ANNUAL Report 1999

NETHERLANDS INSTITUTE FOR SEA RESEARCH (NIOZ)

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ANNUAL REPORT 1999

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CONTENTS

Cross-section of a radiolaria within a diatom (*Ethmodiscus rex*) - ooze of glacial Banda Sea sediment (350x)".

The year 1999 has been important because the scientific and other achievements of NIOZ over the last five years have been reviewed and evaluated by two international peer review committees acting on behalf of the major funding body of NIOZ, i.e. the Netherlands Organisation for Scientific Research (NWO). For this purpose several detailed documents addressing the scientific performance over the period under review, the research proposed for the next five years, and the management of the national facility for sea going research for which NIOZ is responsible, were produced during the first months of the year. Based on these documents and interviews during the site visits the peers reviewing the science and the research organization came to the following conclusions: 'NIOZ as a whole is rated very good, NIOZ is a credit to the country and an internationally competitive institute, NIOZ publications have a long and very good record for both quality and impact'.

The peers reviewing our performance with respect to the management of the national sea going facility, NIOZ-Marine Research Facilities (NIOZ-MRF), concluded that:

'On the working level the performance of the MRF has been very good over the past period. Moreover, the committee would like to compliment the MRF for the dedication of its personnel even though they faced a number of budgetary and organisation problems'.

Nevertheless, the mission statement was changed to some extent:

NIOZ aspires to perform top level curiosity-driven and society-inspired research of marine systems that integrates the natural sciences of relevance to oceanology. NIOZ supports high-quality marine research and education at universities by initiating and facilitating multidisciplinary and sea-going research embedded in national and international programmes.

As a result of the very positive outcome of the peer reviews, no major changes in terms of science directions, research organisation or management are planned for the years to come.

Despite these good evaluations, the basic funding has not been enhanced. As a matter of fact, NIOZ, as well as the other NWO institutes, is facing a general budget cut for the next years. ***This is difficult to understand in a country with such a high economic prosperity as the Netherlands and where the government advertises the slogan: 'Nederland Kennisland' (the Netherlands, land of knowledge)***. It implies that the financial situation remains as critical as it was over the last years, so that our major efforts to obtain funding from other parties than NWO will continue invariably.

Another major activity in 1999, apart from research and education, was the detailed preparation of major renovation and new building projects to be realised in 2000. As a result hereof, NIOZ will have a completely renovated large scale experiment building, an additional 2000 m^2 of office and laboratory space as well as a renovated guest centre at its disposal at the end of 2000.

A third important activity has been the scientific, technical and logistical planning of a cruise of the RV Pelagia around Africa in the first five months of 2000. This cruise has 12 legs and over 21 scientific programs to be executed by many representatives of universities, research schools and institutes, including non-Dutch participants.

In 1999 7 PhD students defended their theses successfully, whereas the number of refereed reports and publications was 143.

A growing part of the scientific output is associated with multidisciplinary research, partly as a result of the co-operation between physical, chemical, biological and geological groups within and outside NIOZ.

Just few publications are mentioned. Two Nature papers reported on major climatological changes in the past. One of them showed that during sapropel formation in the Mediterranean the entire water column could have been anoxic, whereas the water was still circulating through the basin. A beautifully illustrated book of 368 pages entitled: 'Ecologische atlas van de Nederlandse wadvogels' (Ecological Atlas of Dutch wader birds), partly written by Theunis Piersma of the department of Marine Ecology, summarising the latest scientific insights in wader bird ecology, was released at the end of the year. It is hoped that an English translation will be undertaken, so that the contents of this book become widely accessible.

On the educational front a 4 day pilot course in marine ecology was developed by NIOZ and Ecomare for future marine officers. This course was very well received and was awarded the prestigious national clean shipping award. An international award, the two-yearly Schenck award for very promising young biogeochemists, was presented to Stefan Schouten of the department of Marine Biogeochemistry and Toxicology.

In 1999 two former employees died, Prof. G.P. Baerends who served as a board member and some time as director a.i., and Henk Beumkes, our previous harbour master. Early on in 1999 we were shocked by the death of our young librerian Afke Brouwer. She died after she had given birth to a healthy son.

In 1999 the average age of our employees decreased substantially due to the (early) retirement of tenure staff, whereas many young temporary staff were taken aboard thanks to a major increase of competitive funding from third parties.

As usual, the research departments were strongly and optimally supported by the technical and administrative units as well as by the crews of our research vessels. The acquisition group, renamed Information and Presentation Centre (IPC), has been extended to meet the increasing demands of the scientists regarding poster and oral preparations and support during workshops, meetings and congresses at NIOZ.

At the very end of 1999 we have been informed that a relatively large number (9) of the proposals submitted to the EU in which NIOZ is involved during the first round of the 5th framework has been funded. This implies a major impulse for our research associated with margins and methane driven ecosystems, harmful algal blooms, primary productivity, microbial food webs, dissolved organic matter and palaeoclimate studies. Based on this additional funding and many other scientific developments, we are looking forward to a scientifically healthy 2000.

J.W. de Leeuw

A true-colour (spectral band combination) Compact Airborne Spectrographic Imager (CASI) image taken on September 1998 over the NIOZ institute and Marsdiep inlet as part of the COASTIOOC project. Imaging by the Free University of Berlin. The image shows some interesting phenomena in the Marsdiep tidal inlet where vigorous tidal currents create a highly dynamic environment. Foam lines indicate the presence of frontal zones separating different water masses. On the top of the figure patches of highly turbid water can be recognised outside the surf zone.

1. Scientific Activity

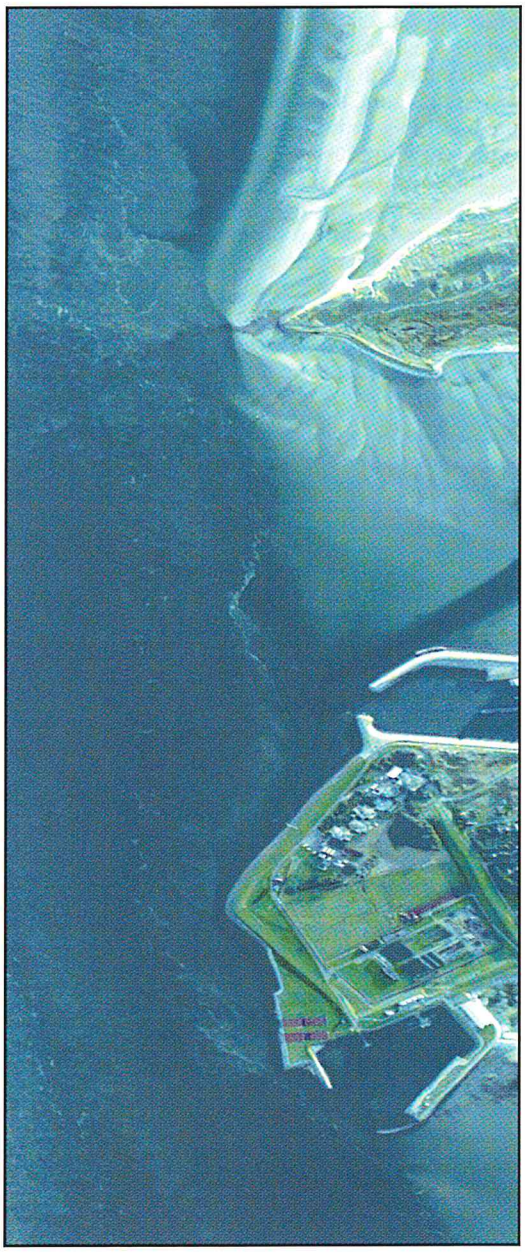


Photo: C. Olbert.

Effects of eutrophication on phytoplankton community structure in the western Wadden Sea: a multidisciplinary approach

Contributors: *Catharina J.M. Philippart, Gerhard C. Cadée, Wim van Raaphorst and Roel Riegman*

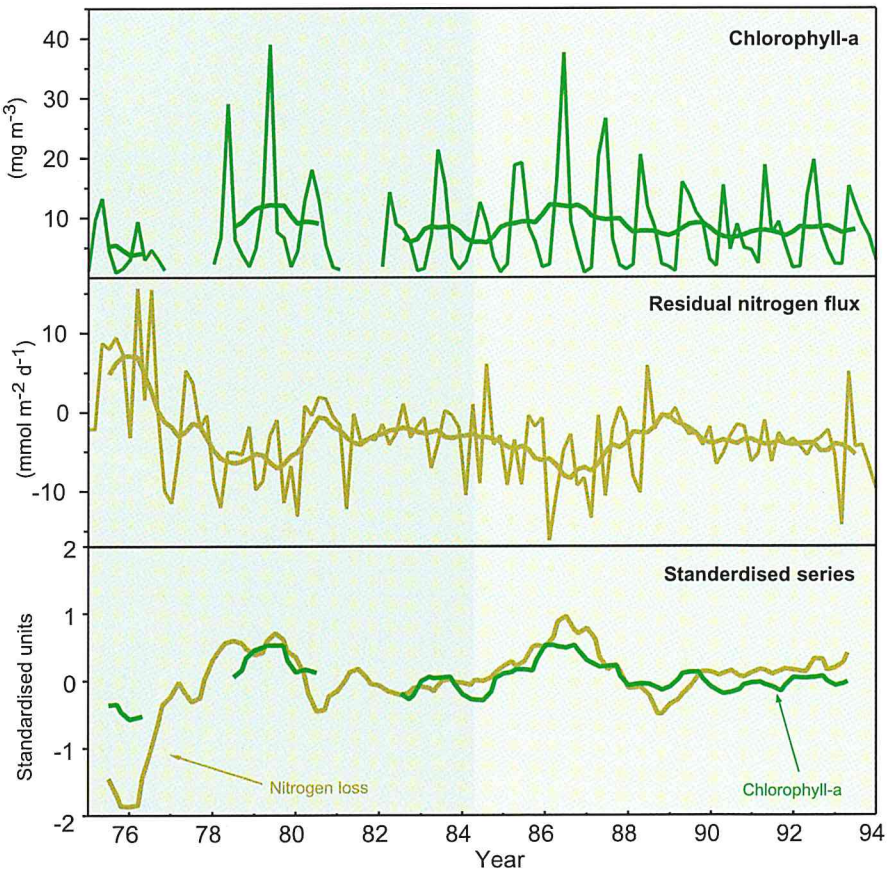
This study was a joint activity of the Departments of Marine Ecology, Marine Chemistry and Geology, and Biological Oceanography. Nutrient budget calculations were based on hydrodynamic modelling by the Department of Physical Oceanography. Funding for this study was partly provided by a research grant (FAIR-CT95-0710) from the European Communities.

Phytoplankton-nutrient interactions

Jan Hegeman, while sampling phytoplankton by means of a bucket at the permanent sampling station in the Marsdiep tidal inlet. Since the late 1960s, phytoplankton is regularly sampled from a jetty at high tide. Sampling frequency is related to algal densities and varies between once every months during winter and two times per week during spring blooms.
By: G.C. Cadée and J. Hegeman.

In shallow coastal marine waters, the total primary production and biomass of phytoplankton is assumed to be related to nutrient loadings from land and subsequent availability of these nutrients in the water column. Current theories on plankton ecology predict that a eutrophic and nitrogen-controlled environment gives rise to a dominance of large phytoplankton species. Due to their larger storage capacity they are better competitors under high and fluctuating nutrient regimes, while the biomass of smaller algae is controlled by microzooplankton. This will subsequently result in an enhanced deposition flux of large phytoplankton species to the benthic realm, where part of the associated nutrients is buried or mineralised.

Since the late 1960s, phytoplankton biomass, species composition and production were measured regularly in the Marsdiep tidal inlet. Bucket water samples were collected at high water from the so-called NIOZ jetty, which is located at the northern shore of the inlet. Sampling frequency varied from once a month in winter to twice a week during phytoplankton blooms. These long-term field observations showed that the mean annual chlorophyll content and primary production of the phytoplankton community almost doubled between 1976 and 1978 and remained high hereafter. The observed changes in phytoplankton biomass and production are considered to be induced by the coinciding increase in nutrient loadings to the western Wadden Sea.

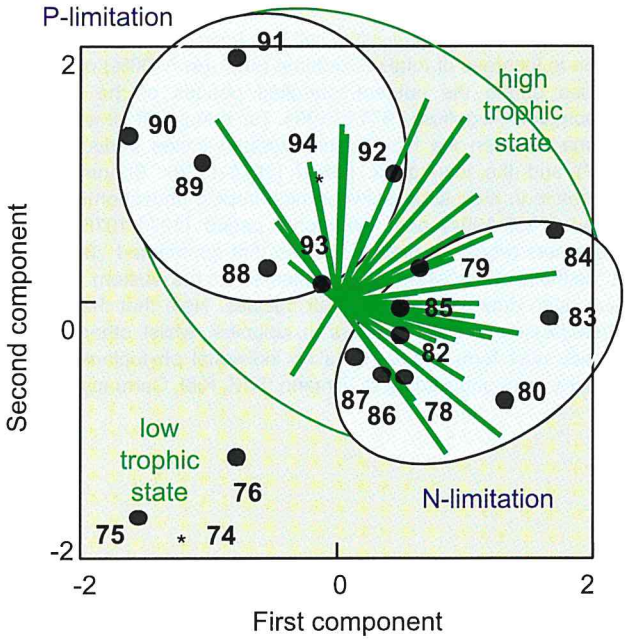


Bi-monthly averaged time-series and 12-month running means in the western Wadden Sea from 1975 to 1993. Top panel: Chlorophyll-a concentrations (mg m^{-3}). Middle panel: Residual nitrogen fluxes (mmol m^{-2} d^{-1}) as estimated by means of nitrogen budgeting. Bottom panel: Running means of standardised (zero mean, unit variance) chlorophyll-a concentrations and nitrogen loss.

It may be questioned whether nutrient control is relevant at all in the Marsdiep. Compared to the open North Sea, the nutrient concentrations are high, even in summer, and incident irradiance levels stay low due to high concentrations of suspended matter. Experimental work, however, indicated that under sub-optimal light conditions, nutrients can still be limiting the specific growth rate. During such nutrient-limited growth at non-saturating irradiance levels, algae enhance their nutrient quota and growth is sustained at higher nutrient concentrations. Just recently, this co-limitating effect of nutrients and light on the physiology and growth response of algae has been described for marine phytoplankton species such as ***Phaeocystis pouchetii*** and coastal diatoms.

Community structure

The increase in phytoplankton biomass and production between 1976 and 1978 coincided with a shift in phytoplankton species composition. Multivariate analysis of timeseries on abundances of 32 algal taxa revealed that the phytoplankton community structure in the western Wadden Sea changed drastically between 1977 and 1978. Although chlorophyll-a levels showed no more drastic changes from 1978 onwards, we observed a second shift in species composition between 1987 and 1988. The community structure was relatively stable during the periods between these two shifts, *viz.* from 1974 to 1976, from 1978 to 1987 and 1988 to 1994.
These major changes in phytoplankton biomass and species composition coincided with changes in absolute and relative (N: P) nutrient concentrations in the western Wadden Sea. A combination of the time series on trophic state (using chlorophyll-a as a proxy) and limiting resources (N: P ratio) showed the same distinctive periods as phytoplankton community structure. The increase in phytoplankton abundance between 1976 and 1978 corresponded with a decrease in N: P ratio. Hereafter, the community structure changed again between 1987 and 1988 upon the re-shift to phosphorus-controlled conditions.

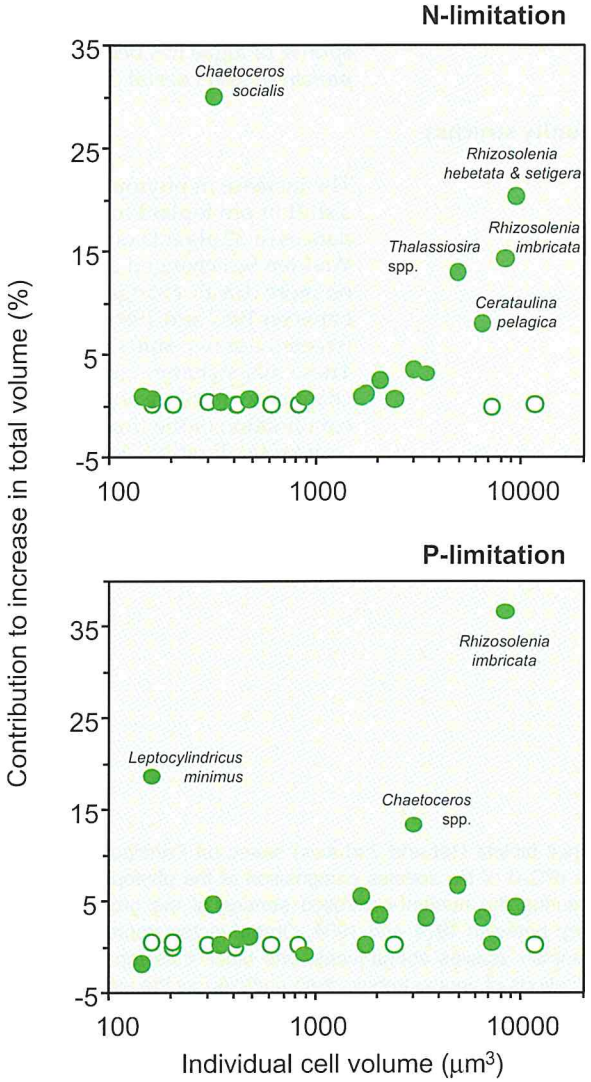


Covariance biplots (1st and 2nd axis) based on Principal Component Analysis (PCA) of the species composition of the phytoplankton community during the nutrient-controlled periods of the growing season (July-Aug) between 1974 and 1994. Green vectors represent relative phytoplankton species abundances, and black dots represent years. The indications of annual trophic state (indexed as the average annual chlorophyll-a concentrations) and ambient N: P ratio (during the growing season from March to August) are restricted to the period for which nutrient data were available (1975-1993), the remaining years (1974 and 1994) are indicated with asterisks. The year 1977 could not be included in the analysis due to insuffient data on phytoplankton species abundances.

Size structure

The interannual changes in phytoplankton biomass and species composition were accompanied by changes in size distribution. Not all species contributed equally to the changes in total cell volume. The increase after 1978 was mainly due to species with large individual volumes, particularly during the nitrogen-controlled conditions. After 1978, the additional biomass of the diatom community during the nutrient-controlled period of the year (July-Aug) was characterised by a high proportion (> 65%) of species with an individual cell size of more than 1000 μm^3 or by smaller diatoms that are able to form colonies, i.e. ***Chaeotoceros socialis***. This development in the western Wadden Sea confirmed the theoretical forecast that eutrophication results in a dominance of large phytoplankton species.

Theory further predicts an extensive overflow of these large phytoplankton species via sedimentation to benthic communities. Most of the large diatom species that increased in the Marsdiep inlet do not appear as single cells but form chains. High densities of chain-forming diatoms rapidly coagulate, which may have further intensified the downward flux of these species, and thus the sedimentation of phytoplankton cells after 1978.

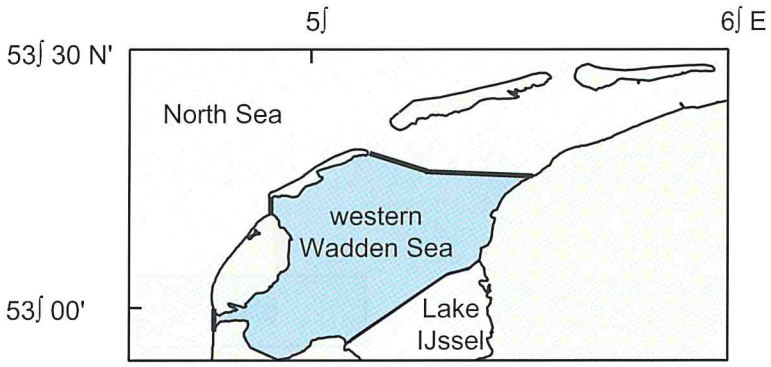


Relationship between individual cell size (μm^3) and relative contribution to increase of total cell volume ($\mu m^3 \cdot \mu m^{-3} \cdot 100\%$) of diatom species during the nutrient-controlled periods of the growing season (July-Aug) from 1974 to 1994. Top panel: Difference in biovolume between the high-trophic nitrogen-limited period (1978-1987) and the low-trophic period (1974-1976). Bottom panel: Difference in biovolume between high-trophic phosphorus-limited period (1988-1994) and low-trophic period (1974-1976). Solid green dots represent diatom species that contributed ≥0.01 cm^3 m^{-3} to the total biovolume of phytoplankton in the western Wadden Sea; open dots refer to the other species. Note that the diatom *Chaeotoceros socialis* appears in colonies, whilst other diatom species may form chains. Data on individual phytoplankton cell volumes were supplied by U.Tillmann (FTZ, Kiel, Germany).

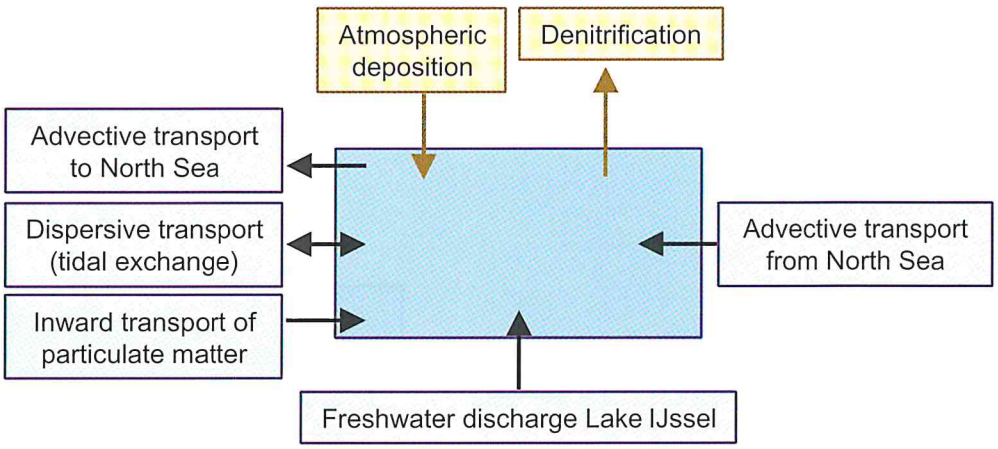
Sedimentation

We applied budget calculations to better understand the response of the western Wadden Sea to changing nutrient supply. To determine the nutrient fluxes to and from the western Wadden Sea, we have compiled the phosphorus and nitrogen budgets for this system for every two-month period from Jan-Feb 1975 to Nov-Dec 1993. The nutrient budgets were based on advective water transport and tidal exchange rates as estimated by Ridderinkhof and co-workers. Nutrient mass fluxes were calculated by multiplying the advective water transport rates with corresponding nutrient concentrations, and the tidal exchange rate with the corresponding nutrient gradient in the tidal inlet.

