01-12
Breugel van Y.		OIO	
Wuchter C.		OIO	
Weijers J.W.H.		OIO	
Huguet M.C.		OIO	m.i.v. 01-04
Baas M.		onderzoekmedewerker	
Rijpstra W.I.C.	19.0 uur	onderzoekmedewerker	
Fischer C.V. Drs.	28.0 uur	laboratoriummedewerker	tot 01-11
Bommel R. van		laboratoriummedewerker	

Kienhuis M.V.M.		laboratoriummedewerker	
Panoto F.E.	30.4 uur	laboratoriummedewerker	
Rampen S.W.		laboratoriummedewerker	
Mets A.		laboratoriummedewerker	
Ossebaar J.		laboratoriummedewerker	
Rietkerk M.D.M.		laboratoriummedewerker	m.i.v. 16-02
Woltering M.L.		laboratoriummedewerker	m.i.v. 01-10
Bouland M.		laboratoriummedewerker	m.i.v. 14-04
			tot 14-10

AFDELING BIOLOGISCHE OCEANOGRAFIE

Herndl G.J. Prof.Dr.		hoofd	
Ruardij P. Drs.		onderzoeker	
Baars M.A. Dr.		senior onderzoeker	
Veldhuis M.J.W. Dr.		senior onderzoeker	
Duyl F.C. van Dr.		senior onderzoeker	
Kuipers B.R. Dr.		onderzoeker	
Bleijswijk J.D.L. van Dr.	19.4 uur	hoofd mol. lab.	
Brussaard C.P.D. Dr.		postdoc	
Arrieta J.M. Drs.		postdoc	
Teira Gonzalez E.M. Dr.		postdoc	
ElKalay K. Dr.		postdoc	
Stoderegger K.E. Dr.	27.55 uur	postdoc	
Kramer G.D.		OIO-NWO	
Winter C.		OIO	tot 11-12
Reinthaler T.		OIO	
Baudoux A.C.		OIO	
Parada V.S.		OIO	
Goeij J.M. de		OIO	m.i.v. 01-03
Wilhartitz I.C.		trainee	m.i.v. 01-08
Kop A.J. Ing.		onderzoekmedewerker tot 01-10	
Oosterhuis S.S.		onderzoekmedewerker	
Hegeman J.		onderzoekmedewerker	
Noordeloos A.A.M. Ing.	31.35 uur	senior laboratoriummedewerker	
Noort G.J. van		senior laboratoriummedewerker	
Witte H.J.		senior laboratoriummedewerker	
Abbas B.A.		laboratoriummedewerker	tot 01-05
Roosken P		laboratoriummedewerker	tot 01-02
Bossink M.		laboratoriummedewerker	
Smit A.T.		laboratoriummedewerker	

AFDELING MARIENE ECOLOGIE

Meer J. van der Dr.		hoofd	
Bak R.P.M. Prof. dr.		senior onderzoeker	
Veer H.W. van der Dr. ir.		senior onderzoeker	
Piersma T. Dr.	15.2 uur	senior onderzoeker	
Bergman M.J.N. Ir.		onderzoeker	
Duineveld G.C. Drs.		onderzoeker	
Daan R. Dr.		onderzoeker	
Dekker R. Drs.		onderzoeker	
Philippart C.J.M. Dr.	30.4 uur	projectonderzoeker	
Lavaleye M.S.S. Drs.		Projectonderzoeker	
Witbaard R. Dr.		projectonderzoeker NWO	
Holmes S.P. Dr.		postdoc	
Williams I.D.		postdoc	tot 05-06
Nugues M.M.		postdoc	
Battley P.F.		postdoc	tot 01-04
Honkoop P.J.C. Dr.		postdoc	m.i.v. 01-02
Gils J. van Drs.	19 uur	onderzoeker	m.i.v. 01-09
Camphuijsen C.J.	21 uur	projectonderzoeker	
Bos O.G.		OIO NWO	
Maier C.		OIO tot 01-10	
Vahl W.K.		OIO RuG	