Each bi-monthly phosphorus budget was closed with a residual total phosphorus (P)-flux, which included the accumulation of particulate matter originating from the open sea, a process described by H. Postma (former NIOZ scientist and director) for the Wadden Sea and several other coastal areas. The average flux of 0.11 mmol P m^{-2} d^{-1} between 1975 and 1993 is similar to the inward transport of particulate matter retaining 2400 kg P per tide that he estimated for the early 1950s



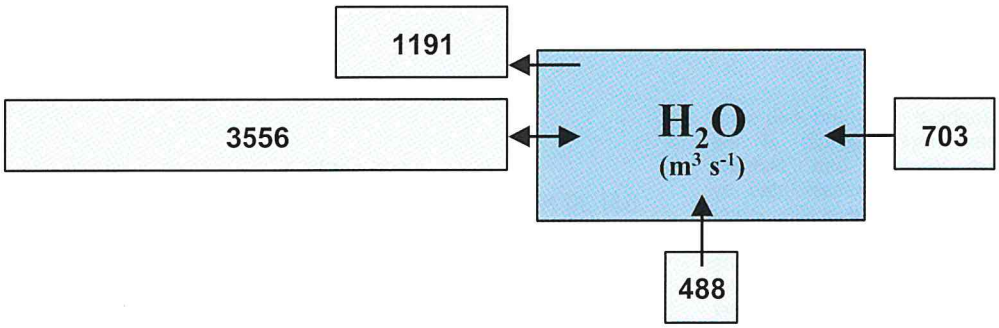
Geographical map and one-compartment representation of the western Wadden Sea. Nutrient mass fluxes were calculated by multiplying the advective water transport rates with corresponding nutrient concentrations, and the tidal exchange rate with the corresponding nutrient gradient. Water transport rates were based on a hydrodynamic model developed by H. Ridderinkhof and co-workers. P.V.M. Bot and J. Doekes (Dutch Ministry of Transport and Public Works) supplied the nutrient data from the Wadden Sea and North Sea.

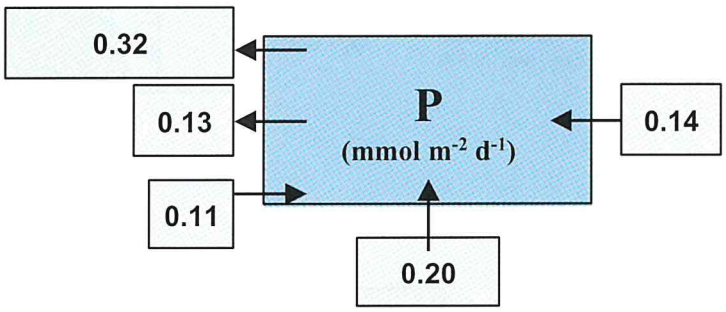


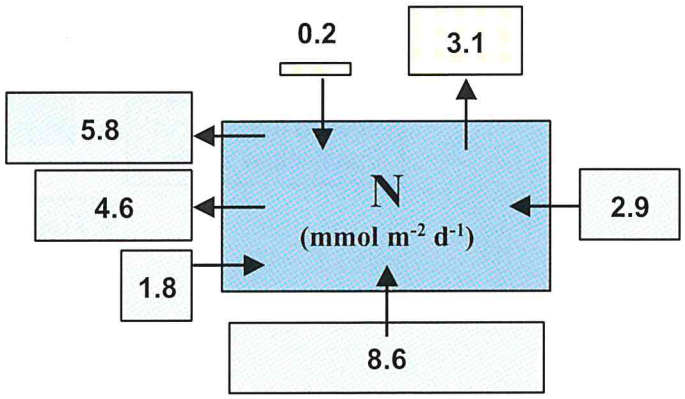
Subsequently, the inward transport rates of nitrogen were calculated from coinciding phosphorus fluxes using ambient nutrient ratios of the suspended particulate matter. Finally, the nitrogen budget was closed with a residual N-specific flux which comprises net inputs (+) or outputs (-) not accounted for in the P-budget. The residual flux of the nitrogen budget was negative after 1978. Because this flux is N-specific, i.e. not accounted for in the P-budget, the most plausible explanation for this loss is denitrification, the reduction of nitrate to N_2-gas.

Rates of benthic denitrification are related to water column concentrations of nitrate and to fluxes of labile organic matter to the sediment following phytoplankton blooms. Subsequently, the increase in nutrient loadings and coinciding higher phytoplankton biomass probably explain the major part of the increase in denitrification in the western Wadden Sea after 1978. Standardised time series of chlorophyll and nitrogen loss showed indeed very similar patterns in the long-term trends between 1978 and 1993. This resemblance in trends strongly suggests phytoplankton biomass to be an important factor determining the interannual variation in nitrogen loss of the western Wadden Sea.

Algal cells can store nitrate in their vacuoles. Deposition of such cells may result in accumulation in the sediment with intact nitrate pools. After disruption of the cells, these pools may have formed an additional but relatively small source of nitrate to the denitrifying community, which resulted in further enhancement of benthic denitrification rates.







Mean water transport rates (m^3 s^{-1}) and nutrient mass fluxes (mmol m^{-2} d^{-1}) of the western Wadden Sea between 1975 and 1993. The transport rates and mass fluxes are explained in the previous figure. The blue arrows represent advective water transports, freshwater inputs, and dispersive exchange with the North Sea. The yellow arrows represent atmospheric deposition and denitrification, i.e. exchange rates of nitrogen with the atmosphere.

Conclusions

The major conclusions of our long-term field observations are that:

(1) The two shifts in N: P ratios (1977-1978 and 1987-1988) have had strong effects on the species composition of the marine phytoplankton community in the western Wadden Sea.

(2) The eutrophic and nitrogen-controlled conditions (between 1978 and 1987) resulted in a disproportional increase of large diatom species (individual cell size > 1000 μm^3).

(3) Long-term trends in chlorophyll-a concentrations were positively correlated with those in nitrogen-loss rates, suggesting enhanced benthic denitrification through increased deposition of phytoplankton biomass.

DEPARTMENT OF PHYSICAL OCEANOGRAPHY

Research within the department of Physical Oceanography (FYS) is performed under the following main themes:

1. water circulation and hydrography of the North Atlantic
2. dynamics of (non)linear marine processes
3. physical aspects of marine ecosystems

The sea-going part of the NWO-funded multidisciplinary research theme 'PROcesses at the Continental Slope' (PROCS) has been carried out succesfully in the Faeroer Shetland Channel, together with the NIOZ departments MCG and MEE. This research programme combines theoretical and sea-going expertise within the department FYS. An extensive dataset was obtained which allows detailed studies on a variety of aspects of internal waves. In addition, a numerical model for the propagation of internal waves in a realistic, yet 2D, geometry was developed. Together with the observations, this model will be used to obtain further insight in internal waves in the interior of the ocean, including its effect on enhanced vertical mixing .

As a part of theme 1) hydrographic data from the TripleB (Bay of Biscay Boundary) programme, which formed part of the WOCE Hydrographic Programme (WHP) with yearly seagoing cruises between 1995 and 1998, have been analyzed in the framework of the EU funded OMEX project.

Within theme 2) theoretical studies on internal waves were complemented with extensive laboratory experiments in the Coriolis laboratory in Grenoble. In particular, the associated class of inertial waves were studied in these laboratory experiments. A theoretical study of the thermohaline circulation using strongly simplified models was finished. Results of this study are described in more detail below.

Multidisciplinary projects in which the department was involved under theme 3) were the study of the behaviour of cohesive sediments in the Dollard, a project on vertical mixing processes in shelf seas, the Bay of Biscay and the application of marine optics in oceanography. Results of the last two projects are described in more detail below.

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

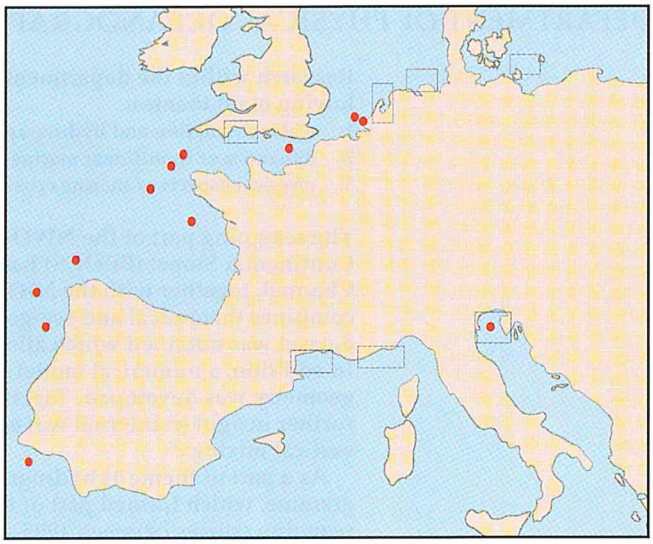
COASTLOOC – COASTAL SURVEILLANCE THROUGH OBSERVATION OF OCEAN COLOUR.

Contributor: *M.R. Wernand*

Ocean colour remote sensing is a well-adapted tool for monitoring the ocean. It has been shown that, even in turbid coastal waters with highly contrasting structures evolving quickly in time and space, a quantitative estimate of water constituents is possible using algorithms based on semi-empirical or semi-analytical approaches.

COASTlOOC was funded by the EC within the commission's program 'Environment and Climate Research and Development'. The three-years project, executed by nine European partners, aimed at the development of algorithms to determine synoptic concentration patterns of optically active materials from coastal colour observations, thereby providing valuable data to better understand coastal biological processes. During the first and second year several contrasting coastal areas were visited and bio-optically sampled from a helicopter. The third year, the compiled database was used to validate existing algorithms.

In the first year of the project a helicopter-dedicated instrumental package was developed and tested to sample in coastal areas. The field experiment started at the end of 1997 with a total of 6 campaigns in 7 coastal areas stretching from the Mediterranean via the North Sea to the Baltic. In addition to the helicopter, two ship campaigns were sailed, in which the same instrument package was used as in the helicopter. Although this kind of water sampling was done earlier, in-situ optical measurements from the helicopter were novel. This way of sampling was investigated on endurance and practicability compared to ship sampling.



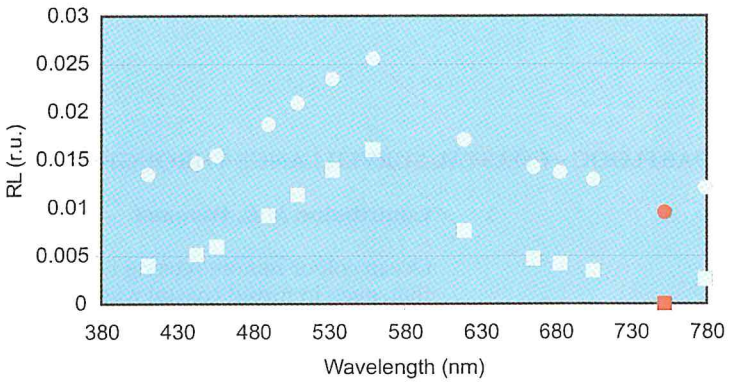
Sampling areas of COASTLOOC. Helicopter areas within the rectangles and the ship areas as dots.

The NIOZ contribution to Coastlooc was to calculate total suspended matter and chlorophyll concentrations from optical measurements by applying available coastal colour algorithms. The algorithms were validated against the in-situ values and refined when necessary.

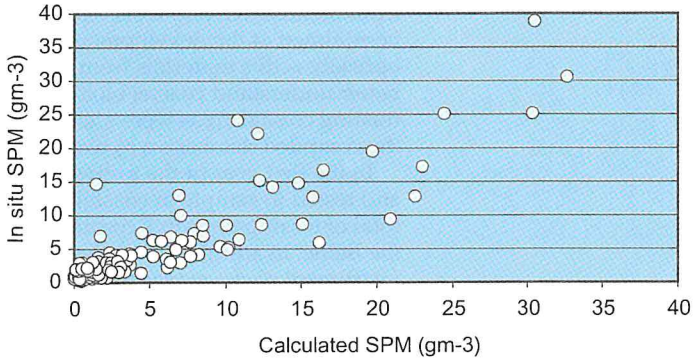
With the Compact Airborne Spectrographic Imager (CASI) build into an aircraft, flights were performed at an altitude of max. 3.5 km. CASI measured the upwelling radiance scattered back from the water column and was used to produce synoptic concentration patterns applying the validated coastal colour algorithms.

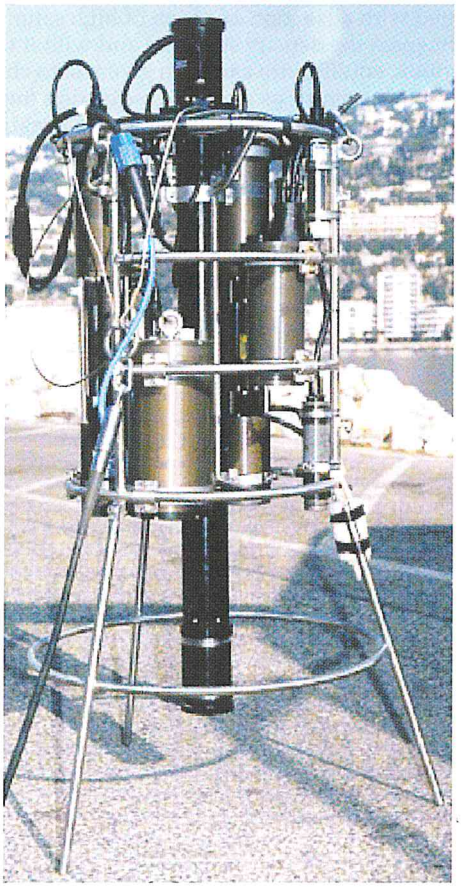
During the helicopter field experiments C3 (Venice) on 30 July 1997 13 stations were sampled and during C6 (Plymouth, Texel, German Bight, Baltic) between 1 to 23 September 1998, 131 stations were sampled. In these campaigns an additional spectral radiometer (PR650) was used to collect the above water radiance between 380 and 780 nm in 101 bands. The instrument pointed towards the sea surface, between 30 and 40 degrees of nadir away from the sun at an altitude of 35 to 75 meters depending on the wave and wind conditions. Quasi-simultaneously the Satlantic radiometer, mounted on the CTD frame, was used during lowering, to collect the incident spectral irradiance with a sampling frequency of 6 Hz. For each spectral band, the remote sensing reflectance was computed from the ratio of the measured radiance and irradiance.

An example of the calculated reflectance (RL) as function of wavelength derived from the ratio of the measured radiance and irradiance. The algorithm corrects for sun/sky glint by subtracting the remote sensing reflectance at 752 nm



As an example this plot shows the comparison of the calculated and the measured suspended matter (SPM) concentration after applying the PMNS MERIS-algorithm, which makes use of the remote sensing reflectance R according to: SPM = $53.1((R_{L(560)}/R_{L(620)}))^{-2.58}$. Earlier findings that semi-empirical relations are a good alternative to estimate suspended matter concentrations from coastal colour data were confirmed. The semi-empirical algorithm was established for North Sea and English Channel waters during former fieldwork (Particulate Matter North Sea [PMNS] project). These types of algorithms are based upon the spectral bands present in the SeaWiFS and MERIS satellite sensors. Investigations are continued to better understand the bio-optical relations that determine the physics underlying these empirical relationships.





Helicopter lift-off. From a winch mounted inside the helicopter a frame for profiling of the water column is launched. On the frame a CTD, water sampling bottles and optical measuring devices, including a back-scattering sensor (Hobilab), two spectral absorption and transmission sensors (ac9 from Wetlabs, filtered and unfiltered water) and a spectral up and downwelling irradiance meter (Satlantic) were mounted. Down-cast and up-cast profiles were collected at a total of 425 stations.

Coastlooc established a unique bio-optical data set of European coastal waters. Also sampling coastal areas by helicopter was shown to be a good and cost-effective alternative compared to traditional sampling from ships. A day of helicopter sampling covered 20 bio-optical stations, a day of ship measurements covered 5 bio-optical stations considering identical areas.

The Coastlooc team consisted of partners from:
Laboratoire de Physique et Chimie Marines Université Pierre et Marie Curie, CNRS, Villefranche sur Mer-France, Joint Research Centre, Institute for Remote Sensing Applications, Ispra-Italy, the universities of Oldenburg and Berlin-Germany, GKSS-Forschungszentrum, Geesthacht-Germany, the university of Trontheim-Norway, Plymouth Marine Laboratory, Plymouth-United Kingdom and NIOZ, Texel, The netherlands, under the co-ordination of the ACRI company (Mecanique des fluid, observation de la terre et science de l'environment), Sophia Antipolis-France.

THE THERMOHALINE CIRCULATION IN A SIMPLE MODEL

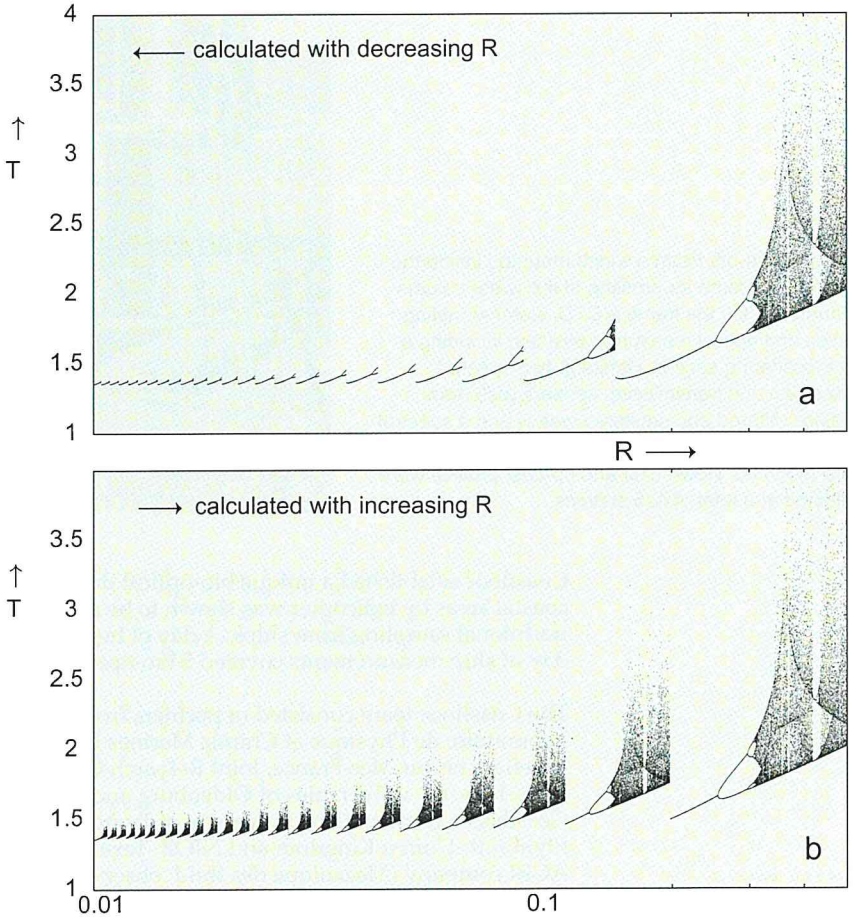
Contributors: *Gerard van der Schrier, Leo Maas, Jef Zimmerman*

Climate modelling has a rich tradition in the realm of analytic process models. This is certainly true for models of the thermohaline circulation (THC), the large-scale ocean circulation driven by horizontal salinity and temperature differences.

In this NWO-funded project, a simple analytical model for the THC was analyzed. Only the dynamics of the large-scale features were resolved, the lowest so-called `moments' of the circulation, salinity and temperature fields. These moments evolve in time due to fluxes of heat and fresh water which enter the ocean through its surface and due to processes as diffusion, advection, inertia and Earth's rotation. The mechanisms of the fluctuations in, and the reasons for the characteristics of the THC were investigated.

The moments model analyzed here can reproduce the multiplicity of equilibria of Stommel's box-model, when simplified to a non-rotating two-dimensional ocean. However, in a full three-dimensional ocean, this multiplicity disappears under the influence of Earth's rotation. The two equilibria with opposing circulation sense cease to occur together. Each equilibrium can be found for a different set of parameters. Moreover, the moments model features variability, associated with advection of a blob of high salinity water by the THC.This anomalously salt water influences the density structure and with it the strength and direction of the overturning. This periodic equilibrium can even give rise to chaotic motion when the circulation is strongly determined by salinity, as was the case during the Cretaceous. The dynamics of the THC in this regime has become unpredictable and irregular.

The absence of multiple equilibria in the moments model for THC when Earth's rotation is included invalidates the hypothesis for abrupt climatic variations proposed previously, and suggests that the dynamics of deep convection may be vital for these variations. A cessation of deep convection and with it the formation of North Atlantic Deep Water (NADW) may interrupt the complete THC. Deep convection in the ocean is a strong, local and time dependent phenomenon which includes several processes on different length and time scales. The moments model has been applied to study some of these processes.



The moments model applied t a convectieve setting produced non-stationary behaviour. This can be periodic, with a regular sequence of consecutive periods, or chaotic, where this regularity lacks. The plots give 50 consecutive dimensionless periods T of the motion, produced by the moments model, for each value of the ratio of cooling and viscosity, the dimensionless parametr R. Figure a is computed from R=o.5 downwards, while b is computed from R=0.01 upwards, where in both cases the endpoint of a run serves as starting point of the next run. This is to make sure that a solution is followed as the parameter varies, until it is beyond reach. The rhythm or self-similarity in the figures as R dcreases, repeats *ad infinitum*.. Characteristic features as multiplicity of solution and the occurrence of chaos are evident from these figures.

The Thermohaline Circulation (THC)

The concept underlying the THC, a horizontal density gradient generating a flow, has already been know to Archimedes, but the earliest applications to geophysics date from the 19th century, from which the following picture emerged.

One of the constraints large-scale circulation in atmosphere and ocean must comply with is the closing of Earth's energy balance. There is an excess of incoming radiated energy at low latitudes and a deficit at high latitudes, because the amount of energy radiated back into space is more or less independent of latitude. The transport of energy from low to high latitudes which makes this possible is approximately divided equally between atmosphere and ocean. As the surface currents in the Atlantic take warm water further northwards, the ocean looses energy to the atmosphere, so that the nordward oceanic heat transport is small compared to that of the atmosphere. This heat is brought over the continent of north-west Europe by the prevailing winds, and is responsible for its mild winters. The THC, which takes care of this oceanic heat transport, is a globe-encircling circulation, often represented as a Conveyor Belt of heat, with branches in every ocean both at the surface and at depth.

Palaeoclimatological studies have indicated that in the present interglacial, the Holocene, the strength of the THC fluctuates slightly and also that transitions between glacials and interglacials have been interrupted by profound cold events, with a very weak THC. These latter periods appear to be coupled to abrupt cessations of deep convection and with it the cessation of the formation of water that flows southwards in the Atlantic at great depth, the North Atlantic Deep Water.

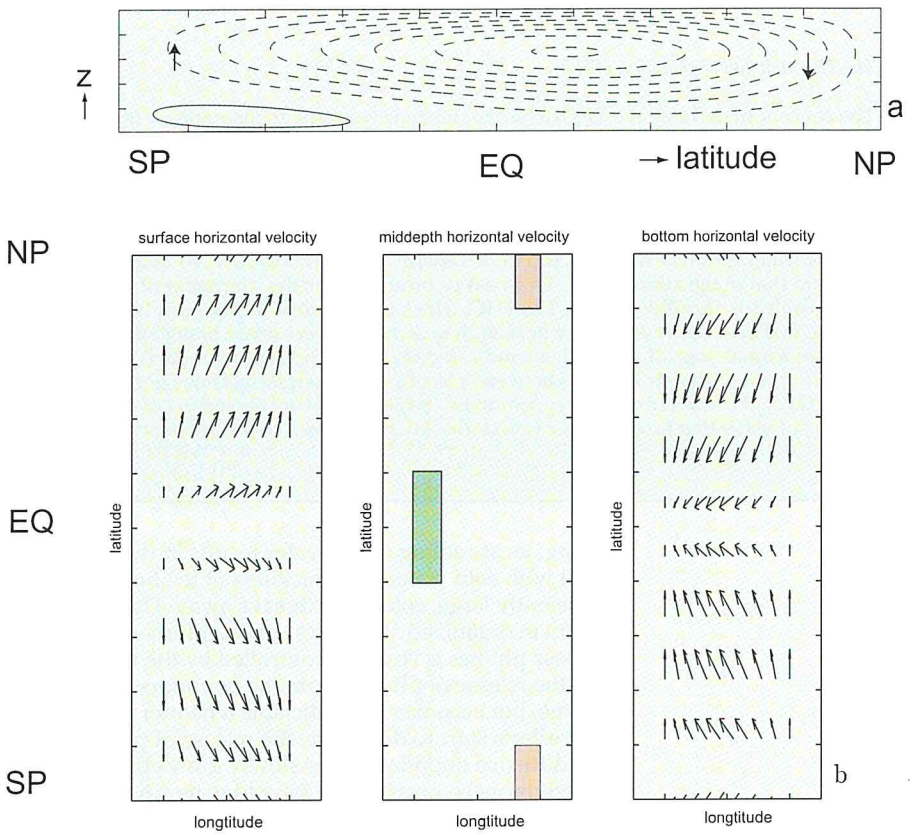
Strong, local cooling of sea water results in the formation of a thin diffusive boundary layer filled with cold water. The thickness of the boundary layer increases and when the thickness is sufficiently large, cold water breaks away. The escape of cold water from the boundary layer occurs in organized structures, called plumes. The moments model showed that the dynamics of these plumes is strongly controlled by the ratio of cooling and viscosity of water. It appeared that the release of plumes from the boundary layer occurs in a regular fashion when this ratio is large, but becomes unpredictable (chaotic) when this ratio decreases towards 1. When viscous effects start to dominate, the release of plumes acquires a strong relaxational character. The diffusive boundary layer slowly grows thicker, due to ongoing cooling, to loose suddenly and vigorously nearly all of its cold water in a plume. The cold water descends downwards, the thickness of the boundary layer is decreased and it slowly starts to accumulate cold water again. The duration of such successive events turned out to depend on the ratio between forcing and viscosity in an extremely complex way.

In the ocean, the most intense currents, and therefore the largest transports, occur in small strips at the western boundaries of their basins, a consequence of Earth's rotation. Because of this western intensification, ocean circulation is sometimes modelled as being in a meridional-vertical plane. These numerical models, when applied to a single basin as the Atlantic, produce an equatorially asymmetric circulation despite the equatorial symmetry of the basin and the fluxes at the ocean surface. The reason for this remarkable feature is an advective feedback. A meridional density difference drives a circulation in the meridional-vertical plane which alters the density field. This means that under certain conditions a perturbation of an equatorially symmetric density field drives a flow that is such that the perturbation grows due to the advection of salt and heat, that can break the equatorial symmetry. These models thus offered an alternative to Wüst's classical hypothesis, which attributed asymmetry in the ocean circulation principally to geographical asymmetries.

The moments model has also been applied to this situation to investigate if the alternative hypothesis holds in a model where the third, zonal dimension, and the effects of Earth's rotation are incorporated. The moments model reproduced the spontaneous symmetry breaking in the non-rotating, two-dimensional case and the model's equilibria are qualitatively similar to those of more advanced models in comparable settings. However, in the transition from a two-

Multiple equilibria of THC

A strongly simplified, but immensely popular model for THC is the analytic box-model of Stommel, published in 1961. This model, in the simplified setting of a non-rotating two-dimensional ocean extending from sub-polar latitudes to the sub-tropics, features an equilibrium that can be associated with the present circulation, but also one with a very weak and reversed circulation. These equilibria can occur together for certain choices of the parameters. Multiplicity of equilibria implies that, when a sufficiently strong perturbation is applied, the THC can switch from one equilibrium to the other. This offers a simple explanation for the abrupt cold spells observed during the transition from the last glacial to the present interglacial where a melt water pulse triggered a transition from one equilibrium to the other. The weakening and reversal of the circulation has profound implications for Earth's heat budget since hardly any heat will then be transported northwards. However, the simplification of the THC to a flow in the meridional-depth plane, where the effects of Earth's rotation on the dynamics are neglected, stands in the way of a direct application to geophysics. The shorter fluctuations of the THC could neither be modelled by the box-model, since it lacks periodic equilibria.



(a) Contours of streamfunction in a latitude-vertical plane (current parallel to contours). The plot gives a characteristic solution of the moments model, in the equatorially-asymmetric regimes, where this solution is one of two possible, having sinking at either 'pole'. The horizontal axis, denoting latitude, runs from South Pole (SP, via Equator (EQ), to North Pole (NP). The vertical axis denotes depth (Z). The equilibrium depicted looses its stability to the one shown in (b) when the third (zonal) dimension is included. (b) Plot of horizontal velocity in a surface (left panal), mid-depth (middle) and bottom layer (right), in the non-rotating limit. The basin is equatorially symmetric,. In the northern hmisphere surface flow is to the north-east with a return flow near the bottom to the south-west. Upwelling is in the dark green area, whereas downwelling occurs in the light brown areas. Amethematically equivalent solution exists with surface flow in the northern hemisphere to the north-west, but the one shown here becomes dominant when rotation is included.

dimensional to a non-rotating, three-dimensional ocean a change in the model's equilibria occurred. The equilibria from the two-dimensional case became unstable to a perturbation with a zonal structure. This means that the geophysical relevance of these solutions diminishes. The stability is lost to a new pair of solutions which are equatorially symmetric under equatorially symmetric boundary conditions but feature a zonal structure. One solution has a surface flow on the northern hemisphere to the north-east, the other to the north-west.

When Earth's rotation was taken into account the surface circulation on the northern hemisphere of the stable solutions turned (more) to the north-east, while the unstable solutions, the relics from the two-dimensional case, now completely disappeared. Thus, the loss of stability of equatorially-asymmetric solutions in a three-dimensional setting suggests that the equatorial asymmetry of the THC is probably not due to advective feedback, as in the alternative hypothesis, and that Wüst's hypothesis still stands.

Equatorial asymmetry of THC

At the beginning of this century it became possible to reconstruct the course of the THC on the basis of measurements. The slow THC is, at the surface, hard to distinguish from the fast and variable wind-driven circulation, while the technical possibilities to measure temperature and salinity at great depth accurately, let alone current velocity, were not at our disposal until this time. However, the fluxes of heat and fresh water at the ocean's surface, which give rise to horizontal differences in temperature and salinity, could be measured earlier. These fluxes, when zonally averaged, were more or less symmetric in the equator, which prompted the German-Russian physicist Emil von Lenz to propose in 1847 that the THC must be characterized by this equatorial symmetry too. The picture he drew of THC in the north Atlantic was a northwards surface current, cooling of the water mass at high latitudes where it descends to the bottom to flow southwards. Near the equator the water had to surface to close the mass balance. For the south Atlantic he proposed the same, but mirror-imaged, situation. This picture of THC remained accepted until the German Meteor expedition (1925-27). Expedition leader Georg Wüst showed that the thermohaline surface flow crosses the equator northwards. At high latitudes NADW is formed which flows southwards across the equator at great depth. At the southern edge of the Atlantic the water is cooled too and Antarctic Bottom Water (AABW) is formed, which flows northwards over the bottom of the Atlantic under the NADW. This surprising equatorial asymmetry was attributed by Wust principally to the equatorially-asymmetric distribution of water and continent, with small areas of NADW formation in the north and the Arctic basin being isolated by high ridges.

MIXING OF HEAT AND MOMENTUM ABOVE A SLOPING BOTTOM

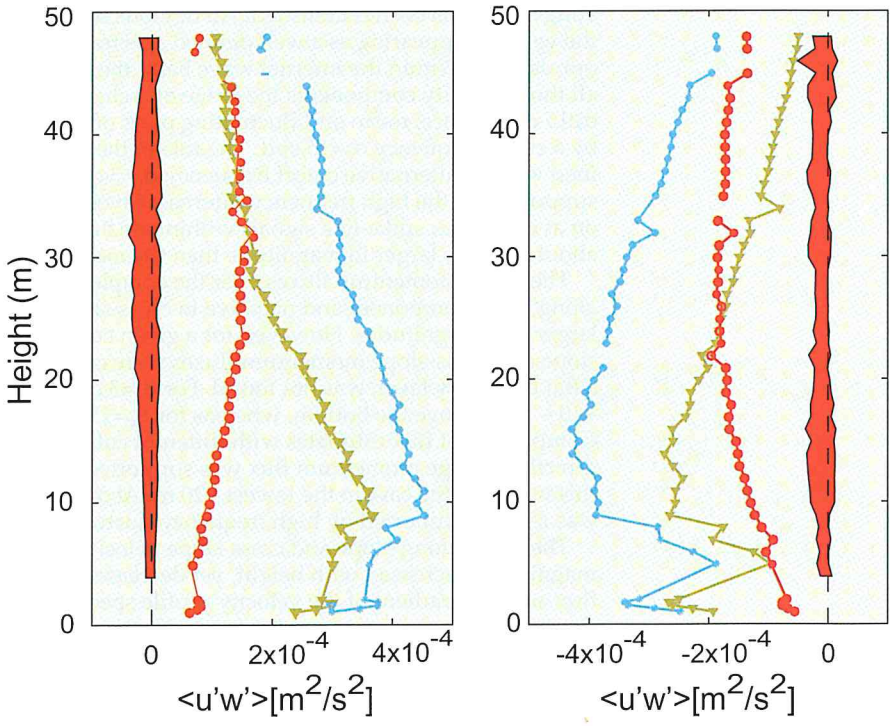
Contributors: *Johannes Gemmrich & Hans van Haren*

The dynamics of the boundary above a sloping bottom are expected to be profoundly different from that above a flat bottom. In particular, interactions of internal waves and sloping boundaries can lead to turbulent boundary mixing. Internal waves reflecting from a sloping boundary preserve their frequency, and an incident wave preserves its angle to the vertical upon reflection rather than to the normal of the boundary. Near critical conditions, when the boundary slope matches the energy propagation direction of the reflected wave, wave-breaking may occur. The mixed fluid may spread into the pycnocline, and thus boundary-layer mixing near a slope may play an important role in cross-isopycnal diffusion in the deep ocean.

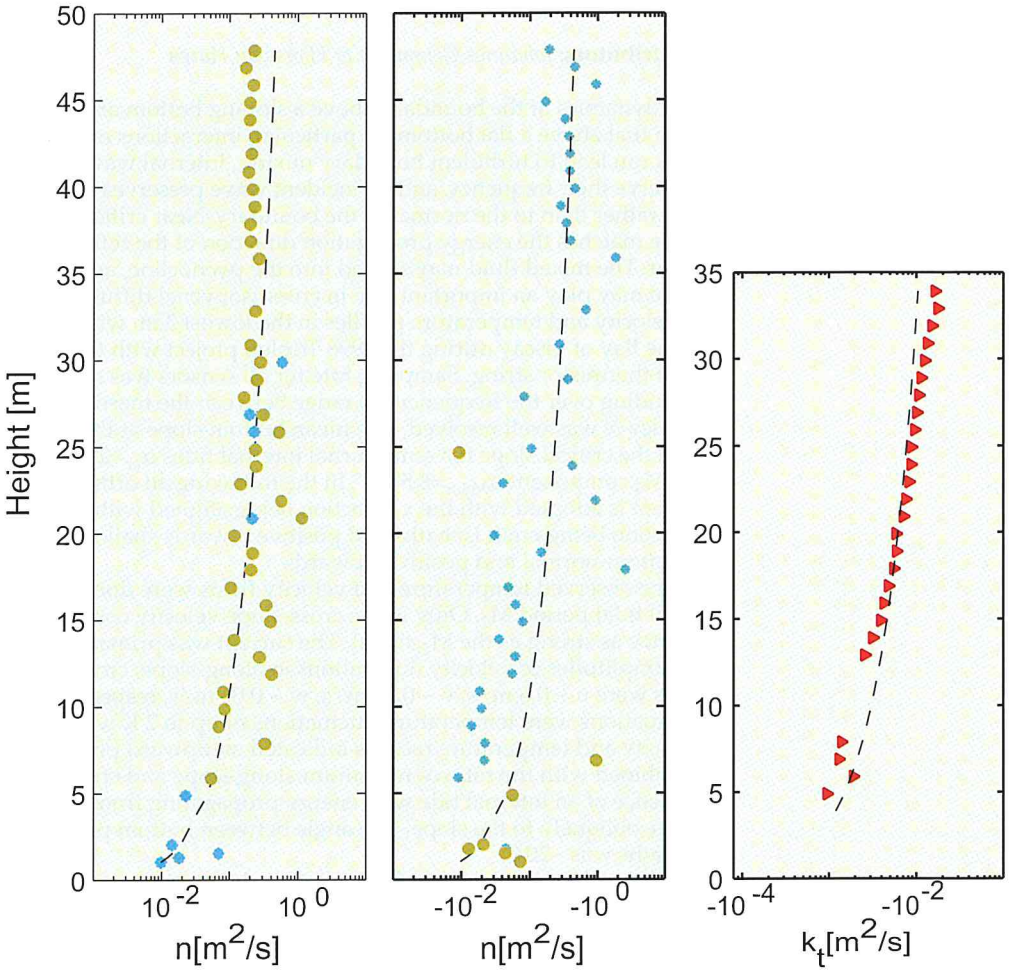
Velocity and temperature profiles in the lowest 35m were obtained on the continental slope in the Bay of Biscay during the 1996 TripleB project with the aid of two ADCP's and a NIOZ-built thermistor string. Sampling rate for all sensors was such that the internal wave band, extending over the frequency (σ) range between the inertial frequency f and the buoyancy frequency N was well resolved. The mean bottom slope at the deployment site α=4.9° was larger than the critical slope for semidiurnal internal tides α_{cr}=2.9° but less than the critical slope for the M_4 component α_{M4cr}=8.5°±3°. In the following an orthogonal, bottom-oriented coordinate system is adopted with the x-direction being aligned with the isobaths (along-slope), the y-direction being cross isobaths and positive towards shallower water (cross-slope) and the z-axis is bottom-normal and positive upwards.

The observed temperature and velocity fields were dominated by fluctuations of the semidiurnal tidal period M_2. Only in the cross-slope velocity component was the signal with M_4 frequency as strong as the M_2 signal. The current was primarily in an along-slope direction and the amplitudes of velocity fluctuations in along-slope, cross-slope and bottom-normal directions were u ~ 0.6 m/s, v ~ 0.25 m/s, w ~ 0.06 m/s, respectively. Associated with these current fluctuations were temperature fluctuations of up to 2 K within one tidal period. Observed velocity and temperature records indicated an upward phase propagation at M_2 period. Combined with the ratio of maximum along-slope and cross-slope velocities this suggested the presence of an internal tide with energy propagating from the shelf break towards the abyssal plain, obliquely to the slope. The angle between bottom projection of the group velocity and isobaths was ~20°.

The bottom-normal eddy flux of heat is defined as a co-varying bottom-normal velocity and temperature fluctuation. Similarly, the covariance of fluctuations of velocity components in a plane parallel to the bottom and the bottom-normal component yield the eddy momentum fluxes. The convergence / divergence of these fluxes at a given location leads to changes in the mean temperature and currents at that position. A decomposition of the velocity and tempera-



Profiles of momentum fluxes averaged over complete deployment period for cut-off frequency σ_c=3 cpd (blue stars), σ_c=15 cpd (red circles) and pass-band 3 cpd - 15 cpd (green triangles). The red areas depict 95% significance levels for σ_c=15 cpd. a) Flux of along slope momentum, b) flux of cross-slope momentum.



Profiles of mean eddy viscosity ν obtained from along-slope direction (asterisks) and cross-slope direction (circles) and eddy diffusivity k_t (triangles). Dashed lines depict linear z-dependence, predicted for flat boundary layers. Note, along-slope eddy viscosities are predominately negative and cross-slope direction eddy viscosities are positive, except near the bottom. The middle and right panel show negative values !

ture record can be obtained after an appropriate cut-off frequency σ_c between mean and fluctuating signal has been established. An obvious separation of the mean and fluctuating part of the velocity, appearing as a well defined spectral gap in the power spectra, was not apparent in our data set. Within the internal wave band the velocity spectra fall off as σ^{-n}. We found that for all three velocity components the value of n changed from $n \geq 2$ at low frequencies to $n \approx 0.7$ at $\sigma \geq 15$ cpd. Hence, mean and fluctuating parts of velocity and temperature signals were defined by a cutoff frequency $\sigma_c = 15$ cpd. The role of the low frequency internal waveband was examined with an alternative cutoff frequency $\sigma_c = 3$ cpd. Both, momentum fluxes and heat fluxes supported by the high frequency internal waveband ($\sigma \geq 15$ cpd) showed large fluctuations with on average four spike-like signals within one tidal cycle. These events lasted ~0.5h and were about 10 times larger in magnitude than the mean values.

The mean momentum fluxes over the complete deployment period were positive for the along-slope component and negative in cross-slope direction. Lower cut-off frequencies yielded larger flux magnitudes. However, for a given cut-off frequency the magnitude of the along-slope and cross-slope momentum fluxes were comparable. A constant stress layer, predicted in a flat boundary layer, was not found. For $\sigma_c = 3$ cpd a momentum flux maximum was present at ~10 – 15 m above the bottom, whereas for $\sigma_c = 15$ cpd momentum fluxes increased with height. Comparison of flux estimates with different cut-off frequencies indicated that in the along-slope direction a large momentum flux was supported by low frequencies, whereas in the cross-slope this was only the case in the lowest ~20 m. Above this height the cross-slope momentum flux was mainly supported by high frequency fluctuations.

The mean along-slope and cross-slope velocities were negative. Close to the bottom their magnitudes increased with height, yet decreased above ~5 m. The ratio between momentum flux and the gradient of the velocity profile specifies the eddy viscosity, and analogously heat flux and the temperature gradients specify the eddy diffusivity. These parameters are commonly used to parameterize eddy exchange processes. The magnitude of the inferred eddy viscosity increased with distance from the bottom and the values were at least three orders of magnitude larger than eddy diffusivities observed in the ocean interior. In the along-slope

direction predominately negative eddy viscosity values were obtained, indicating that internal waves may drive the mean flow.

The mean heat flux supported by the high frequency internal wave band was positive and, except at levels very close to the bottom, the estimated flux was statistically different from zero at 95% significance. Inclusion of the low frequency internal waves yielded heat fluxes which are statistically not significant. The observed mean temperature gradient was positive and nearly constant at 0.01 K/m, yielding negative eddy diffusivities $O(-10^{-1}\ m^2/s^2)$. The inferred negative eddy diffusivities imply that high frequency internal waves on average restratify the bottom boundary layer. However, internal waves can also be a mechanism for mixing which can be seen in the frequent brief events of negative heat fluxes supported by the high frequency internal wave band.

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EXTERNAL PROJECTS OF THE DEPARTMENT OF PHYSICAL OCEANOGRAPHY

- Processes on the Continental Slope (PROCS, NWO-ALW)
  H. Ridderinkhof, H. van Haren, L. Maas
- The morpho-dynamic and bio-dynamic behaviour of mud in tidal areas (NWO-BOA)
  H. Ridderinkhof, R. van de Ham, J.T.F. Zimmerman
- Non-linear dynamics in physical oceanography (NWO-GOA)
  J.T.F. Zimmerman, G. Schramkowski, G. van der Schrier, L.R.M. Maas, H. Ridderinkhof
- Ocean Margin Exchanges II (OMEX II; EC-MAST)
  H.M. van Aken, M.A. Hiehle, R.X. de Koster
- Processes of Vertical Exchange in Shelf Seas (PROVESS, EC-MAST)
  J.J.M. van Haren, H. Ridderinkhof, M.T.J. Hillebrand
- Coastal Surveillance Through Observation of Ocean Colour (COASTLOOC, EC-MAST)
  M.Wernand
- Coastal region long-term measurements for colour remote sensing development and validation (COLORS, EC-MAST)
  M.R. Wernand
- Internal wave band fluxes and frontal passages above a sloping bottom in the Bay of Biscay. (EC-TMR)
  J.J.M. van Haren, J.R. Gemmrich
- Inertial Wave Attractors (Use of Large-Scale Facility in Coriolis Laboratory Grenoble, EC)
  L.R.M. Maas

DEPARTMENT OF MARINE CHEMISTRY AND GEOLOGY

Scientific efforts within MCG were organised along four main research themes:

1. **Carbon and trace metals in the oceanic water column**
2. **Sedimentation and sediment transport processes**
3. **Early diagenetic processes**
4. **Palaeoceography**

Within theme 1 efforts were concentrating on the role of iron as limiting factor for phytoplankton growth. Experiments were carried out in the laboratory as well as in the field and concentrate progressively on speciation and the role of organic ligands. Fieldwork was carried out within a.o. EU programmes as MERLIM and CARUSO.