Scheffers S.R.		OIO	tot 01-02
Amaro T.		OIO	
Cardoso J.		OIO	
Smallegange I.M.	30.4 uur	OIO	
Reneerkens J.W.H.	30.4 uur	OIO	
Compton T.		OIO RuG	
Hout P.J. van den	30.4 uur	OIO m.i.v. 01-04	
Kraan C.	30.4 uur	OIO	m.i.v. 01-04
Dapper R.		automatiseringsdeskundige	
Berghuis E.M.		senior onderzoekmedewerker	
Nieuwland G.		senior onderzoekmedewerker	
Spaans B. Drs.		senior onderzoekmedewerker	
Dekinga A. Drs. Ing.		senior onderzoekmedewerker	
Mulder M.		onderzoekmedewerker	
Witte J.IJ.		onderzoekmedewerker	
Koutrik A. van	15.2 uur	laboratoriummedewerker	
Bol-den Heijer A.C.	29.25 uur	laboratoriummedewerker	
Iperen J. van	15.2 uur	senior laboratoriummedewerker	
Waasdorp C.M.		laboratoriummedewerker tot	
Brugge M.C.		dierverzorger	

ONDERSTEUNENDE DIENSTEN

Dienst gebouwen en installaties

Groot S.P.	22.8 uur	medewerker	
Lakeman R.	20.0 uur	medewerker	
Daalder R.M.		medewerker	
Witte R.J.C.		medewerker	
Trap B.		medewerker	
Heerschap J.H.		medewerker	m.i.v. 01-08
Bonne E.		medewerker (detachering)	

Receptie

Hillebrand-Kikkert A.	20.0 uur	telefoniste/receptioniste	
Dapper-Maas M.A.	19.0 uur	telefoniste/receptioniste	
Berbee-Bossen J.		telefoniste/receptioniste (inval)	
Boks-Visser H.		telefoniste/receptioniste (inval)	

Informatie en presentatie centrum

Pool W.G. Dr.		hoofd	
Malschaert H. Ing.		systeem/netwerkbeheerder	
Derksen J.D.J.		systeem/netwerkbeheerder	
Aggenbach R.P.D.		eerste medewerker	
Manshanden G.M.	13.5 uur	automatiseringsdeskundige	
Barten-Krijgsman N.	15.2 uur	medewerker	

Bibliotheek

Grippeling R.S.M.	30.4 uur	hoofd	
Bruining-De Porto M.E.	31.5 uur	medewerker	

Redactie

Philippart C.J.M. Dr.	7.6 uur	hoofdredacteur	
Bak-Gade B.	20.0 uur	assistent redacteur	

TECHNISCHE DIENSTEN

Instrumentmaken

Boekel H.J.		hoofd	
Keijzer E.J.H.		medewerker	
Heerwaarden J. van		medewerker	

Electronica

Groenewegen R.L. Ing.	30.4 uur	hoofd	

Koster B. Ing.	plv. hoofd	
Franken H. Ing.	hoger electronicus	
Laan M.	hoger electronicus	
Asjes A.J.	medewerker	
Buijsman D.J.	medewerker	m.i.v. 01-07

Zeetechniek

Smit M.G.	hoofd	m.i.v. 15-02
Porto H.H. de	senior medewerker	
Schilling J.	senior medewerker	
Polman W.	medewerker	
Bakker M.C.	medewerker	
Blom J.J.	medewerker	
Wuis L.M.	medewerker	
Boom L.	medewerker	
Gieles S.J.M.	medewerker	
Grisnich P.W.	medewerker	
Witte Y.	medewerker	tot 01-12
Zijm C.J.	medewerker	m.i.v. 20-01
		tot 01-10
Zijm J.M.	medewerker	m.i.v. 19-08

Vaartuigen en logistiek

Buisman T.C.J.	hoofd	
Groot J.C.	senior gezagvoerder Pelagia	
Leeuw C.O.	senior gezagvoerder	m.i.v. 21-07
Ellen J.C.	gezagvoerder Pelagia	
Duyn M.D. van	stuurman Pelagia	
Puijman E.A.	stuurman Pelagia	
Seepma J.	hoofdwerktuigkundige Pelagia	
Kikkert K.C.	hoofdwerktuigkundige Pelagia	m.i.v. 01-01
Stevens C.T.	scheepstechnicus Pelagia	
Kleine, M.D.M. de	2e werktuigkundige	m.i.v. 27-01
Mik G.	scheepskok Pelagia	
Betsema G.L.J.	scheepstechnicus Pelagia	
Slikke R. van der	scheepstechnicus Pelagia	m.i.v. 10-02
Maas J.J.M.	scheepstechnicus Pelagia	
Heide R. van der	scheepstechnicus Pelagia	
Meijer N.O.	scheepstechnicus Pelagia	
Boon P.	scheepstechnicus Pelagia	
Vermeulen G.P.	matroos/kok	m.i.v. 22-04
Dresken J.T.	matroos/kok	m.i.v. 05-06
Adriaans E.J.	havenmeester/schipper Griend	
Star C.J. van der	schipper Navicula	
Vis van der P.C.A	machinist/motordrijver Navicula	
Vries de H.	scheepstechnicus/kok Navicula	
Jongejan W.P.	komvisser	