Work on the oceanic inorganic carbon cycle is not only carried in the Southern Ocean within the German Dutch NEBROC programme, but also in the Northern Atlantic and the North Sea. For the latter area we will try to focus on inorganic carbon budgets and the role of coastal systems as net importers or exporters of inorganic carbon.

Within theme 2 fieldwork is carried out along the European North Atlantic Margins, such as the Iberian Margin, the Faeroe-Shetland region and the Rockall area. Most research was embedded in national and international multidisciplinary programmes (ALW-PROCS, EU-OMEX II, EU-ENAM). Specific points of interest were the occurrence of carbonate mounds, gas hydrates and cold-water corals.

Theme 3 focuses on carbon mineralisation processes and burial of organic carbon along margin transects (EU-OMEX II at the Iberian Margin). The role of amino-acids is the subject of a NIOZ-OIO project while in the ALW-SMILE project, a cooperation with the Department of Earth Sciences at RUU and NIOO-CEMO, detailed laboratory and field studies were carried out on the role of Fe- and Mn- cycling in early diagenesis.
Development and application of in-situ measuring devices (micro-sensors, benthic chambers, current fields, and topographical variation) is an essential part both of theme 2 and 3.

Paeleoceanographic studies (theme 4) focus on interpretation of (ODP) cores (Congo Fan, Angola Basin,Walvis Ridge, Cape Basin). Central points of interest were historical variations in the position of the Benguela frontal system, as well as the use of terrigenous proxies for African climate reconstruction. On both subjects there was a close cooperation with GeoWissenschaften, University Bremen within the NEBROC context.

NITROUS OXIDE AND METHANE IN MARINE SYSTEMS

Contributor: *H. de Wilde*

The present increase in the atmospheric concentrations of nitrous oxide (N_2O) and methane (CH_4) is of concern since together these gases account for about 20% of the enhanced global warming due to human activities. In addition N_2O is involved in the destruction of the stratospheric ozone layer. The aim of this project was to contribute to a better assessment of the marine environment as a source of atmospheric N_2O and CH_4, thereby focusing on the role of estuaries, coastal waters, and upwelling regions. Research concentrated on (1) the quantification of the distribution of N_2O and CH_4 in contrasting marine environments; (2) the assessment of the resulting gas emissions to the atmosphere; and (3) the identification of the microbial processes underlying the emissions. The project was supported by the former Netherlands Marine Research Foundation (SOZ) of the NWO (NIOP programme), the National Research Programme on Global Air Pollution and Climate Change (NRP), and the EC Environment and Climate programme (ELOISE-BIOGEST).

N_2O in the northwest Indian Ocean.

A study on N_2O was carried out in the Somali Basin, northwest Indian Ocean, during the height of the southwest monsoon season. The strong monsoon winds, inducing upwelling of cold subsurface water off the Somalian coast, had a major impact on the biogeochemistry of the region. The vertical N_2O distribution over the water column of the Somali Basin exhibited two maxima (1) a sharp subsurface maximum at about 150 m depth, characterised by N_2O supersaturations of up to ~1000% with respect to atmospheric solubility, and (2) a broad deep water maximum around 800 m depth, characterised by saturations up to ~800%. Below the wind mixed layer, N_2O was always negatively correlated with oxygen and positively with nitrate, indicating that N_2O was produced by nitrification.

The N_2O saturation in the surface waters was inversely correlated with temperature, indicating that monsoon-driven upwelling of cold N_2O-rich water controlled the saturation degree of N_2O in surface waters. Outside the upwelling region, surface waters were only slightly supersaturated with respect to the atmosphere, whereas the N_2O saturation in freshly upwelled waters amounted to 330%. The strong monsoon wind driving the upwelling also induced strong vertical mixing and effective air-sea gas exchange. As a consequence, N_2O emissions into the atmosphere reached values as high as 260 to 500 µmol m^{-2} d^{-1}, which is nearly 3 orders of magnitude above the globally mean oceanic N_2O flux. By using temperature as an indicator of upwelling, satellite images of sea surface temperature were applied to extrapolate the observed N_2O emissions in space and time. It was estimated that during the two months of most intense upwelling, the Somalian upwelling region may account for 2.5 - 5% of the global marine N_2O emission, from an area of less than 0.011% of the world ocean.

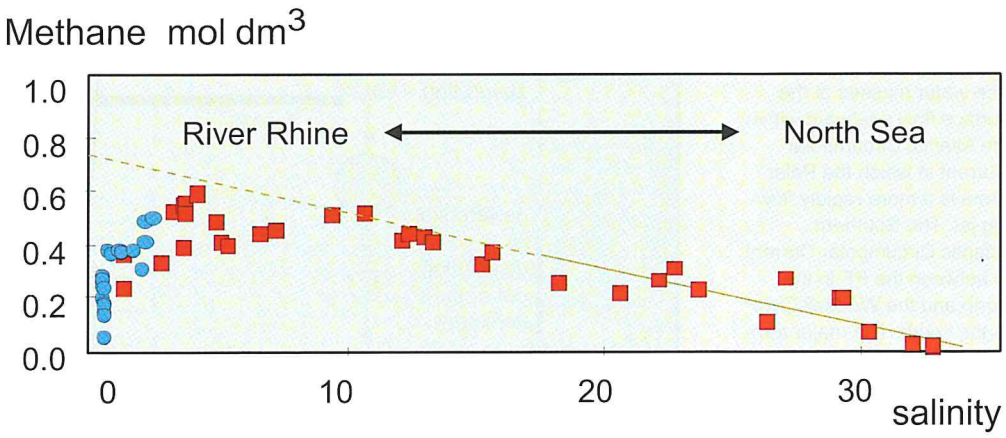
N_2O in the Scheldt estuary.

The Scheldt estuary is characterised by elevated loadings of organic matter and nutrients, which induce intense mineralisation and associated depletion of oxygen in the upper estuary. Dissolved N_2O was always supersaturated with respect to the atmosphere. Saturation ranged from about 3000% in the oxygen-poor waters at low salinity to slight supersaturation at the mouth of the estuary. N_2O production largely originated from nitrification in the water column. The location and intensity of nitrification was controlled by (1) the oxygen gradient along the estuary, ranging from strong undersaturation at low salinities to complete saturation at sea, and (2) the NH_4^+ concentration of the river water entering the estuary. Comparison with a data set from 1978, reported in literature, indicated that the main locus of N_2O production had shifted upstream during the last decades in response to the gradually decreasing eutrophication and increasing oxygen concentrations in the estuary. Due to the residence time of about two months, nearly all N_2O was lost to the atmosphere within the estuary rather than being transported to the open sea. The average N_2O flux per unit area amounted to about 75 µmol m^{-2} d^{-1}, which is comparable to the fluxes in the Somalian upwelling region, but larger than values reported for most other estuaries. The mean annual emission from the Scheldt estuary to the atmosphere was estimated to be 2.8×10^8 g. Extrapolation to the global scale indicated that the world-wide estuarine emission may be as large as 1.5 Tg yr^{-1}, corresponding to about 25% of the present estimates of the global marine N_2O source.

CH_4 in the Rhine estuary.

Concentrations of CH_4 were measured in the Rhine estuary, its lower tributaries, and in its plume off the Dutch coast during 4 seasons. Surface waters were always supersaturated with CH_4 relative to the atmospheric concentration, along the entire transect from river to the coastal sea. Highest CH_4 concentrations were measured in the low salinity region of the estuary (S = 1-4), corresponding to 140-330 times supersaturation, which is high compared to other estuaries. Only about 30% of the CH_4 in the estuary was supplied by its major tributaries, whereas the remaining 70% was produced *in situ*, likely by the estuarine sediments. The *in situ* production in the estuary was positively related to temperature, suggesting that CH_4 originated from a microbial source.

The emission of CH_4 from the estuary to the atmosphere (6 - 12 kmol d^{-1}) was about one order of magnitude lower than the CH_4 export to the coastal zone of the North Sea (46 - 111 kmol d^{-1}). In the coastal zone, the estuarine water mass was transported northward by the residual current in a coastal plume extending 25 km offshore. In this plume, the distribution



Distribution of dissolved CH_4 in the Rhine estuary *versus* salinity in October 1996. Part of the salinity transect was sailed twice, blue dots and red squares point at different sampling dates. The green line indicates conservative mixing at salinity > 10-20. The CH_4 concentration in the river Rhine was ~0.2 mmol dm^{-3}, which is much lower than the conservative mixing line. The plot thus shows that CH_4 is produced *in situ* in the low salinity range.

pattern of CH_4 followed the freshwater fraction, with contours parallel to the shoreline. Coastal CH_4 concentrations ranged from ~100 times supersaturated near the mouth of the Rhine estuary, down to slight supersaturation outside the plume of the Rhine. The atmospheric loss in the plume of the Rhine was 3 to 4 times higher than the CH_4 exported by the estuary. Consequently, most of the coastal CH_4 was not supplied by the Rhine estuary, but rather by the coastal sediments. Extrapolation of the CH_4 emission from the Rhine estuary to the global scale suggests that the world-wide estuarine CH_4 emission amounts to 0.4 - 1.4 Tg CH_4 yr^{-1}. Although this emission corresponds to about 10% of the total marine CH_4 source, it contributes little to the global CH_4 budget which is dominated by terrestrial sources.

INFLUENCE OF HYDROGRAPHIC AND BIOLOGICAL PROCESSES ON THE DISTRIBUTION OF TRACE METALS IN THE SOUTHERN OCEAN

Contributor: *B.M. Löscher*

The oceans provide large storage reservoirs for carbondioxide (CO_2). In the upper photic zone of the water column, CO_2 is exchanged with the atmosphere and converted into organic matter by phototrophic organisms. Although most of this organic matter is remineralized (re-producing CO_2), some part is converted into largely refractory dissolved organic carbon (DOC) and another part escapes to deeper waters of which an even smaller part ultimately is buried in the sediments. An increase in the mass of inorganic plus organic carbon stored in the oceans as well as the continuous flux to the sediments both constitute a sink in global carbon budgets and thus counteract 'Greenhouse-effects'. The uptake of CO_2 during photosynthesis is the primary step in this biologically driven oceanic carbon sink. Some oceans, however, are characterized by low primary production despite the ample availability of major nutrients such as nitrate. Such oceans have become known as 'High Nutrient – Low Chlorophyll' areas. During the last decade it became evident that trace metals such as dissolved Fe may be limiting phytoplankton growth in these areas. This project focussed on the distribution of the trace metals Fe, Mn, Ni, Cu, Zn and Cd in the Southern Ocean in relation to the major nutrients nitrate, phosphate and silicid acid and to chlorophyll *a*, which was used as an indicator for phytopankton biomass. The study was sponsored by NWO/GOA and through grants from the Dutch Commission for Antarctic Research.

Data were collected with the R/V Polarstern during the JGOFS Antarctic Ocean expedition ANT X/6 in October/November 1992 along 6°W in the eastward flowing Antarctic Circumpolar Current (ACC). The transect crossed, from north to south, the Polar Front and the

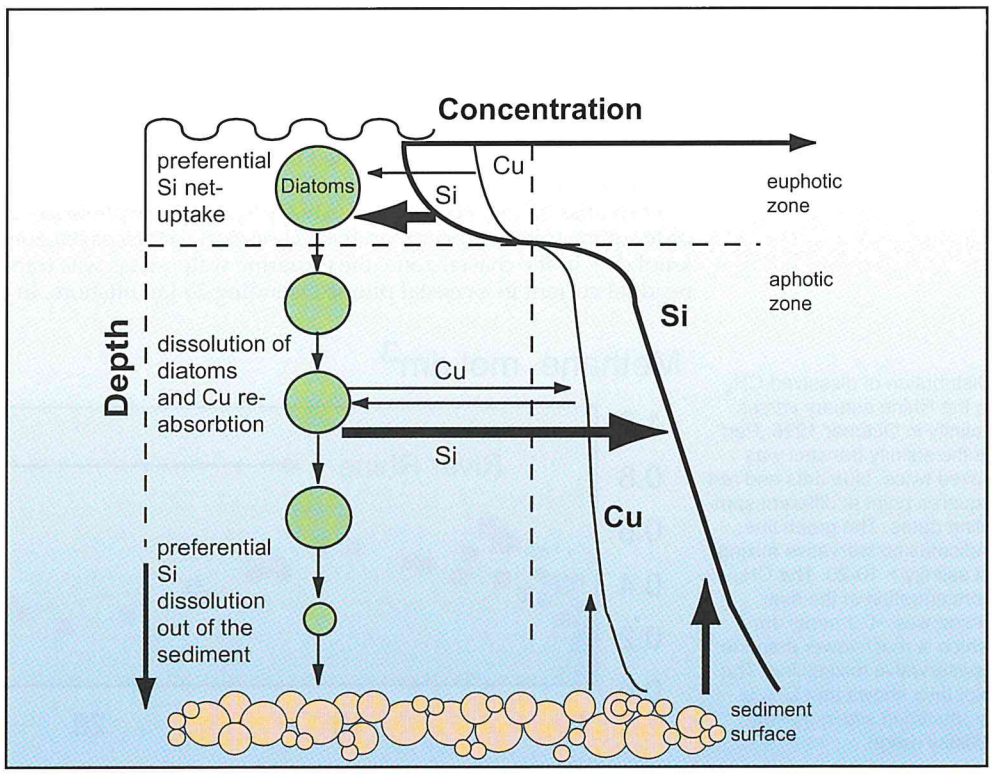
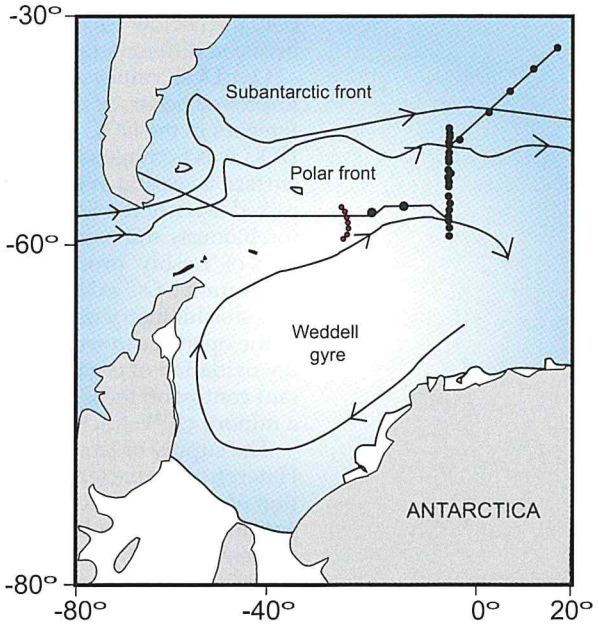


Chart of the Southern Ocean where the ANT X/6 cruise was performed in October-November 1992. The water masses at the surface flow eastward within the Atlantic Circumpolar Current in which the Polar Front is a more rapidly flowing jet. The Southern Atlantic Circumpolar Current is between the PF in the north and the Weddell Gyre in the south. The major transect of ANT X/6 along 6°W and between ~48-58°S is indicated.

southern ACC (sACC). A diatom bloom, which developed at the Polar Front during the cruise, offered the possibility to study trace metal uptake by phytoplankton in the field. In the upper 100 m of the sACC both dissolved Fe and Chloropphyll-*a* were low (0.04-1.9 nM and < 0.5 µM, respectively) while the phytoplankton community was dominated by cells < 2 µm. In contrast, dissolved Fe was high (1-5.5 nM) at the PF at the onset of the diatom bloom. We observed a decrease of both CO_2 and Fe during the bloom, which confirms earlier evidence on the link between Fe and primary production. It was calculated that the two major High Nutrient – Low Chlorophyll areas in the world, the sACC in the Southern Ocean and the Northeast Pacific Ocean, have different sources of Fe but similar supply rates. In the sACC, upwelling of deeper-water masses was estimated to be the most important source, whereas in the NE Pacific Ocean aeolian inputs (aerosols) seem dominant.

Subsurface maxima of trace metal concentrations were observed between 50 and 200 m depth in the sACC and the Polar Front. We attributed these maxima to the release from sea-ice diatoms that settle in the water column upon melting of the ice. The co-occurring sub-surface peaks of DOC and Chlorophyll-*a* as well as the occurrence of chlorophyll-*b* containing organisms supported this conclusion. The released Cu and Ni remained in the water column due to complexation by strong ligands, but Mn an Zn disappeared probably due to adsorption onto the surface of the settling diatoms or incorporation in the diatom frustules. Thus, Mn and Zn became concentrated in marine snow that accumulates on top of the major pycnocline and, upon dissolution of the frustules, produced concentration peaks there.

At the Polar Front, the developing diatom spring bloom was responsible for the uptake of Cd, Ni, Cu and Zn together with the macro-nutrients. During uptake, the Cd to phosphate ratio decreased, which indicates that Cd was consumed preferentially over phosphate. Deep in the water column the Cd concentration and the Cd to phosphate ratio increased continuously with age of the deep-water mass when going to the south. The Cu to silicic acid ratio in the surface water increased during the diatom bloom, suggesting preferential uptake of silicic acid over Cu. This same ratio decreased with depth at both PF and sACC, albeit much stronger at Polar Front. Thus, our data suggest the mineralization and dissolution of diatom remains deeper in the water column which, due to their uptake preferences in the surface water, may be enriched in Cd and silicic acid relative to phosphate and Cu, respectively. However, other processes such as re-adsorption of Cu at mid-depth, preferential mineralization and scavenging of Cd in the deep water and a prolonged retention of Cu in the sediments after dissolution of the biogenic silica, may play a role as well.



Schematic representation of the combined Cu- and Si-cycling in the Polar Front area, characterized by relatively high diatom production. In the euphotic zone silicic acid is consumed preferentially relative to Cu, which causes a relatively high Cu to Si ratio. Upon settling below the surface mixed layer, silicic acid is released due to dissolution of diatom frustules together with relatively small amounts of dissolved Cu. Part of this Cu is re-adsorbed by the remaining frustules settling onto the sediment. Here, Cu is retained more efficiently than silicic acid, thus causing a low ratio of the fluxes of Cu and Si, respectively. Together, these phenomena explain the relatively low Cu to Si ratio in the deeper water masses at Polar Front.

DISSOLVED ORGANIC CARBON AND BACTERIOPLANKTON IN THE UPPER OCEAN

Contributor: *C.J. Wiebinga*

The oceans play an important role in the global climate system by mediating as buffer of heat and greenhouse gasses (e.g. CO_2). Oceanic water constitutes one of the largest carbon (C) reservoirs of the earth and fluxes in the marine system affect the global biogeochemical cycle of C. Oceanic uptake of atmospheric CO_2 results mainly from primary production. A part of this newly fixed organic matter is eventually transformed into a dissolved phase. The export of particulate and dissolved organic carbon (DOC) from the surface layers to deep water and, eventually, burial of carbon in the sediments, results in a net reduction of the atmospheric CO_2 concentration. The primary objective of the international Joint Global Ocean Flux Study (JGOFS) in which the research encompassed in this project was carried out, was to quantify and understand the physical and biological controls on these fluxes. The specific goal of the project, sponsored by NWO-GOA, was to contribute to a better understanding of the processes that link the production of DOC by autotrophs and the consumption by heterotrophic bacteria in the upper ocean.

Oceanic DOC represents one of the largest pools (~740 G-tonnes C) of reduced C on earth, yet little is known about the characterisation, transformation or absolute concentration of DOC in seawater. Until recently, DOC was not considered to be important to the global biogeochemical cycle of carbon. Renewed interest in DOC was initiated by the introduction of a new high temperature combustion (HTC) method, initially yielding 2-3 times higher values than those previously observed. Recent re-evaluations and improvement of the HTC method, with special emphasis on the blank correction and instrument performance, have facilitated reliable quantification of marine DOC. One of the outcomes of this and other recent research was that high values of the HTC-method, published over the last decade, were overestimates due to high system blanks and improper data analysis.

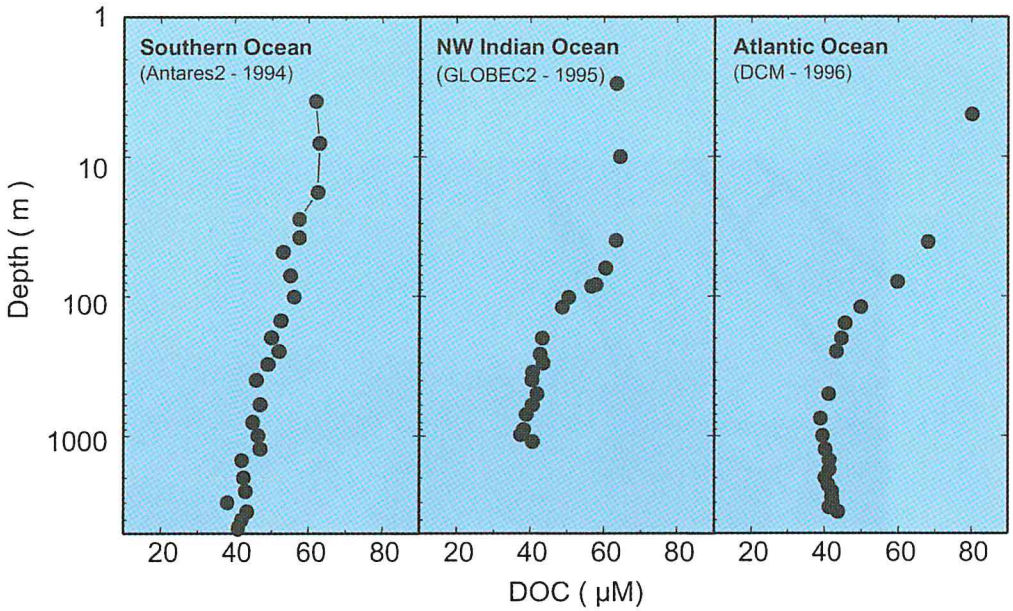
In the Southern Ocean along 62°E (France-JGOFS / ANTARES 2) we observed mixed layer concentrations of DOC between 52 µM in the Antarctic Divergence (64°S) and 63 µM in the Polar Frontal Zone (49°S). Vertical profiles showed a slight, but significant, decrease in organic carbon below the mixed layer to about 42 µM below 2000 m across the transect. The homogeneity and low concentration of organic carbon in deep water is consistent with data from the Atlantic Ocean (DCM-1996) and NW Indian Ocean (US GLOBEC2). Comparison of vertical profiles of DOC in different ocean basins supports the evidence for constant deep water DOC concentration, comprised of biologically resistant material. Besides, the homogeneous low value (~40 µM) below ~1000 m depth provides a first approximation to validate comparisons between different data sets.

Our DOC values are similar to those reported in past decades (e.g. Duursma in 1961), but the improved accuracy and precision of modern analyses allow for the detection of significant differences in the DOC pool in the ocean, which is important to assess elemental fluxes. Whereas DOC was homogeneously distributed in the deep ocean, significant differences appeared in the surface layer and at intermediate depth. Despite the relatively low concentration of DOC in the mixed layer of the Southern Ocean, organic carbon showed a positive trend with phytoplankton biomass and bacterial production, underlining the dependence of bacterial growth on a pool of 'freshly' produced DOC. In the depth range between the mixed layer and the oxygen minimum, DOC exhibited a modest inverse trend versus apparent oxygen utilisation (AOU). The stoichiometry of this trend suggested that only a minor fraction of the oxygen consumption in the open ocean would be due to mineralization of DOC. However, being an intermediate in the oxidation of organic matter the transfer of C through the DOC pool should have an important control on the C-flux in the ocean. Our findings indicate that this presumably involves only a minor (<10%) fraction of the DOC pool. By far the largest fraction remains inert.

The supply of labile DOC is a key factor controlling the productivity of bacterioplankton. Heterotrophic bacterioplankton mediates in particle-dissolved transition and the remineralisation of organic matter, thereby in their turn effecting the distribution of DOC, oxygen and nutrients in the water column. In the NW Indian Ocean, the diversity of physical and biological processes affecting plankton productivity was reflected in a broad range of both phyto- and bacterioplankton production. Heterotrophic activity and primary production were closely correlated, indicating the dependence of bacterioplankton on local phytoplankton-derived DOC and their ability to adapt quickly to changes in the environment. The highest bacterial production occurred during enrichment of the surface water in the Somali current, related to upwelling of cold, nutrient-rich, deep water during the SW-monsoon. In contrast, the Gulf of Aden and the Red Sea were shown to be most productive during the NE-monsoon. In the NW Indian Ocean bacterial production, controlled by the supply of labile DOC, was vertically uncoupled from primary production and extended below the euphotic zone (0-35 m) to the mixing depth of ca. 100 m. Apparently, the climatological conditions prevailing during the SW-

monsoon result in a (temporal) uncoupling of organic matter production, export and decomposition. In the stratified (sub)tropical North Atlantic Ocean, as opposed to the NW Indian Ocean, there was evidence for a strong co-variance of bacterial production rates and vertical distribution of autotrophic C assimilation. Bacterial production by the summer population was relatively low and equivalent to <9% of primary production. Little variability in the ratio of bacterial production to primary production (BP:PP) between different sites suggested strong coupling between the two plankton groups. This uniform coupling of daily rates of heterotrophic and autotrophic production in the oligotrophic ocean is in keeping with the notion that *in situ* recycling of nutrients by the heterotrophic food web continuously supports primary production. In the NW Indian Ocean, driven by seasonality of monsoons, the BP:PP ratio appeared to be consistently higher (0.09-0.34) supporting the hypothesis that the ratio is generally low only under quasi-steady state conditions as encountered in the (sub)tropical North Atlantic.

Specifically designed incubation experiments indicated that bacterial growth rates typically exceed 0.6 d^{-1}, which is close to the *in situ* specific growth rates (μ_{cell}) estimated from the observed difference in bacterial abundance's between dawn and dusk. An independent estimate of the bacterial growth rate was obtained from the incorporation rate of radiotracers. ^{3}H-thymidine incorporation rates yielded growth rates (μ_{DNA}) of ~0.03 d^{-1}, remarkably lower than μ_{cell}. Bacterial production has commonly been estimated by using assumed mean oceanic values of the conversion factor (CF), which translates ^{3}H incorporation rate into terms of bacterial growth. We re-evaluated CF by taking into account the proportion of dividing cells, quantified on the basis of cell specific DNA content measured by flow-cytometry. Application of the new CF yielded a μ_{DNA} of~ 0.3 d^{-1}, essentially similar to the computed heterotrophic μ_{cell} and close to the specific growth rate of the phototrophic prokaryotes of about 1 d^{-1}. The traditionally applied CF values were apparently suffering from a large portion of non-viable, non-dividing cells, thus underestimating the division rate of the small portion of viable, dividing cells. The now proven high growth rates of heterotrophic bacteria are in agreement with the hypothesised strong coupling between autotrophic and heterotrophic processes in the oligotrophic ocean.



Profiles of dissolved organic carbon along 62°E in the Southern Ocean (ANTARES2 - 1994), at 11°N, 52°E in the NW Indian Ocean (GLOBEC2 -1995) and along 53°W in the (sub)tropical Atlantic Ocean (DCM - 1996). Error bars indicate mean DOC concentration of different hydrocasts. Water samples were analysed during a single run on the Shimadzu TOC-5000A Carbon analyser. At regular intervals the analyses were intermitted by two reference samples to track the stability of the instrument performance during the run. In addition, a set of DOC reference ampoules (deep-ocean and blank) was included in the run to check the accuracy of the method.

NIOZ has a long-standing tradition in dissolved organic carbon (DOC) analysis. From the seventies onwards, G.C. Cadée and J. Hegeman published a number of papers about the distribution and interactions of DOC in a variety of marine environments, using the wet chemical oxidation method. At present, H.J.W. De Baar en coworkers apply the high temperature combustion (HTC) methodology. However, history of DOC analysis at NIOZ goes back further in time.

In the late fifties, E. K. Duursma assisted by J. Rommets developed a reliable method for the determination of DOC in seawater. Despite the laborious method these pioneers obtained a unique data set of DOC measurements in the Wadden Sea, North Sea, Norwegian Sea and the North Atlantic. Besides, Duursma provided a detailed description of the apparatus, the analytical procedure and the factors that may affect the accuracy and precision of the method. The complete Ph.D. thesis of E.K. Duursma, entitled 'Dissolved organic carbon, nitrogen and phosphorous in the sea', was published in 1961 as the very first issue of the until recently *Netherlands Journal of Sea Research*, currently (starting from 1997) the *Journal of Sea Research*. Most remarkably, the pioneering findings of Duursma were generally considered obsolete in the 1986-1991 period, as they were presumably too low compared to the newly reported high values obtained by the, at that time, novel HTC methodology. For example, at the September 1988 second meeting of the SCOR-JGOFS scientific Steering Committee in The Hague, the then NIOZ director Prof. Duursma had briefly shown his 'old' DOC data in his welcoming words, but this was politely ignored by the diplomatic audience. Nowadays, one decade later, HTC methods have been modified and updated. One of the outcomes is that the 'old DOC values have been vindicated after all by the most recent HTC results.

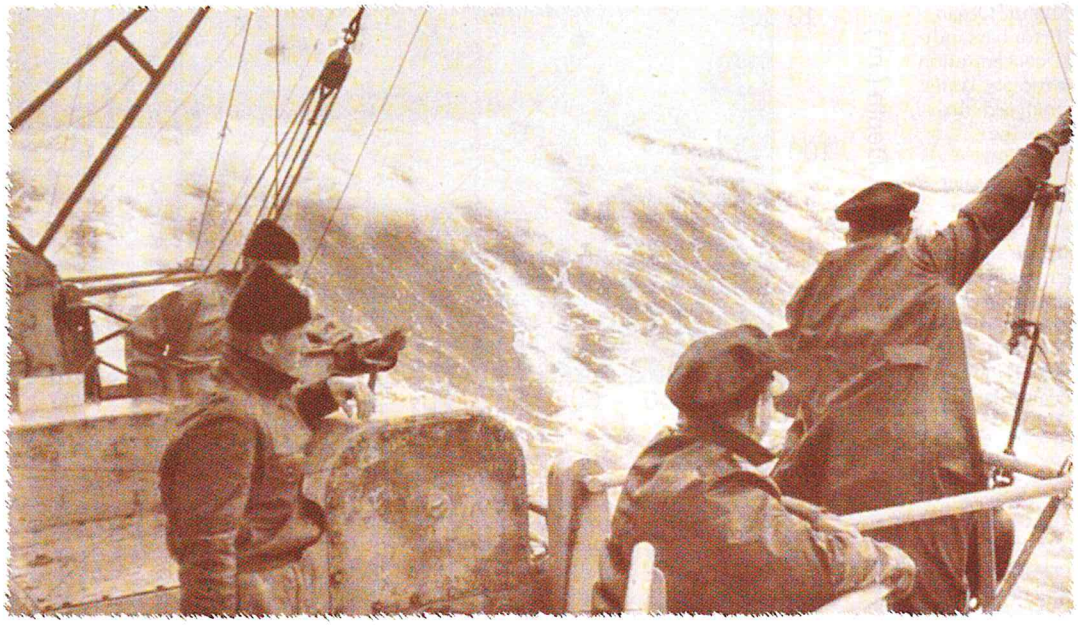


Plate 1 in the thesis of E.K. Duursma published in the Netherlands Journal of Sea Research in 1961. The photo shows sampling operation on board 'Anton Dohrn'. Second North Atlantic Cruise 1958. Wind: beauford 9 (photo: Dr. H. Weidemann).

EXTERNAL PROJECTS OF THE DEPARTMENT OF MARINE CHEMISTRY AND GEOLOGY

- Air-sea carbon-dioxide fluxes (NWO-NOP II)
  H.J.W. de Baar, M.H.C. Stoll
- Teluk Banten: Coastal marine sediments and sedimentation (NWO)
  T.C.E. Van Weering, G. Van De Berg, W. Boer
- Trace elements-Phytoplankton interactions (NWO-NAAP)
  H.J.W. de Baar, J.T.M. De Jong, R.F, Nolting
- Cycling of silicate (NEBROC)
  W. Helder, E. Koning, G.-J.A. Brummer, J. Van Iperen, W. van Raaphorst
- Biological availability of trace elements
  H.J.W. De Baar, K.R. Timmermans
- Neogene history of the Benguela Current (NWO)
  J.H.F. Jansen, E. Schefuss, S. West
- Corescanner Texel (CORTEX; University Bremen)
  J.H.F. Jansen, S.J. Van Der Gaast, A.J. Vaars, B. Koster, W. Helder
- Mineralogical and sedimentological proxies of the African climate in records from the southeastern Atlantic Ocean (NSG)
  J.H.F. Jansen, J.B. Stuut
- Mixing of Agulhas Rings Experiment: Palaeoceanographic observations of the Agulhas Ring Corridor (MARE-C; NWO-CLIVAR)
  G.-J.A. Brummer, J.H.F. Jansen, N. Loncaric
- Sedimentary manganese and iron cycles (SMILE; NWO-ALW)
  W. Van Raaphorst, C. Van Der Zee, W. Helder, J.F.P. Malschaert
- European North Atlantic Margins (ENAM-II; EU-MAST)
  T.C.E. Van Weering, H.J. De Stigter, H. De Haas, W. Boer
- Air-sea gas exchange of MAGE (ASGAMAGE; EU-MAST)
  H.J.W. De Baar, M.H.C. Stoll
- Marine ecosystem regulation: Trace metals and carbon dioxide regulation (MERLIM; EU-MAST)
  H.J.W. De Baar, K.R. Timmermans, R.F. Nolting, J.T.M. De Jong
- Mass transfer and ecosystem response (MATER; EU-MAST)
  W. Helder, E. Koning, H.T. Kloosterhuis
- Autonomous lander instrument packages for oceanographic research (ALIPOR, EU-MAST)
  W. Helder, T.C.E. Van Weering, L. Lohse, H. Franken, B. Koster, E.H.G. Epping
- Biogases in European estuaries (BIOGEST; EU-MAST)
  W. Helder, H.P.J. De Wilde
- Ocean margin exchanges (OMEX-II; EU-MAST)
  W. Helder, T.C.E. Van Weering,, H.T. Kloosterhuis, H.J. De Stigter, H. De Haas, E.H.G. Epping
- Carbon dioxide uptake by the Southrn Ocean (CARUSO; EU-MAST)
  H.J.W. De Baar
- Atlantic data base for exchange processes at the deepsea floor (ADEPD; EU-MAST)
  W. Helder
- Sedimentology Faeroe-Shetland area (GEM; SAGA, Atlanticon)
  T.C.E. Van Weering, H. De Haas
- Processes on the Continental Slope, zonation of settling fluxes (PROCS II, NWO-ALW)
  W. Van Raaphorst, G.-J.A. Brummer, J. Bonnin, J.F.P. Malschaert
- Climate history, North Atlantic (NEBROC)
  T.C.E. Van Weering, T. Richter
- Carbon Cycle, Transient Tracers (NEBROC)
  H.J.W. De Baar, M.C.H. Stoll
- Carbon Cycle, Biological Forcing I & II (NEBROC)
  H.J.W. De Baar, K.R. Timmermans, P. Croot
- Coastal and Continental Margin Processes (NEBROC)
  W. Helder, H.J.W. De Baar, H. Thomass
- Climate History South East Atlantic I (NEBROC)
  J.H.F. Jansen, N. Loncaric, G.-J.A. Brummer

DEPARTMENT OF MARINE BIOGEOCHEMISTRY AND TOXICOLOGY

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

Which organic compounds of either natural or anthropogenic origin are present in the different compartments (biota, sediment, water) of the marine environment ?
What are the reaction pathways involved in their biosynthesis, biotransformation and diagenesis?
What are the reaction kinetics and how are these influenced by environmental conditions ?
In the case of biogeochemistry: when did the reactions take place (geological component)
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 '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'.

In 1999 several new projects were started in MBT. We are also very proud to have in our midst Dr. Ir. Stefan Schouten, who won the prestigious Schenk award for the best biogeochemist under 35 years of age. A rather unusual project in the sense that it is financed by the industrial body of the 'Bromine Science and Environmental Forum (BSEF, Brussels) was started on the occurrence of polybrominated diphenylether (PBDE) flame retardants in North Sea organisms and some laminated sediment cores.

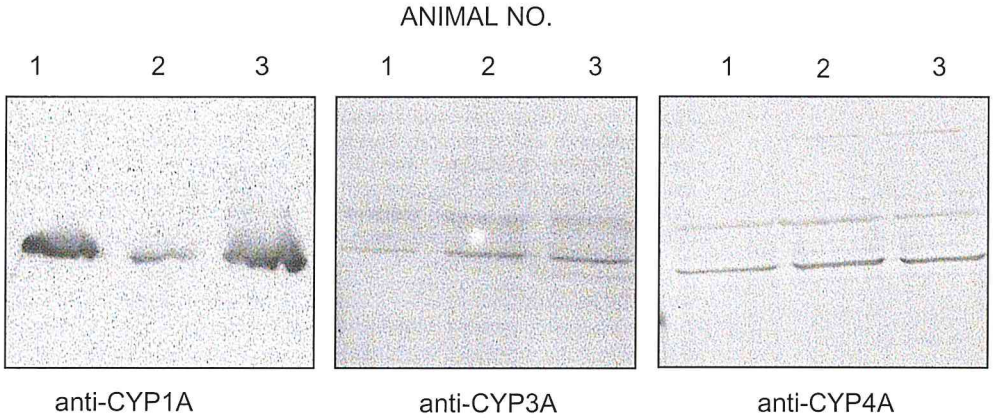
One of our former PhD. Students, the now Dr. Ir. Berend Mensink successfully defended his Ph.D. thesis 'Imposex in the common whelk, *Buccinum undatum*, at Wageningen University. A description of his project was already given in last year's annual report. The results of another Ph.D. project on the molecular composition of kerogen in marine sediments are described below ; Ingeborg Höld will defend her Ph.D. work in the beginning of 2000 at Utrecht University. Dr. Rich Pancost had the exhilarating experience to take his samples at the bottom of the Mediterranean from the French submarine Nautile. He also explains his work in the following pages. A toxicological project finished this year addresses the question whether the biotransformation ability of marine mammals towards anthropogenic contaminants can be derived from the presence of different isozymes of the biotransformation enzyme superfamily cytochrome P450. The last part of this work was performed by Dr. Robert Letcher who worked at MBT through his appointment at the Research School Environmental Chemistry and Toxicology.

CAN THE CATALYTIC ACTIVITY OF HEPATIC MICROSOMES FROM DIFFERENT MARINE MAMMAL SPECIES BE DERIVED FROM THE IMMUNOCHEMICALLY DETECTED ISOFORMS OF CYTOCHROME P450?

Contributors: *Jan P. Boon, Robert J. Letcher, Cecile J.M. van Hezik, Wilma E. Lewis*

To compare the metabolic ability of different marine mammals, it is important to identify the different iso-enzymes of CYP that are responsible for the metabolism of different classes of compounds. In this project the CYP450 iso-enzymes of the families involved in the biotransformation of pollutants (CYP1-CYP4) have been profiled from hepatic catalytic activity in in vitro incubation assays and by immunochemical detection. The goal of this project was to investigate whether the immunochemical pattern of CYP450 iso-enzymes can be used to predict the organohalogen contaminants that can be metabolised by a marine mammal. The project was a co-operation within the Research School Environmental Chemistry and Toxicology (M&T), and was carried out in co-operation with H.-J. de Geus of Netherlands Institute for Fisheries Investigations (RIVO) and A. Goksøyr of the University of Bergen (Norway).

The liver samples necessary for this research were obtained from a number of live-stranded marine mammals that died on the beach. It was essential that all samples could be obtained and frozen in liquid nitrogen within hours after death, since enzymes, being proteins, rapidly loose their catalytic properties due to degradation. In this case, liver samples could also be taken from three adult male sperm whales that stranded alive on the North Sea coasts 1995 and 1997. The samples of a Baltic grey seal were a gift from Dr. Madeleine Nyman-Mattson of the Finnish Game and Fisheries Research Institute in Helsinki.

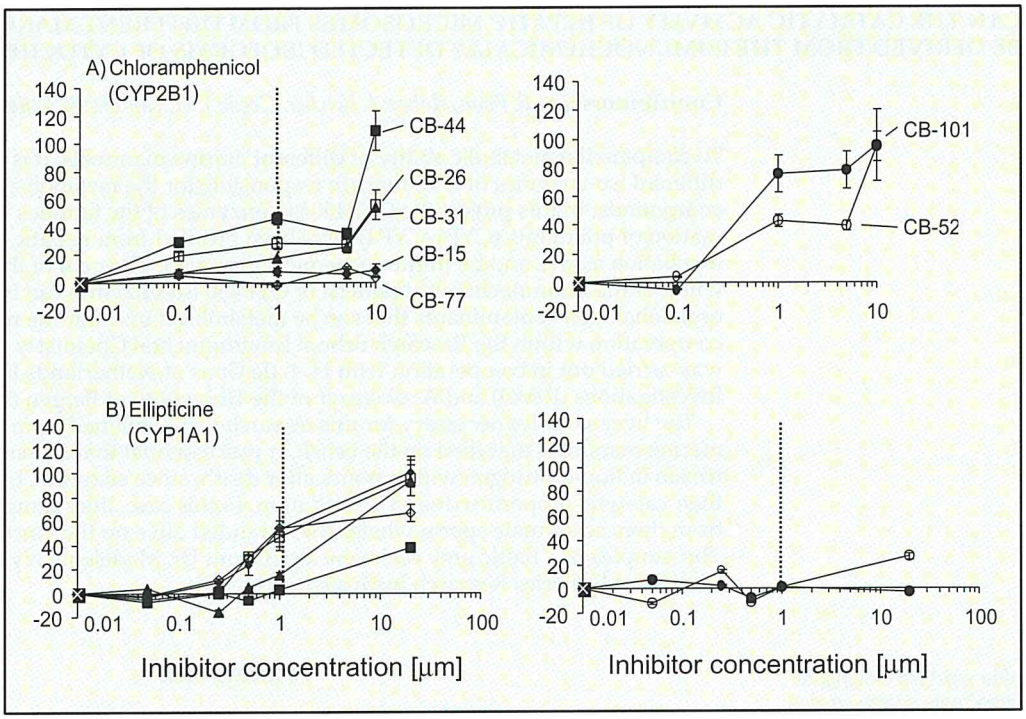


After western blotting, all three male sperm whales showed similar immunochemical CYP patterns: bands of CYP1A1/2, CYP3A and CYP4A were present. In contrast, bands of CYP2B isoenzymes did not emerge. The same result was found for samples of a whitebeaked dolphin and a harbour porpoise. Samples of harbour and grey seals also showed bands of all these CYP forms; but additional bands of CYP2B1/2 were also visible (not shown).

The in vitro biotransformation capacity of the microsomes was studied for selected polychlorinated biphenyls (PCBs), dibenzodioxins (PCDDs), dibenzofurans (PCDFs) and chlorobornanes derived from the insecticide toxaphene®. Metabolism was measured as the depletion of the parent compounds. Sperm whale microsomes metabolised 4,4´-chlorobiphenyl (CB-15), 2,7-dichlorodibenzo-p-dioxin, and 1,2,3,4,8-pentadibenzofuran, but the chlorobornanes CHB-32 and CHB-62 and the PCB 3,3´,4,4´-tetrachlorobiphenyl (CB-77) were persistent. In contrast, these three compounds were metabolised by microsomal preparations of harbour and grey seal.

Since the only immunochemical difference in CYP isoforms between sperm whales and seals was the exclusive presence of CYP2B in seals, it was first hypothesised that this isozyme played the main role in the metabolism of the chlorobornanes. However, the strongest concentration-dependent inhibition of metabolism was observed in the presence of the CYP3A inhibitor ketoconazole. The CYP1A inhibitor ellipticine also inhibited CHB-32 and -62 metabolism in the microsomes of grey seal, but to a much lower degree. Inhibition of CHB metabolism was not observed after the addition of goat anti-rat CYP2B antibodies or Aldrin, which is used as a model CYP2B substrate in rat. This study showed for the first time that a CYP3A-like isoform is probably involved in the metabolism of chlorobornanes metabolism in seals. Thus, the sperm whale micromsomes did not metabolise both chlorobornanes despite the immunochemical presence of a CYP3A-like iso-enzyme.