ARBEIDSVOORWAARDEN

Collectieve Arbeidsovereenskomst (CAO)

In december 2003 is tussen de CAO partijen het akkoord bereikt over de verlenging van de Collectieve Arbeidsovereenkomst voor de Onderzoekinstellingen (CAO-OI). De looptijd van deze CAO geldt van 1 oktober 2003 tot en met 31 december 2004.
In de geest van het Najaarsakkoord dat Kabinet en Sociale partners in oktober 2003 hebben afgesloten, waren werkgevers genoodzaakt om ten aanzien van de algemene loonontwikkeling soberheid te betrachten. Dit heeft geresulteerd in een verhoging van de structurele eindejaars-uitkering met 1,1% tot 4,1% van het jaarsalaris. Voor deze uitkering geldt een bodem van €1000,- bij een fulltime dienstverband. Daartegenover zijn de salarissen van de onderzoekers in opleiding aanzienlijk verbeterd en lopen hiermee in de pas van de salarisontwikkeling zoals die geldt voor deze categorie bij de Nederlandse Universiteiten.

De indexering voor de tegemoetkoming in de premie voor de particuliere ziektekostenverzekering (ZKOI-bijdrage) is voor het jaar 2004 vastgesteld op 7,5%. Ziekenfondsverzekerden ontvangen per 1 januari 2004 een tegemoetkoming van € 10,- netto per maand in verband met de verhoging van de premie.

Overeengekomen werd om het verlofstelsel te vereenvoudigen door het als kunstmatig ervaren onderscheid tussen adv-uren en verlofuren te laten vervallen. De afspraak werd gemaakt om voor het einde van het jaar hiertoe een voorstel uit te werken zodat de wijziging per 1 januari 2004 kan worden ingevoerd.

Het verouderde functiewaarderingssyteem de "Beredeneerde Vergelijking" is per 1 juli 2003 vervangen door een eigen systeem van functiewaardering voor de WVOI, de zogenaamde FunctieNiveauMatrix (FNM). Uiterlijk 1 juli 2005, met een mogelijke uitloop van 6 maanden, dienen alle functies binnen de organisatie te worden ingedeeld door middel van het nieuwe systeem. Indien de indeling van een functie tot een hogere schaal leidt, zal dit met terugwerkende kracht tot 1 april 2003 worden gerealiseerd. Een lagere functiewaarde zal geen consequenties hebben voor het salarisperspectief van de zittende medewerker.

De Seniorenregeling Onderzoekinstellingen is verlengd tot 1 januari 2005, de datum waarop de verlengde CAO afloopt. De regeling is op een aantal punten flexibeler geworden. Zo kunnen medewerkers tussentijds de werktijd aanpassen of afbouwen binnen een marge van 5 tot 40%.

Verlofstuwmeer

In 2003 zijn er binnen het Koninklijk NIOZ afspraken gemaakt teneinde het bestaande verlofstuwmeer te reduceren. Voor een deel wordt dit stuwmeer veroorzaakt door compensatieverlof, dat feitelijk niet als vakantieverlof kan worden aangemerkt, opgebouwd tijdens vaarexpedities.

Jaarlijks dienen afdelingshoofden met hun medewerkers in dit verband afspraken te maken teneinde ultimo 2007 het stuwmeer tot "gemiddeld nul" te hebben teruggebracht.

Hierna werden in 2003 tevens op CAO-niveau afspraken gemaakt, in het kader van de vereenvoudiging van het verlofstelsel, teneinde verlofstuwmeren te verminderen. Deze zullen er toe moeten leiden dat in het vervolg niet meer dan 80 verlofuren naar een volgend jaar mogen worden meegenomen.

Arbeidsvoorwaarden op maat

In 2003 konden medewerkers van het Koninklijk NIOZ voor het eerst gebruik maken van de bron verlofuren teneinde AVOM-doelen (ArbeidsVoorwaarden Op Maat), zoals een fiets of een PC, aan te schaffen.