In grey seal microsomes, the CYP1A1/2 inhibitor ellipticine selectively inhibited CB-15, -26 and -31 metabolism already at 0.5 mM. At concentrations above 1.0 µM, the metabolism of the CBs -44 and -77 was also inhibited. All these congeners possess hydrogen atoms on neighbouring carbon atoms (vicinal H-atoms) either exclusively in the ortho- and meta- positions, or in combination with additional vicinal hydrogen atoms in the meta- and para-positions. In con-



The effects of two inhibitor compounds on the in vitro metabolism of seven PCB congeners in the hepatic microsomes of Baltic grey seal (Halichoerus grypus). The % inhibition of metabolism is shown for CB-15 (dark diamond), CB-26 (empty square), CB-31 (dark triangle), CB-44 (dark square) and CB-52 (empty circle), CB-77 (empty diamond) and CB-101 (dark circle). Each data point in the mean of 3 or 4 replicate assays. The lowest point (square with cross) represents assays without inhibitors present, and thus maximum PCB depletion. Standard deviations are indicated by error bars. The dashed vertical line indicates the inhibitor concentrations above which non CYP-specific inhibition rapidly increases.

trast, the metabolism of CB-52 and -101 remained essentially unaffected by ellipticine up to 20uM. These congeners possess vicinal hydrogen atoms exclusively at the meta- and para- positions. Their metabolism was inhibited most strongly by the CYP2B inhibitor chloramphenicol.

Thus, although CYP1A/2 was immunochemically present in the sperm whales, their microsomal preparations metabolised only CB-15, but not CB-77. This was a second indication that the ability to metabolise a certain substrate cannot be simply derived from the immunochemical presence of certain CYP isoforms in the microsomal preparations.

RATIONALE OF THIS TYPE OF RESEARCH

Marine mammals are at the top of the marine food web and, thus, may bioaccumulate high concentrations of lipophilic organohalogen contaminants. Besides lipophilicity and molecular size of the molecules, enzyme-mediated biotransformation plays a crucial role in the environmental fate of lipophilic organic pollutants that lack a reactive group. Biotransformation of an organohalogen contaminant determines whether bioaccumulation will occur, and the changes in molecular structure upon biotransformation can have strong effects on toxicity.

Cytochrome P450 (CYP450) is the central enzyme system in phase I metabolism of organohalogen contaminants. This complex enzyme system consists of many structurally related iso-enzymes involved in the metabolism of both endogenous and foreign compounds. Individual iso-enzymes are assigned into families and subfamilies on the basis of structural homology. A wide number of CYP450 isoforms have been characterised in various species of invertebrates, fish, birds and marine mammals. Iso-enzymes belonging to the families CYP1-CYP4 are mainly involved in the biotransformation of xenobiotic compounds. Enzymes belonging to the other families are mainly involved in the metabolism of endogenous compounds such as steroid hormones and fatty acids. Since considerable differences in iso-enzyme patterns can occur between the different animal groups and between different species of the same group, the bioaccumulation patterns and toxicity of the compound mixtures can differ also.

STRUCTURAL ANALYSIS OF MARINE KEROGENS THROUGH A COMBINED CHEMICAL AND THERMAL DEGRADATION APPROACH

Contributor: *I. Höld*

Approximately 95% of the sedimentary organic matter in the geosphere exists in the form of kerogen, a macromolecular substance that is insoluble in water and normal organic solvents. There have been numerous attempts to elucidate the chemical structure of kerogens since it is not only the major sink for organic carbon in the oceans but also the main precursor of crude oils. Despite the importance of these studies, the structure of kerogens, especially from marine origin, remains a matter of debate. Thus, the objective of this research project was to gain a better insight in the chemical composition of marine kerogens. A useful tool for this is chemical degradation which can release a number of structural moieties from kerogens for subsequent analysis. However, all previously reported studies showed that only small amounts of compounds were released. Studies on the effect of chemical degradation on the structure of the remaining kerogen residues have been very limited. This project showed that additional valuable information may be gained on the structure of kerogens, when both the released compounds and the effect on the structure of kerogens are studied by the combination of chemical and thermal degradation (pyrolysis). These techniques were also combined with the determination of the stable carbon isotopic composition of specific compounds so as to identify their origin.

First, the pyrolysis products of several marine kerogens were analyzed. The stable carbon isotopic composition of the released n-alkanes (C_{10}-C_{25}) were quite similar to those of the n-alkenes (C_{13}-C_{20}), suggesting that they are derived from resistant, non-hydrolysable algal biopolymers. The carbon isotopic compositions of isoprenoid alkanes were different from those of the n-alkanes and n-alkenes. These isoprenoids could be derived from an algal biopolymer similar to that biosynthesized by the freshwater algae *Botryococcus braunii* race L.

Flash pyrolysis and sequential chemical degradation were combined to unravel the molecular composition of an immature Type II-S kerogen from the Miocene Monterey Formation. The variety of compound classes present in the flash pyrolysate of this kerogen, e.g. normal, branched and cyclic hydrocarbons, alkyl aromatic hydrocarbons, alkylthiophenes and alkylpyrroles, as well as the fact that the sediments were extensively studied previously, made this kerogen appropriate for this project. The cleavage of ether bonds resulted in the release of linear and isoprenoid alkanes and alkenes. These compounds are probably derived from n-alkyl and isoprenoid biopolymers biosynthesized by marine algae. The precursor moieties of the alkylthiophenes generated upon pyrolysis were released upon cleavage of sulfide-bonds. These alkylthiophenes originate most probably from sugar derivatives. This is a surprising result, since sugars are usually regarded as very labile compounds which are quickly recycled in the food chain and thus not readily preserved in marine sediments. Upon ether- and sulfur-bond cleavage, alkylpyrroles were released indicating that their precursors, probably tetrapyrrole pigments, occur ether- and sulfur-bound in the kerogen. Furthermore, prist-l-ene as well as tocopherols were removed from the flash pyrolysate after ether-bond cleavage, suggesting ether-bound tocopherols as a major source of prist- 1 -ene in the kerogen pyrolysates of the Miocene Monterey Formation.

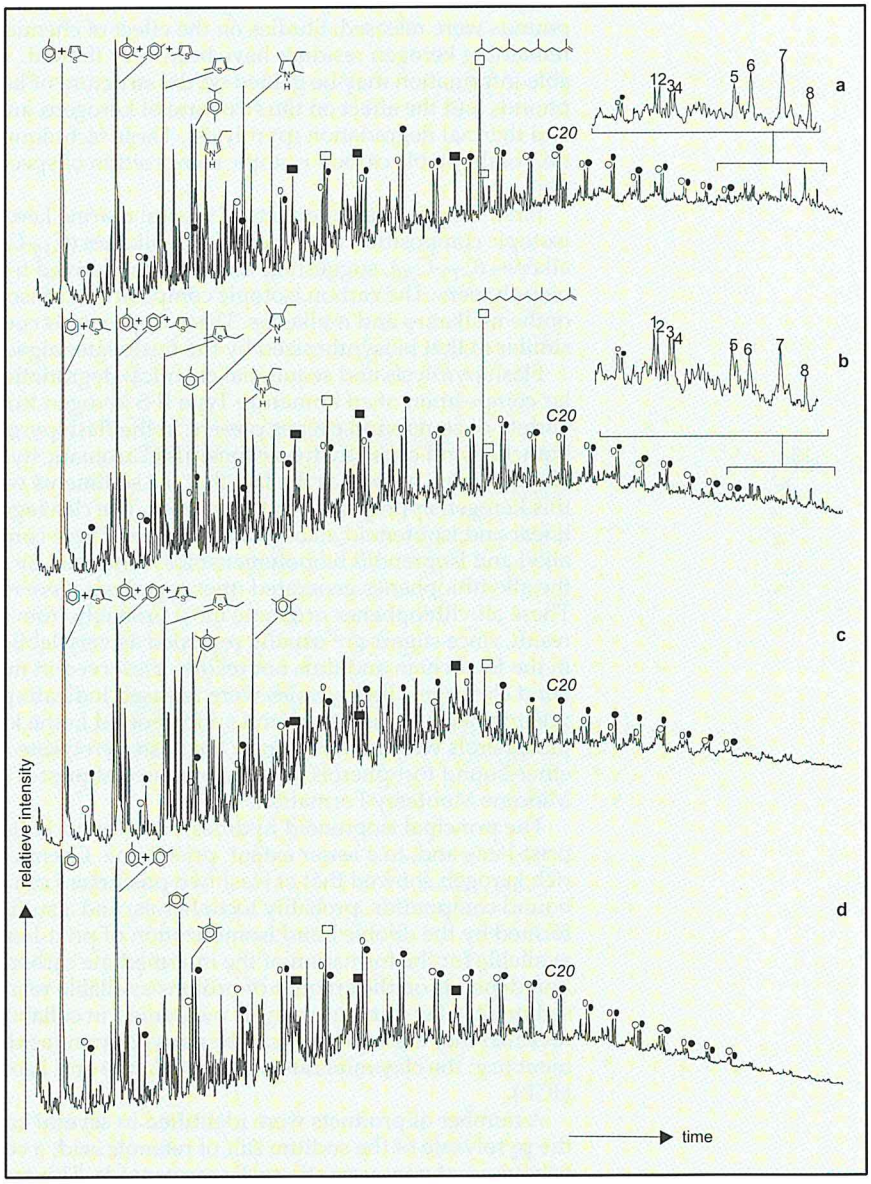
The principal isoprenoid hydrocarbons found in flash pyrolysates of immature kerogens are prist-l-ene and, to a lesser extent, prist-2-ene. Chemical degradation experiments on a sulfur-rich kerogen showed that at least two precursors can generate pristenes upon pyrolysis: ether-bound compounds, probably tocopherols, and a sulfur-bound precursor. Prist-2-ene is likely formed by the double bond isomerization of prist-l-ene and depends on the amount of protons available for the formation of the intermediate carbonium ion. Thus, the degree of isomerization depends on the amount of protons available relative to the organic carbon content of the sediment. Clay mineral analysis performed in collaboration with the department of MCG revealed that these protons can be derived from (acidified) aluminosilicates present in the sediment (c.g. the clay minerals montmorillonite and kaolinite) or from inorganic acids (e.g. HI, HCL).

A number of products were identified in several kerogen pyrolysates that were also found in the pyrolysate of the sodium salt of retenoic acid, a compound thought to mimic the pyrolysis behaviour of non-aromatic cyclic carotenoids. This suggests that non-aromatic cyclic carotenoids such as β-carotene may be present in kerogens. Selective chemical degradation experiments suggest that these carotenoids are ether-bound. The relatively high amounts of a number of methylated benzenes (e.g. 1,2,3-trimethylbenzene) identified in these kerogen pyrolysates are partly derived from aromatized products formed during the diagenesis of carotenoids.

The Huqf oil from Oman and other infra-Cambrian oils are characterized by relatively high amounts of mid-chain branched monomethyl alkanes. The crude oil, the saturated hydrocarbon fractions, the desulfurized polar fractions of the bitumens and the kerogen pyrolysates of three

potential source rocks from the Huqf Formation (Oman) were analyzed to resolve the origin of these characteristic compounds. Using off-line pyrolysis and chemical degradation in combination with compound specific carbon isotope analysis, it was assessed that the mid-chain branched monomethyl alkanes are probably derived from lipids with C_{28+} carbon skeletons and methyl branching at the 12- or 13-positions. These lipids were incorporated in the kerogen through reactions of sulfur with functional groups at different positions in the precursor lipid(s). The results suggest that these may have been membrane lipids which were biosynthesized during the earliest stages of evolution.

In summary, this project has significantly increased our knowledge about the types of molecules that can be preserved in marine kerogens, their possible origin and diagenetic reactions. For instance, it has been shown now that resistant algal biopolymers and labile compounds such as carotenoids and sugars form significant parts of kerogens and can be preserved in sediments for over millions of years.



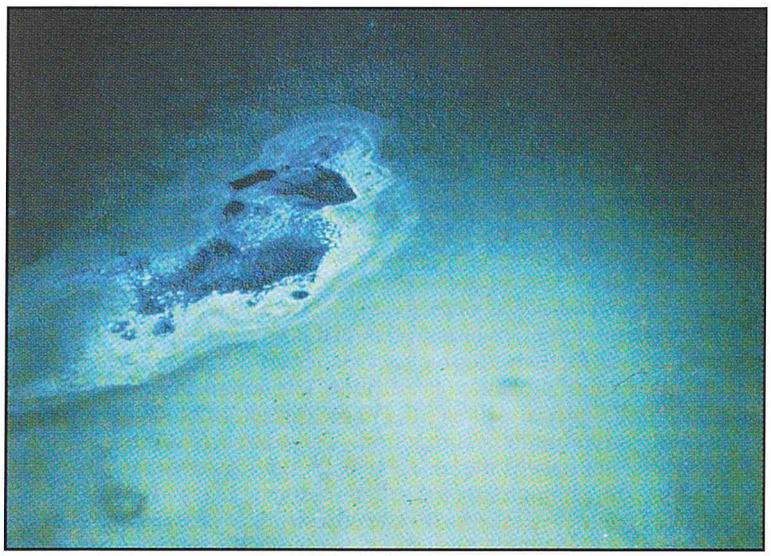
Partial total ion current trace of the flash pyrolysate (Curie temperature 610°C) of (a) the isolated kerogen of a type II-S kerogen, (b) the residue R_1 after alkaline hydrolysis, (c) the residue R_2 after ether-bond cleavage, (d) the residue R_3 after desulfurization. Filled and open circles indicate the homologous series of n-alkanes and n-alk-1-enes, respectively. Their number of carbon atoms is indicated with italic numbers. Filled and open squares indicate pseudo homologous series of isoprenoid alkanes and alk-1-enes, respectively. Key: 1= cholestan-3-ol , 2 = 5α-cholestane, 3 trisnorhop- 17(21)-ene, 4 = cholestadiene, 5 = 30-norhop- 17(21)-ene, 6 = γ-tocopherol, 7 = α–tocopherol, 8 = cholest-4-en-3-one.

MOLECULAR ISOTOPIC INVESTIGATIONS OF MICROBIAL PROCESSES IN COLD SEEPS ASSOCIATED WITH MEDITERRANEAN MUD VOLCANOES

Contributors: *Richard D. Pancost, Jaap S. Sinninghe Damsté*

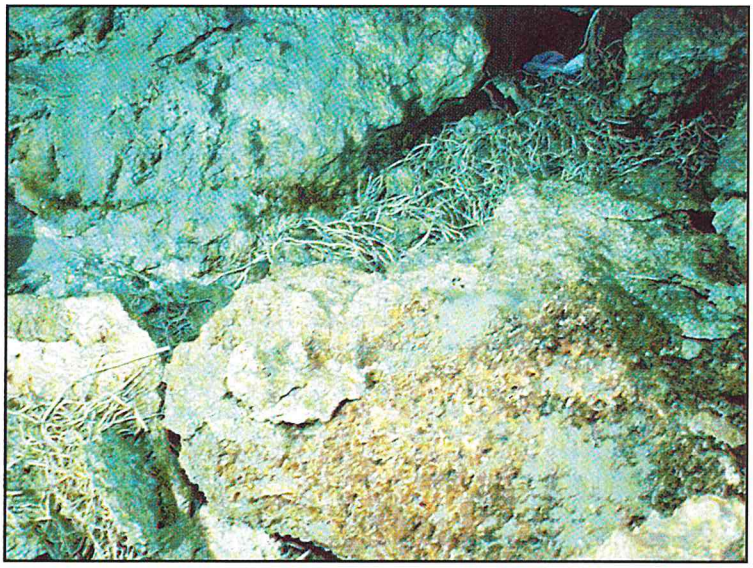
Methane can have a stronger greenhouse effect than CO_2, and recent work has highlighted its potential climatic impact on glacial timescales and in relation to major geologic events. Consequently, controls on methane production and consumption are important concerns in the evaluation of past and future climate change. Of particular interest are marine sediments, in which large quantities of methane can be generated but only a very small percentage actually fluxes into the water column. To study dynamics of methane release from marine settings, the department of Marine Biogeochemistry and Toxicology is participating in an international and multi-disciplinary study of mud volcanism of the Eastern Mediterranean Ridge. Mud volcanism in the Mediterranean is of particular interest because it is known that vast quantities of methane are stored in sub-surface sediments and this methane could be released by warming of Mediterranean bottom-waters.

The Medinaut Program is jointly funded by NWO (which also fully funded the companion Medmud Program) and IFREMER and was conducted during two cruises. During November and December of 1998, mud volcanoes were examined during dives of the submersible Nautile deployed from the French research vessel Nadir. This resulted in not only detailed examinations of tectonic, geological, and biological features of the mud volcanoes, but also allowed highly site-specific sampling. A typical seep from Napoli mud volcano (part of the Olimpi field south of Crete) is shown in the figure. One of the profound discoveries of this study was the presence of brines on Napoli mud volcano. This and other results, confirmed the association of brines, mud volcanoes, and methane release with fault planes of the East Mediterranean Ridge.

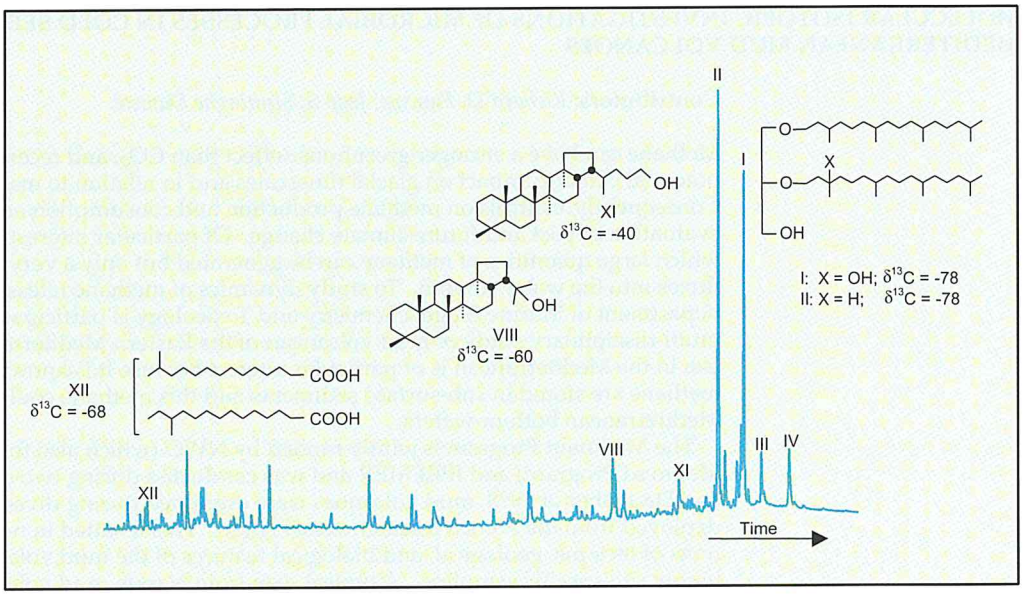


Photograph of a cold seep on Napoli mud volcano (South of Crete on the East Mediterranean Ridge; 2200 m depth) taken by the Nautile during a dive in December of 1998. The dark blue patches are apparently bacterial mats approximately 0.5 cm thick and comprised of a consortium of methane oxidizing bacteria. The whitish material surrounding the mats are salts related to the expulsion of brines from the seep.

The second cruise was conducted in August of 1999 aboard the Russian R/V Professor Logachev. The goals of this cruise were the collection of multiple cores extending to significantly greater depths than those collected by the Nautile, several CTDs allowing measurement of methane in water above mud volcanoes and brine lakes, and seismic data useful for studying the tectonic control on mud volcanism. One immediate result of this work was direct confirmation of mud volcanoes on the Florence Rise – the third confirmed field in the Mediterranean Sea. Of the two mud volcanoes discovered on the Florence Rise, one was named Texel in honor of S. Asjes, M. Bakker, K. Bakker, and W. Polman, continuing the tradition of naming newly discovered mud volcanoes after the 'home-towns' of shipboard scientists and personnel.



Detailed picture of a cold seep showing dense communities of tube worms and extensive carbonate crusts.



Gas chromatogram of the polar fraction extracted from cold seep sediments on Napoli Mud Volcano. Note the high abundance of arhaealipids (I-IV) and the low $\delta^{13}C$ values (‰) of most biomarkers, indicating a microbial communty fueled by ^{13}C-depleted methane.

The Medinaut Program has benefited from a collaborative arrangement of many Dutch and French scientists studying all aspects of mud volcanism, including tectonics, sedimentology, pore-water and bottom-water geochemistry, solid phase geochemistry, microbiology, and macrofaunal ecology. The unique contribution of the Department of MBT to this investigation is the application of molecular biogeochemistry techniques, which naturally bridge many of the other involved disciplines. This work represents one of the first applications of these techniques to such environments and preliminary data has already been submitted for publication and been presented at professional meetings. Of particular interest was the observation that significant quantities of methane in mud volcano sediments are consumed by microbially mediated anaerobic methane oxidation. Although it has been argued that this process is widespread in marine sediments, the mechansim by which it occurs remains elusive. Recent work, including our own, has shown that archaea are fundamental in this process.

Despite the fact that significant quantities of ^{13}C-depleted methane diffuse upwards from underlying mud volcano sediments, the dominant biomarkers in the seeps are specific for nominally methanogenic archaea rather than methanotrophic bacteria. Such diagnostic compounds include hydroxyarchaeol (I) and pentamethylicosane. In addition, less source-specific archaea biomarkers including archaeol (II) and biphytane diols (III, IV) are present in several samples; and in most samples archaeol is the most abundant compound. These biomarkers are also highly depleted in ^{13}C indicating that methane is the source of carbon for these organisms. Similarly low $\delta^{13}C$ values of co-occurring biomarkers for sulfate-reducing bacteria (V) and chemoorganotrophs (VI) confirm previous hypotheses that a consortium of archaea and bacteria is responsible for anaerobic methane oxidation. Moreover, depth profiles developed for mud breccias near the seep suggest that this process can consume a large part of the methane flux (>95 %). Because of the detailed sampling strategies of the Medinaut cruises, we have been able to examine diverse settings (mud flows, seeps, brines, crusts) from multiple mud volcanoes; the occurrence of ^{13}C-depleted methanogen lipids at most sites indicates that reverse methanogenesis is widespread in these settings. However, the distribution of compounds is highly variable and this work is among the first to highlight the probable heterogeneity of microbial communities responsible for this process.

Implications of anaerobic methane oxidation by methanogenic archaea are profound; potentially, this process could mitigate the impact of methane release from dissolving clathrates on bottom water chemistry and atmospheric methane concentrations. Future work will continue to examine the controls on methane cycling in these sediments and microbial diversity using ^{13}C-label pulse-chase studies, lipid analyses of cultured bacteria, and detailed examinations of multiple mud breccia profiles.

EXTERNAL PROJECTS OF THE DEPARTMENT OF MARINE BIOGEOCHEMISTRY AND TOXICOLOGY

- Marine microalgae as major contributors to marine sedimentary organic matter and crude oils NWO-ALW
  P. Blokker, J.S. Sinninghe Damsté, J.W. de Leeuw
- 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
- Neogene history of the Benguela Current and climate in southeastern Africa: a high resolution study of biomarkers and plantonic Foraminifera NWO-ALW
  E. Schefuß, G.J.M. Versteegh, F.J.H. Jansen, J.S. Sinninghe Damsté (main contractor: MCG)
- A molecular and carbon isotopic biogeochemical study of environmental conditions leading to deposition of 'black shales' during the Cenomanian/Turonian oceanic anoxic event NWO-ALW
  M.M.M. Kuypers, J.S. Sinninghe Damsté
- Multidisciplinary Study of Mud Volcanism in the Eastern Mediterranean (Medinaut).
  R.D. Pancost, J.S. Sinninghe Damsté NWO-ALW
- Medmud: Mediterranean Cold Seeps and Mud Volcanoes - Part II: Carbon isotopic biogechemistry of eastern Mediterranean mud volcanoes NWO-ALW
  R.D. Pancost, J.S. Sinninghe Damsté.
- Early diagenetic transformations of carotenoids: A key to understanding past environmental changes. NWO-ALW
  E.C. Hopmans, S. Schouten, J.S. Sinninghe Damsté
- Climate variability on a decadal time scale in the North Sea as revealed by biomarker analysis NEBROC
  B. van Dongen, 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
- Action to demonstrate the harmful impact of TBT. Effective communication strategies between scientists and policy makers to assist in policy development (EU-LIFE).
  J.P. Boon, C.C. ten Hallers-Tjabbes.
- Coccolithophorid evolutionary biodiversity and ecology network (CODENET; EU-TMR)
  H. Kinkel, G.J.M. Versteegh, J.S. Sinninghe Damsté
- 'In vitro biotransformation of organohalogens and specific cytochrome P450 isozyme activities in microsomal preparations of harbour seal' (Research School Environmental Chemistry and Toxicology).
  R.J. Letcher, J.P. Boon.
- Passive sampling of organic contaminants in the waterphase (Ministry of Transport, Public Works and Water Management; National Institute for Coastal and Marine Management/RIKZ).
  K. Booij
- Determination of TBT and TPT levels in sea water and tissues of experimentally exposed juvenile whelks (Ministry of Transport, Public Works and Water Management; National Institute for Coastal and Marine Management/RIKZ).
  J.P. Boon
- Course ISM-MARPOL for students of the Nautical Faculty of the Amsterdam University for Professional Educations. (Ministry of Transport, Public Works and Water Management, Directorate-General for Freight Transport/DGG).
  J.P. Boon (Co-ordinator), A. van Schanke, C.C. ten Hallers-Tjabbes; in co-operation with the departments FYS, MCG, BIO and MEE of NIOZ, and 'Ecomare', the Centre for Wadden and North Sea..
- Molecular and geochemical analysis of hot spring cyanobacterial and Chloroflexus mats as stromatolite analogs (NASA)
  M. van der Meer, S. Schouten , J.W. de Leeuw
- Occurrence of polybrominated diphenylether (PBDE) flame retardants in marine foodwebs and sediments. (Bromine Science and Environmental Forum, Brussels)
  B.N. Zegers, J.P. Boon
- Levels of PCBs in marine mammals from the North Sea (Museum of Natural History 'Naturalis')
  J.P. Boon
- Impact of TBT in Neptunea antiqua from the North Sea (Ministry of Transport, Public Works and Water Management, Directorate General for Freight Transport/DGG).
  C.C. ten Hallers-Tjabbes, J.P. Boon
- The occurrence of imposex in marine snails in relation to levels of organotin compounds in the coastal waters of Portugal (University of Porto)
  J.P Boon
- Course ISM-MARPOL for students of the Rotterdam University of Professional Educations. (Foundation 'The North Sea')
  J.P. Boon (Co-ordinator), A. van Schanke, C.C. ten Hallers-Tjabbes; in co-operation with the departments FYS, MCG, BIO and MEE of NIOZ, and 'Ecomare', the Centre for Wadden and North Sea.

DEPARTMENT OF BIOLOGICAL OCEANOGRAPHY

The Department of Biological Oceanography focuses on the role of planktonic organisms in the carbon and energy fluxes and nutrient recycling in the North Sea and the Atlantic Ocean. Emphasis was put on 6 research topics:

1. **Competition experiments for inorganic nutrients with selected phytoplankton species and grazing experiments with microzooplankton were performed and the phasing of cell division of phytoplankton and the desintegration of single phytoplankton cells was studied using flow cytometry and novel fluorescent stains.**
2. **The role of food quality on the limitation of zooplankton growth was investigated. Focus was put on the rate of growth and development of copepods in relation to their food and on the use of chitobiase as a measure for crustacean zooplankton production.**
3. **The development of plankton communities (bacteria, phytoplankton and microzooplankton) from contrasting oceanic provinces held at identical light and temperature conditions was investigated. The hypothesis was tested that the environmental conditions determine the presence or absence of a specific plankton community.**
4. **The role of the bacterioplankton in regulating the grazing pressure by their main consumers, the flagellates, was studied. It was found that bacteria with polysaccharidic capsules are grazed 3-4 times more efficient than bacteria lacking a capsular envelope.**
5. **The structure of the bacterial community was studied in a diverse range of habitats ranging from microbial mats to the water column of the Mediterranean Sea using a diverse array of molecular techniques.**
6. **Focus was also put on the further development and application of the European Regional Seas Ecosystem Model (ERSEM) which has been developed in 2 successive EU-MAST projects. The ERSEM model was coupled to a 1D hydrodynamical model and has been applied to the Baltic and the Adriatic Sea. Furthermore, it was specifically adapted to model the deep chlorophyll maximum layer and the diel hydrogen peroxide dynamics in the upper water column of the subtropical Atlantic.**

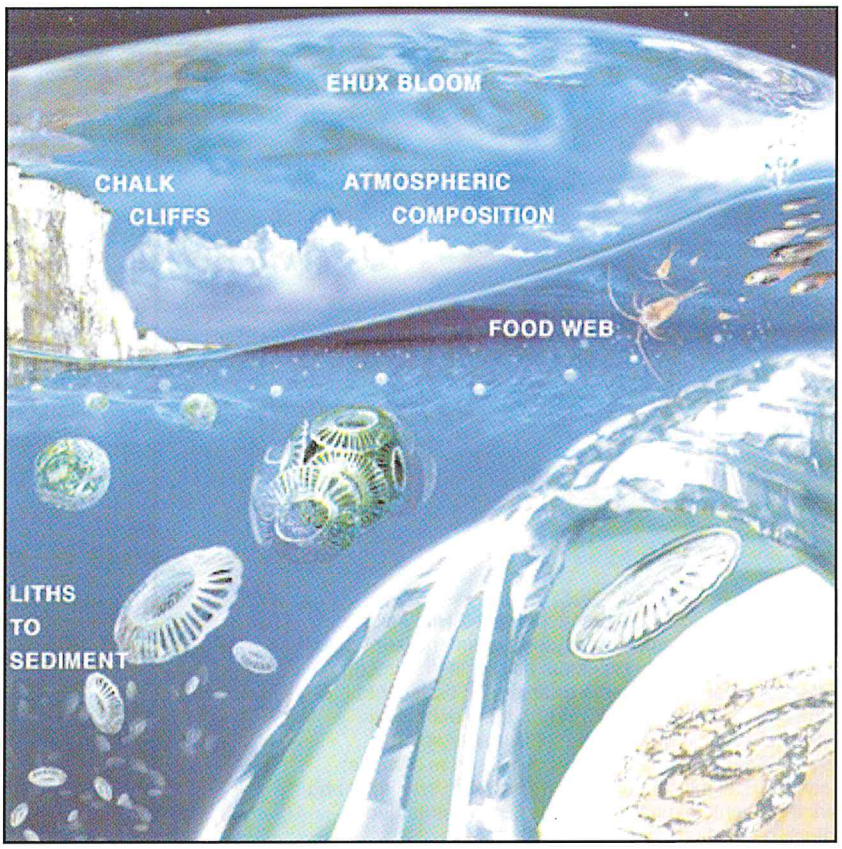
A MODEL SYSTEM APPROACH TO THE BIOLOGICAL CLIMATE FORCING: THE EXAMPLE OF EMILIANIA HUXLEYI

Contributors: *R. Riegman, W. Stolte, A.A.M. Noordeloos, D. Slezak*

The coccolithophorid *Emiliania huxleyi* (Lohman) Hay and Mohler is considered to be the world's major producer of calcite. It has a world-wide distribution and forms extensive blooms in both coastal and open oceanic waters. Embedded within the framework of the Dutch National Research Programme on Global Air Pollution and Climate Change an extensive laboratory study on the ecophysiology of *E. huxleyi* in light- and nutrient-limited continuous cultures was carried out to generate data for modelling purposes. The project was performed in close cooperation with Prof. S.A.L.M. Kooijman and Dr. C. Zonneveld (Department of theoretical Biology; Vrije Universiteit, Amsterdam), Prof. P. Westbroek (University of Leiden), Dr. W.W.C. Gieskes and Dr. M. van Rijssel (University of Groningen).

In continuous cultures, light-limitation was studied at six different growth rates and nitrogen- and phosphate-limitation were studied at four different growth rates. Actual and potential rates of photosynthesis and nitrogen- and phosphate uptake were measured at a standard temperature of 15°C. Cellular composition, including C, N, P, pigments, and calcite, was determined for each steady state condition.

We demonstrated that *E. huxleyi* had a high growth affinity for light (27×10^{-3} m^2 s μmol^{-1} d^{-1}) which was comparable to oceanic specialists such as *Synechococcus* and prochlorophytes. The affinity for nitrate was relatively low (0.37 L μmol^{-1} h^{-1}). However, most exceptional was its affinity for phosphate (20 L μmol^{-1} h^{-1}). This showed to be the highest value ever recorded for a phytoplankton species. Also unique for this obligatory photo-autotrophic species was the presence of two different alkaline phosphatase systems under P-limitation. These properties make *E. huxleyi* an excellent competitor for P, especially when there is rapid recycling of P *via* the organic-P pool. From a mechanistic point of view, *E. huxleyi* blooms are expected to be initiated in P-controlled ecosystems, *i.e.* in the presence of high supply rates of irradiance, nitrate, and organic-P. This conclusion is in agreement with earlier reported field observations. The successive biomass accumulation during the development of the bloom is a consequence of cascading effects in the pelagic food web. The ecophysiological profile of *E. huxleyi* explains why this species mainly occurs in P-controlled environments. Consequently, we concluded that the removal of CO_2 from the biosphere *via* the burial of calcium-carbonate from the major calcifier in the world oceans is controlled by phosphorus rather than nitrogen.



Artist impression of the *Emiliania* model system (by G. Gorick).

CONTRASTING EFFECTS OF SOLAR RADIATION ON DISSOLVED ORGANIC MATTER AND ITS BIOAVAILABILITY TO MARINE BACTERIOPLANKTON

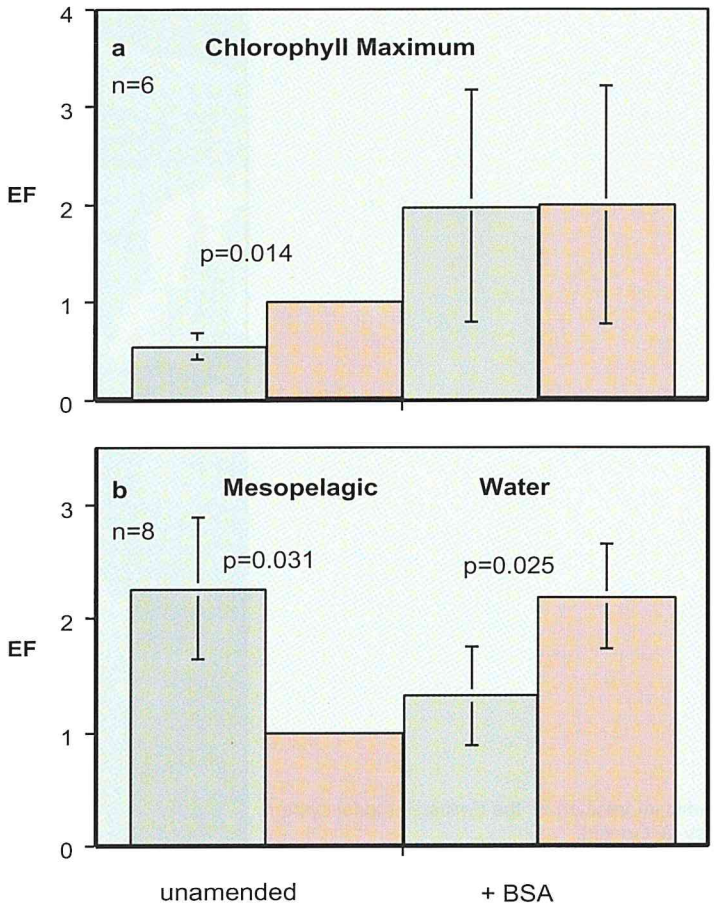
Contributors: *Ingrid Obernosterer, Gerhard J. Herndl*

The processes regulating the cycling of oceanic dissolved organic matter (DOM), one of the largest organic carbon reservoirs of the Earth's biosphere, are still poorly understood. Only the bacterially - mediated turnover of the more labile DOM pool comprising less than 20% of the total oceanic DOM has been intensively studied. Recently, the direct and indirect effects of solar radiation on the turnover rates of DOM have received considerable attention also. DOM exhibits photoreactive properties, sensitive especially to the UV - B (280 - 320 nm) and the UV - A (320 - 400 nm) range. It is still unclear, however, to what extent the oceanic DOM pool is altered on a molecular level upon exposure to sunlight, and how this alteration affects its subsequent bioavailability to bacterioplankton.

The experiments were performed during cruises in the Strait of Gibraltar (June 1997) and the Aegean Sea (September 1997) as well as off CARMABI station at Curaçao (Caribbean Sea, November 1996). This research was funded by grants from the CEC – Marine Science and Technology (CANIGO project MAS3-CT96-0060 and MATER project MAS3-CT96-0051) and by the Environment and Climate Program of the European Union (MICOR, project no. EV5V-CT94-0512).

Bacterial response to irradiated DOM originating from surface and mesopelagic waters

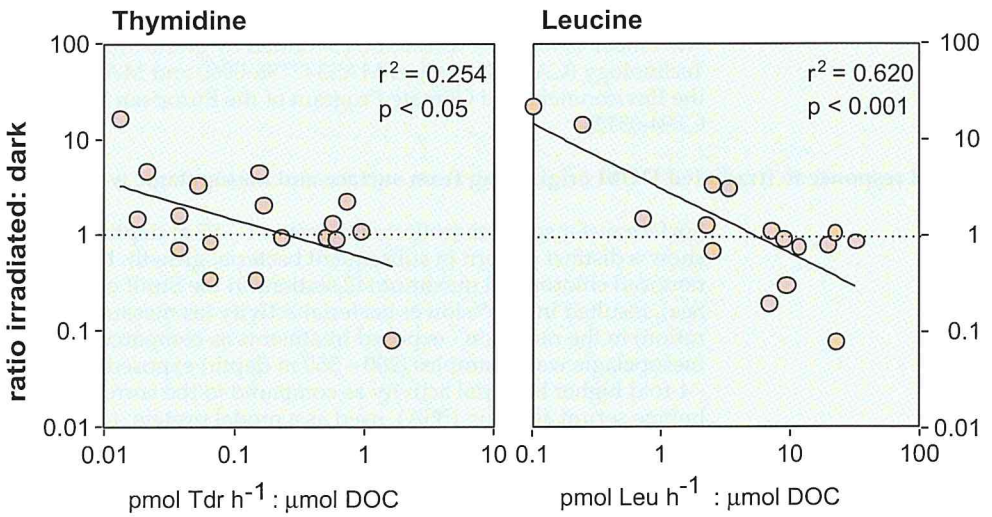
Surface water samples (collected between 1 – 85 m depth) exposed to solar radiation did not show a distinct pattern in subsequent bacterial growth. However, samples collected from a pronounced chlorophyll maximum (2 stations in the Strait of Gibraltar, 4 stations in the Aegean Sea), resulted in a 50% lower bacterial activity (as measured by thymidine and leucine incorporation) in the radiation - exposed treatments as compared to the dark controls. In contrast, mesopelagic water samples (200 – 350 m depth) exposed to surface solar radiation exhibited a 2 - 4-fold higher bacterial activity as compared to the corresponding dark controls. Addition of bovine serum albumin (BSA), used as a model protein, to mesopelagic water samples and subsequent exposure to solar radiation resulted in a 50% lower bacterial activity as compared to the dark treatments, indicating photochemically – induced changes to this labile compound.



Mean bacterial activity (as measured by [3H]thymidine incorporation) in irradiated and dark treatments expressed as enhancement factor (bacterial activity in irradiated DOM/ bacterial activity in the unamended dark control; EF) of the chlorophyll maximum (a) and the mesopelagic waters (b). Data from the Strait of Gibraltar and the Aegean Sea are pooled. BSA - bovine serum albumin; mean ± SE; significant differences between irradiated and dark treatments of unamended and BSA - amended waters, respectively, are indicated.

This decrease in bacterial activity in BSA – amended, irradiated water was also detectable in surface waters sampled off Curaçao, while BSA – amendment to surface water from the Mediterranean Sea did not result in a distinct pattern in bacterial activity.

Based on the pooled data from the 2 sampling areas in the Mediterranean Sea, it was evident that the response of the bacterioplankton community to DOM exposed to solar radiation was related to the initial bioavailability of the DOM. As an integrative measure of the bioavailability of the nutrient pool, we used the ratio between bacterial activity (thymidine and leucine incorporation) and the DOC concentration. A high ratio of bacterial activity to DOC concentration indicates rapid utilization of the DOC and is therefore considered to indicate more labile DOC. On the contrary, a low ratio indicates a more refractory nature of the DOC pool. Slow uptake of DOC might also indicate that other elements are limiting bacterial growth. With increasing ratios of bacterial activity to DOC concentration, the ratios of bacterial activity in the solar radi-

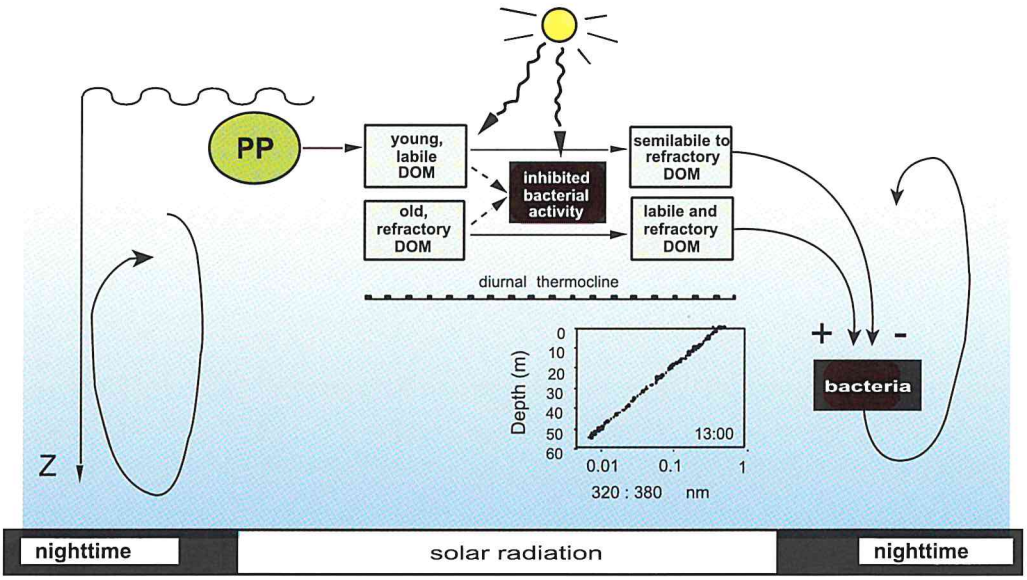


Relation between bacterial activity measured as [3H]thymidine (Tdr) and [3H]leucine (Leu) incorporation in the dark treatment normalized to DOC and the ratio of bacterial activity measured in the irradiated treatment to bacterial activity measured in the dark treatment (ratio irradiated : dark). A bacterial activity ratio irradiated : dark treatment of < 1 indicates lower bacterial activity in the treatment exposed to solar radiation as compared to the bacterial activity in the dark treatment.

ation - exposed treatment to dark treatment declined. Thus, with increasing initial bioavailability of the DOC, exposure of the DOC pool to solar radiation leads to decreasing post - exposure availability of the DOC pool. If the initial bioavailability of the DOC pool is low, exposure of the DOC pool to solar radiation leads to stimulated bacterial activity.

We suggest two irradiation-induced processes leading to contrasting effects on the bioavailability of DOM to bacterioplankton. A net positive (stimulating) effect on bacterioplankton activity seems to dominate in waters containing a higher fraction of labile compounds, such as in the chlorophyll maximum layers.

The ultimate question when evaluating the ecological role of UV radiation on bacterioplankton activity and DOM is how long are organisms and DOM in the uppermost layers of aquatic systems exposed to high radiation levels? There is evidence that diurnal stratification is a common phenomenon. In the subtropical North Atlantic, we used hydrogen peroxide (H_2O_2) as a tracer for vertical mixing. The advantage of using H_2O_2 as a tracer of vertical mixing in studies of the impact of UV is that H_2O_2 is mainly formed by UV acting on DOM. Throughout the subtropical North Atlantic, diurnal stratification has been detected. The diurnally stratified layers are mixed with the underlying water shortly before dusk due to surface cooling. It is therefore reasonable to assume that DOM and planktonic organisms are confined in the highly irradiated surface water layers during most of the day receiving a considerable dose of high-energy radiation. Bacterioplankton are then significantly retarded in their activity and photoproducts are formed from the parent DOM. Before dusk these waters are mixed into deeper layers where bacterioplankton use UV-A and the lower PAR range to repair damage and take up parts of the photoproducts formed in the surface layers during the period of intense solar radiation. Whether the bacterioplankton activity is significantly enhanced or reduced by the photochemical alteration of the DOM is dependent on the overall availability of the DOM. If the DOM consists mainly of phytoplankton-derived, young DOM then the photoproducts formed are likely to lead to a reduced bacterial activity while originally refractory DOM stimulates bacterioplankton, leading to enhanced bacterial activity in surface waters. Such areas of greatly enhanced bacterial activity due to photochemically altered DOM should be upwelling areas (coastal and offshore) where deep water is transported into the sunlit surface layers.