De belangstelling voor het gebruik van AVOM is ten opzichte van 2002 progressief toegenomen.

Circa 30% van de vaste en tijdelijke medewerkers hebben in 2003 één of meerdere doelen aangeschaft zoals hieronder globaal gespecificeerd:

PC`s	34
Fietsen	25
Verkopen verlof	18 (medewerkers)
Kopen verlof	3 (medewerkers)
Studieregeling	1 (medewerker)

Opleiding en training

Er is in 2003 veel aandacht besteed aan opleiding, vorming en training. Vanuit het Koninklijk NIOZ zijn diverse trainingen georganiseerd om uitvoering te geven aan opfrissing en ontwikkeling van kennis en vaardigheden op het gebied van o.a. management, persoonlijk functioneren en kennisoverdracht. De volgende trainingen zijn georganiseerd:

Vaarbewijs I en II
Conflictbeheersing
Survival at Sea
Gezond presteren onder druk
Timemanagement
Zakelijk schrijven
Engels
Autocad
Booglassen

De leergang Management in Onderzoekorganisaties, in 2002 gestart voor afdelingshoofden, is begin 2003 afgesloten met een management game. Deze leergang vond zijn vervolg in de zogenaamde "Pelikaandagen". Gedurende deze twee dagen discussieerde het wetenschappelijke kader van het Koninklijk NIOZ over zaken die betrekking hadden op o.a. de missie en bedrijfsvoering van het instituut.

De uit wetgeving voortvloeiende cursus Vaarbewijs I en II, teneinde o.a. rubberboten te mogen bevaren die een snelheid hebben van meer dan 20 km per uur, en de gevolgde training Survival at Sea zijn aanleiding geweest om een protocol "Veilig werken op het wad" op te stellen. In overleg met de betrokken geledingen zal de praktische uitwerking in 2004 gerealiseerd worden.

Naast de groepstrainingen volgden 17 personen vanuit het Koninklijk NIOZ op individuele basis een (externe) opleiding, training of cursus. Deze staan los van wetenschappelijke bijeenkomsten/seminars, zijn functiegericht en aan de werkplek gerelateerd. Een aantal van deze opleidingen/cursussen loopt door in 2004.

Individueel Klachtrecht

Koninklijk NIOZ beschikt sinds jaren over een regeling Individueel Klachtrecht. Deze regeling biedt werknemers de mogelijkheid om klachten, over een gedraging door of vanwege de werkgever bespreekbaar te maken en te doen onderzoeken. In 2003 zijn er bij de Klachtadviescommissie geen klachten ingediend.

Arbo- en Milieujaarverslag

Inleiding

In dit verslag wordt gerapporteerd over de belangrijkste activiteiten op het terrein van arbo en milieu die in 2003 hebben plaatsgevonden.

Beleid

In dit jaar is de risicoinventarisatie weer opgepakt. De huidige inventarisatie is van 2001 en is vanwege de nieuwbouw gedateerd. Als eerste is er een beoordeling geweest voor de nieuw te bouwen kantoren van de dienst zeetechniek. Het afvalbeleid is opnieuw op papier gezet met als doel de verschillende soorten afval gestructureerder af te voeren. De interne web-pagina van arbo en milieu is in zijn geheel verbeterd een aangevuld met nieuwe informatie voor het personeel.

Arbo- en Milieucommissie

De Arbo- en Milieucommissie heeft een adviserende en signalerende taak naar Directie en Ondernemingsraad op het gebied van veiligheid en milieu. De commissie is breed van samenstelling. Geledingen uit de technische dienst, de wetenschappelijke afdelingen, haven en vaartuigen, ondernemingsraad, bedrijfsvoering en personeels- arbo- en milieuzaken zijn in de commissie vertegenwoordigd. De commissie is in 2003 vier keer bijeen geweest.

Ongevallen

In dit jaar bleven de ongevallen die zich voordeden beperkt tot kleine verwondingen. In het ergste geval ging het om een medewerker die zich sneed met het schoonmaken van glaswerk. Deze medewerker werd doorverwezen naar een huisarts.

Veiligheids- en milieuzaken

Ten behoeve van de door Rijkswaterstaat verleende lozingsvergunning zijn elk kwartaal analyses gedaan van het afvalwater van het aquariumgebouw en de laboratoria.

Via de speciaal hiertoe uitgeruste container is door het afvalverwerkingsbedrijf SITA het nodige klein gevaarlijk afval afgevoerd. Voor het verzamelen van TL buizen is er een verzamelbak bijgekomen. De overige belangrijkste af te voeren componenten waren oplosmiddelen, giftige chemicaliën, laboratoriumafval en batterijen.

Bedrijfsgezondheidszorg

De opvarenden van de schepen en de leden van de bedrijfsbrandweer zijn dit jaar weer periodiek gekeurd en goed bevonden. Ook zijn er niet reguliere keuringen gedaan voor personeel dat voer op buitenlandse schepen of keuringen voor duikers.

Ziekteverzuim

De daling van het ziekteverzuim in de laatste jaren heeft zich in 2003 voortgezet. Ten opzichte van 2002 is het ziekteverzuim in 2003 met 0.3% afgenomen (3.8% in 2003 tegen 4.1% in 2002).

	WP	M	V	NWP	M	V
2000	5.6	5.8	4.9	8.6	6.9	15.6
2001	3.7	4.0	2.5	5.7	4.1	12.9
2002	3.5	3.5	3.4	5.0	3.1	13.9
2003	1.5	1.3	2.3	6.8	6.7	7.4

Bedrijfshulpverlening

Ten behoeve van de EHBO voorziening zijn zeventien personen op herhalingscursus geweest voor het eenheidsdiploma EHBO van het Oranje Kruis. De cursus werd gegeven op het instituut door DHTC. Van deze zeventien zijn er acht varende op de schepen.

De leden van de bedrijfsbrandweer oefenden naast de maandelijks oefeningen ook met de gemeente brandweer. Deze multidisciplinaire oefening werd georganiseerd door het NIOZ in samenwerking met de regionale brandweer. Er werd onder andere aan deelgenomen door de brandweer van Texel en van Den Helder. Ook de Ambulancedienst was er bij betrokken met een ambulance en het nodige personeel.
In totaal deden er negen voertuigen aan mee en vierenvijftig personen.
Het aantal leden van de bedrijfsbrandweer betreft momenteel twaalf personen. Voor het werken met de nieuwe brandmeldcentrale zijn er twee personen op cursus geweest bij de firma Siemens voor het diploma Opgeleid Persoon.

Investeringen

Voor het komende jaar zal er onder meer geïnvesteerd worden in communicatiemiddelen voor de bedrijfsbrandweer.

Vergunningen

In verband met de vergunning voor het lozen van afvalwater op de Waddenzee heeft het laboratorium van Tauw Milieu in Deventer ieder kwartaal het geloosde afvalwater geanalyseerd.

Het NIOZ heeft opgave gedaan van de geloosde hoeveelheid zeewater en laboratoriumafvalwater in m3/kwartaal. Deze gegevens zijn uiterlijk één maand na het beëindigen van ieder kwartaal toegezonden aan Rijkswaterstaat Directie Noord Holland met afschrift aan het RIZA. In 2003 is er in totaal 81.000 m3 water afgevoerd.

DE PERSONEELSVERENIGING

In 2004 zijn enkele veranderingen in het beleid van de personeelsvereniging toegepast. Zo is er een start gemaakt met het invoeren van een jaarlijkse algemene ledenvergadering. Op deze vergadering presenteerde het PV-bestuur de geplande activiteiten voor het komende jaar met een bijbehorend kosten overzichtplaatje. Op deze manier kan de PV zijn plannen beter aanpassen aan de wensen van zijn leden. Er is besloten om ook onze buren van Alterra voortaan bij onze activiteiten uit te nodigen. Zij zullen dan naar rato bijdragen in de gemaakte kosten. Verder zijn we erg blij dat Santiago Gonzalez terugkomt als bestuurslid.

In het jaar 2003 zijn er veel veranderingen geweest op het NIOZ, welke gevierd zijn met grote feesten. Vaak heeft de PV hierbij op de achtergrond geholpen. Hiermee zijn de eigen activiteiten gedurende dit jaar op een laag pitje komen te staan. In de zomer is echter wel een "sportdag" georganiseerd, die als een bom is ingeslagen. Het was prachtig weer en 's avonds werd het puzzel-leed verzacht met een drankje en hapje bij de Texelse golfclub.

Ook heeft elk PV-lid een flesje wijn gekregen voor de kerstdagen. Op 18 december werd het jaar weer afgesloten met een kerstborrel. Dit was weer als vanouds een groot succes met dank aan iedereen die hier aan meegeholpen heeft.