Scheme of the interaction between diurnal stratification and the action of solar radiation on the DOM pool and on bacterioplankton in the stratified surface layers. PP- primary production. The inset indicates the relation between depth and the irradiance-ratio of 320: 380 nm wavelength. The 320 nm wavelength stands for the damaging radiation range, the 380 nm for the radiation range used for the photoenzymatic repair by bacterioplankton. The rapid decline of the damaging radiation range with depth is obvious.

EXTERNAL PROJECTS OF THE DEPARTMENT OF BIOLOGICAL OCEANOGRAPHY

- Role of non-phytoplankton food for zooplankton in the North Sea. (ALW- NWO project)
  M.A. Baars
- Preparation and integration of analysis tool towards operational forecast of nutrients in estuaries of European rivers (PIONEER, MAST III project)
  P. Ruardij
- Mass transfer and ecosystem response (MATER, MAST III project)
  P. Ruardij
- Baltic Sea System Study (BASYS, MAST III project)
  P. Ruardij
- Mass transfer and ecosystem response (MATER, MAST III project)
  G.J. Herndl
- Canary Islands Azores Gibraltar Observations (CANIGO, MAST III project)
  G.J. Herndl
- The chemical composition and reactivity of bacterially derived dissolved organic carbon (DOC) and its contribution to the bulk oceanic DOC pool (ALW-NWO project)
  G.J. Herndl
- Ecological role and diversity of planktonic bacteriophages in the North Sea and the Wadden Sea. (ALW- NWO project)
  G.J. Herndl
- Bacterioplankton exopolymer production, exopolymer reactivity and contribution to the oceanic dissolved organic carbon pool (TMR-Environment and Climate)
  G.J. Herndl
- Role of ultraviolet radiation on the interaction between phytoplankton, dissolved organic matter and bacterioplankton (TMR-MAST III project)
  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, 5th FWP of the EU)
  G.J. Herndl

DEPARTMENT OF MARINE ECOLOGY

Both the structure and the functioning of marine ecosystems, in particular benthic communities, offer a wealth of interesting, important and urgent scientific problems. Numerous processes of a complex nature, involving biological, physical as well as (geo)chemical interactions, underlay the continued existence of these systems and are still poorly understood. Furthermore, climate change, eutrophication, pollution, fisheries and several other human activities significantly influence these systems. With the political urge for sustainable use of ecosystems, including protection of biodiversity, the concern about the effects of man-induced global change, and the increasing awareness that natural variation can be huge, there is a growing need for basic knowledge on the structure and functioning of marine ecosystems.

The department of Marine Ecology focuses its research on the short- and long-term development of marine ecosystems in shallow and deeper seas at the species, inter-species and community level. At all levels the research is a major part of NIOZ prioritised research area II: 'Marine system variability through time', at the community level the research contributes to priority area I: 'Processes determining the transport of energy and matter in coastal, continental slope and ocean systems'. It contributes to the NIOZ research areas C: 'Ecology of marine species, community dynamics and biodiversity' and D: 'Temporal variability in marine systems and climate change'.

We aim to contribute to answering questions like:

- **What is the interannual and decadal variability of the biomass and/or species composition of algae and macrofauna in coastal marine areas, and what are the causes of the variability observed (nutrient loadings, climate, fisheries, biological interactions, or others?).**
- **Is there evidence for climate induced changes in soft bottom communities and in high biodiversity communities such as tropical reefs, and how do these changes compare to other man-induced perturbations.**
- **How is the abundance and distribution of key species and communities controlled by magnitude and quality of food particle flux and how does this affect the recycling of fresh organic matter in sediment.**
- **In which life phases of macrobenthic organisms does density-dependent mortality occur and what are the population-dynamical consequences?**
- **Is there any evidence of local adaptation in terms of predator-avoidance mechanisms, such as deep burying in bivalves, and if so what is the effect on the competitive relationships and the structure of the benthic community.**

SPONGE-CORAL INTERACTIONS ON CARIBBEAN REEFS

Contributor: *Lisanne A.M. Aerts*

Coral reefs harbour a wide variety of sessile organisms, which live close to each other, competing for space, light and food. Human activities, such as expansion of coastal developments, increase in waste production, over-fishing and deforestation have put coral reef ecosystems under increasing pressure ('stress'). This results in a rapid decrease of species diversity and coral cover in many parts of the world.

To improve our understanding of dynamics and change in coral reef communities, the expected responses of coral reef organisms to increasing levels of anthropogenic disturbances need to be studied. Earlier studies on the effects of natural or anthropogenic disturbances mainly focused on species diversity and cover, without understanding the influence of stress on reef-structuring processes. This study was initiated to evaluate the influence of stress on one of the most important reef-structuring processes: competition.

Competition for space is an important factor limiting populations of sessile organisms. Two of the major sessile invertebrate groups on Caribbean reefs are scleractinian corals and sponges. Because coral growth is light-dependent, corals are very abundant in shallow water, whereas sponges become dominant at greater depths, exceeding 20-30 m. However, coral and sponge distributions show considerable overlap and as a consequence sponges and corals frequently come into contact with each other. Encounters between corals and sponges (spatial competition) often result in damage to the coral.

Two Caribbean reef systems with different environmental conditions were chosen for our study. Reefs of the Santa Marta area, NE Colombia, as an example of reefs adapted to stress (high sediment load, low visibility, large variations in pH, salinity and temperature). Reefs surrounding the Island of Curaçao were chosen as an example of reefs with relatively low stress.

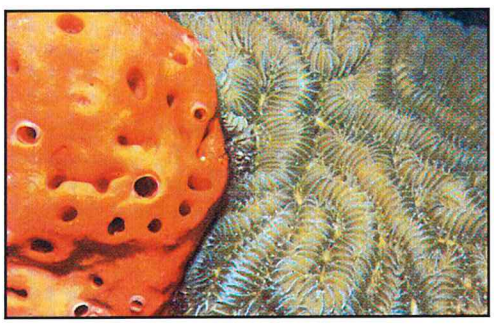
Anthropogenic stress, resulting in nutrient enrichment, may enhance benthic algal biomass and primary production in the water column. Increased primary production favours benthic fil-

ter-feeding organisms, which may outcompete corals. As far as nutrient and sediment increase are concerned, corals and sponges have opposite responses: sponge biomass increases and coral biomass decreases on reefs subject to high loads of sediments and organic pollution. It is logical to hypothesize that coral stress, induced by environmental conditions, is advantageous for sponges, which benefit on a community level by an increased ability to overgrow living coral. The 'stressed' reefs of Santa Marta were particularly suitable to test this hypothesis. In total 3866 sponge-coral encounters were studied involving 21 coral and 95 sponge species. Overgrowth of coral by sponges occurred in only 2.5% of these encounters. These field data indicate that our hypothesis could be rejected. This was corroborated by studies around Curaçao. On the relatively well-developed coral reefs of Curaçao, with less physical stress, coral overgrowth by sponges occurred more frequently. Under high coral cover observed here, the sponge community appeared to be dominated by 'aggressive' = competitively dominant species. Competition for space between corals and sponges appeared most important on well developed reefs.

In case of coral damage, damage repair may locally reduce competitive ability of the coral. Artificial colony damage indeed showed an increase in sponge overgrowth when compared with undamaged specimens as was shown for the sponge *Rhaphidophlus venosus* and the coral *Montastrea cavernosa*. Coral damage on reefs therefore could enhance coral deterioration through increasing susceptibility to sponge overgrowth.

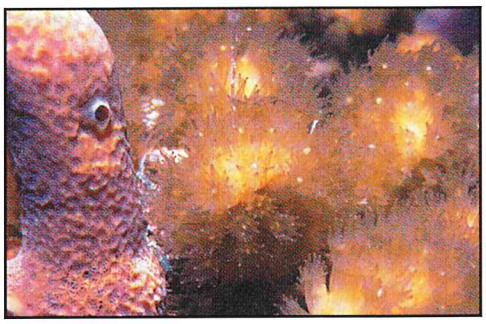
The sponge *Desmapsamma anchorata* appeared to be very 'aggressive' towards all reef organisms. Overgrowth success was not mediated by chemical substances, but by its fast growth rate, high regenerative efficiency and ability of fragments to reattach, coupled with efficient anti-predator and anti-fouling mechanisms. The sponge *Niphates erecta* appeared also a succesful competitor for space, moreover its toxicity proved lethal to the coral *Madracis mirabilis* in aquarium experiments. However, this extreme toxic effect stood in no relation to its overgrowth activity observed in the field. Experiments with fishes demonstrated high toxicity and low palatibility for *N. erecta*. Probably as a compensation for its low regenerative efficiency and growth rate, toxic substances are used to defend and maintain its position on the substratum. Toxic chemicals are used passively to maintain space not actively to compete for it. A rapid growth rate and high regenerative capacity are actively used in competition for space and the variation in competitive ability among sponges depends mainly on interspecific variations in these ecological characteristics.

The increased occurrence of overgrowth of coral reefs by sponges is not related to increased physical stress. The impact of competition for space between corals and sponges was more important on well developed reefs with a low level of physical disturbance.



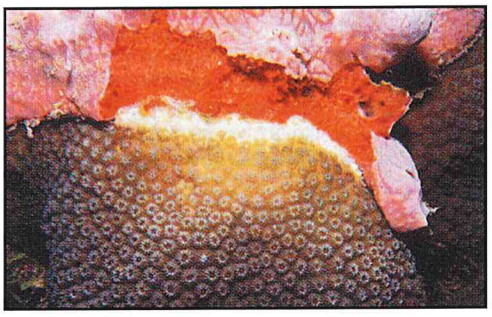
A

A=*Agelas clathrodes* and *Meandrina meandrites*



B

B=*Aplysina cauliformis* and *Madracis mirabilis*



C

C= *Desmapsamma anchorata* and *Monastrea annularis*

D

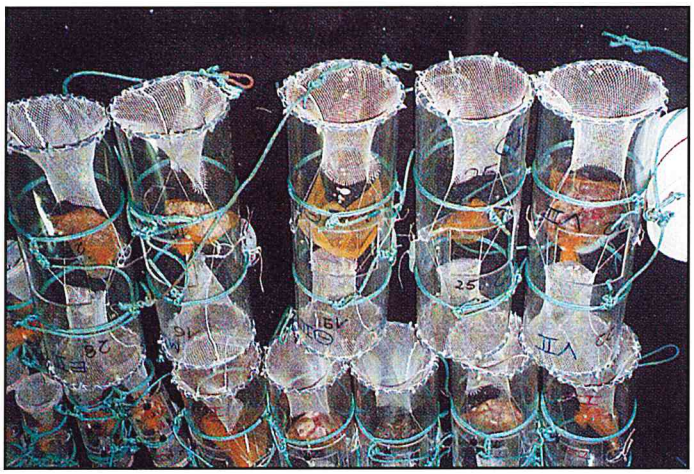
D=*Aplysina archeri* and *Siderastrea siderea*

SCAVENGING ON DAMAGED BOTTOM FAUNA AND DISCARD FISH PRODUCED BY BEAM TRAWL FISHERY

Contributor: *Stefan Groenewold*

Trawls were certainly used already in the thirteenth century for fishing in the North Sea and as early as the fourteenth century UK fisherman were concerned that fishing gear altered sea-floor habitats. Fisheries in the North Sea increased considerably with industrialization of the fleet in the beginning of the 20th century. The development of beam trawling for flatfish started after 1945 and increased in particular after 1960. Beam trawls are efficient gears to catch flatfish and are rigged with a set of tickler chains in front of the ground rope in order to start the flatfish from the seabed. Most beam trawlers are equipped with two 12-m wide beam trawls.

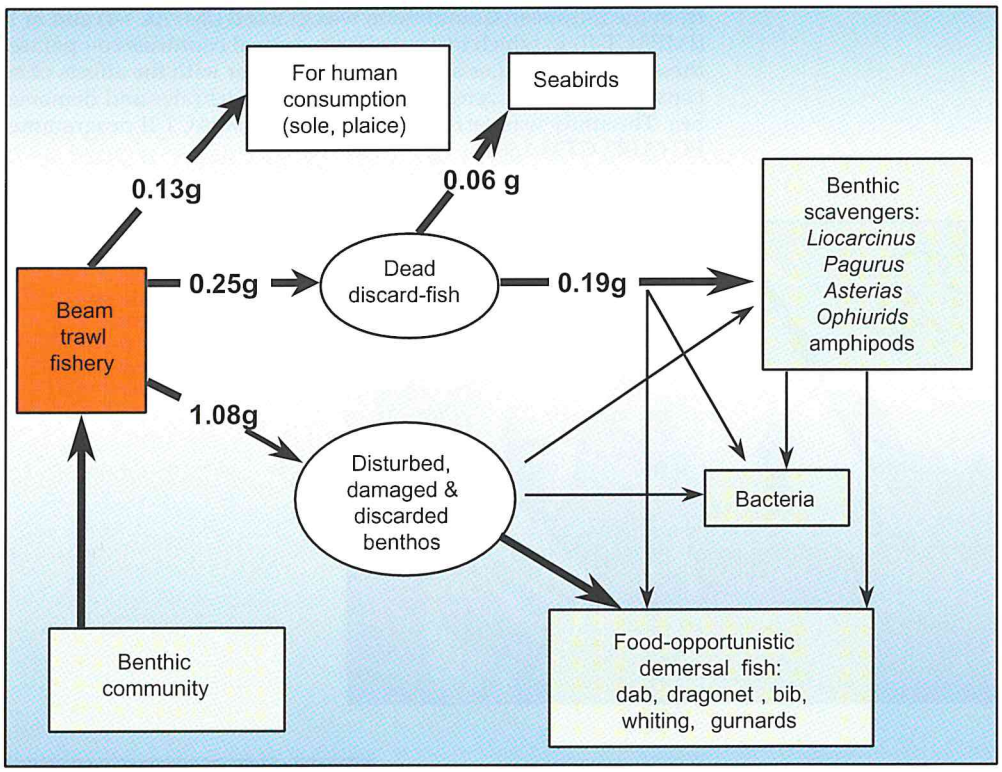
International concern about the increasing trawling effort was voiced for the first time at the 58th ICES meeting in Copenhagen in 1970. First reports appeared in this period also. In 1988 a study group of ICES was initiated to re-examine the ecological effects of bottom trawling. Their main conclusion was that the heavier gears now in use might have a greater effect on benthic communities and new observations were required. In the Netherlands this was taken up by the Netherlands Institute for Fishery Research (RIVO-DLO), the Netherlands Institute for Sea Research (NIOZ) and the North Sea Directorate of the Ministry of Transport and Public Works (RWS-DNZ) and gradually other institutes joined the research project (the Geological Survey of the Netherlands and the Netherlands Institute of Ecology (NIOO-CEMO). In 1991 a contract from the European Commission was granted (IMPACT-I) and in 1994 a renewal was agreed (IMPACT-II) in which institutes from several countries co-operated. This research was part of these IMPACT studies and dealt in particular with the effects of beam trawl fishery on food consumption of scavenging epibenthic invertebrates and demersal fish in the southern North Sea. The study was carried out during the IMPACT II programme 1994-1998, supported by the EC (AIR2-CT94-1664).



Baited traps used on the North Sea bottom.
(Photo's: S. Groenewold)

Stomach contents of fish immigrating into a newly trawled area were investigated and *in-situ* clearance rates of dead discard fish was measured in comparison to the rates of decay of dead fish at different temperatures. Catches of traps, baited with different kinds of discard materials and exposed on the bottom in the southern North Sea, were analysed in order to find out what kind of scavengers are feeding on what kind of discards. Dead discard fish were mainly consumed by scavenging invertebrates (swimming crabs, hermit crabs, shrimps and starfish) whereas damaged and exposed bottomfauna in the trawl-tracks were mainly consumed by fast-moving fish (dab, plaice, dragonet, whiting and other gadoid fish, gurnards). Dead crustaceans were particularly consumed by scavenging amphipods.

In the laboratory daily food consumption of some common invertebrate scavengers, such as swimming crab and hermit crab, was measured and their feeding behaviour recorded using video cameras. When dead fish were offered to starfish, hermit crabs and swimming crabs, male swimming crabs were the first to arrive, starfish moved more slowly (8 $m.hr^{-1}$ at 15°C), obviously following a trail of odour. Aggressive interactions were often observed between swimming crab males and also between swimming crabs and hermit crabs, who usually lost. Other potential scavengers showed little or no response to exposed fish carrion when they were kept together with swimming crabs, hermit crabs and starfish.



Production of discards and damaged bottomfauna expressed in gram ash-free dry weight m^{-2} after trawling once with 12-m beamtrawls. The values are averages for the four different areas in the southern North Sea where experimental trawling was carried out. Discard fish was mainly consumed by invertebrate scavengers, damaged benthic organisms were mainly consumed by demersal fish. Scavenging demersal fish have more advantages from discard and damaged material produced by beam trawling than the benthic invertebrates and birds.

THE DAZZLING INTERTIDAL BENTHIC BIODIVERSITY OF ROEBUCK BAY, TROPICAL NORTHWEST AUSTRALIA

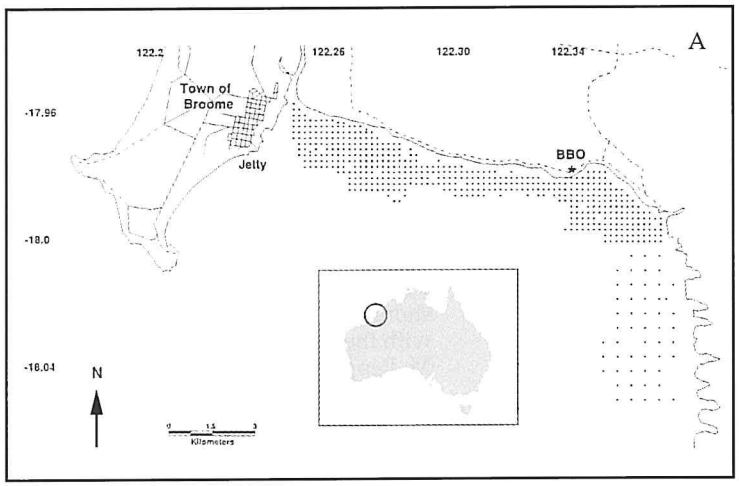
Contributors: *Theunis Piersma, Marc Lavaleye*

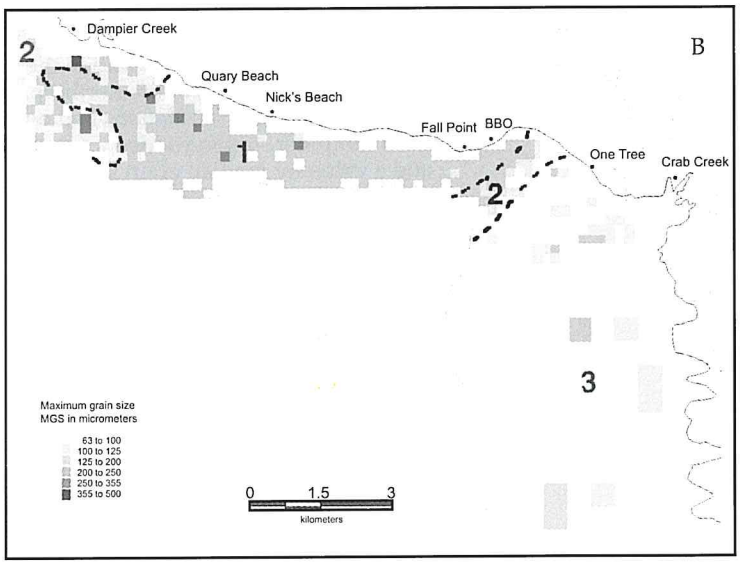
A major heuristic tool in biology is comparison. Comparing related species living in different habitats can inform us about the functional significance of the various traits of these species. Similarly, comparisons of geomorphologically similar habitats in different parts of the world and in different climate zones may yield insights into the forces structuring the respective communities. As part of the NWO sponsored PIONIER-project on 'Shorebird flyways and intertidal benthic communities' we have started a series of investigations on the macrozoobenthic and shorebird communities of tropical mudflat systems in northwest Australia, in collaboration with the western Australian Department of Conservation and Land Management (G. Pearson, M. Pepping). From our Wadden Sea perspective, and using the same methods and tools, we described the sedimentary characteristics and mapped the macrobenthic invertebrates in Roebuck Bay in June 1997. This was followed up by a mapping of the shorebirds as soon as they had returned from the northern hemisphere breeding grounds in October 1997. With its extensive tidal flats (c 180 km^2), Roebuck Bay near Broome (NW Australia) is one of the foremost internationally important sites for shorebirds in the Asia-Pacific shorebird flyway system. It is home to 150,000 shorebirds during the nonbreeding season. This progress report tells about the first general findings of our study.

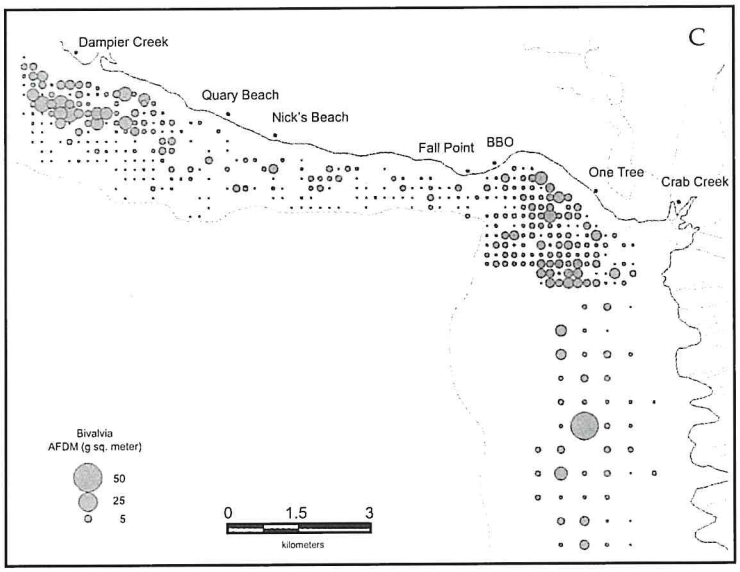
For a series of 12 successive days at almost every low tide 2-4 three-person teams walked parts of the study area. In addition there was a two-person Hovercraft team working the outlying sites. Covering the entire northern shore of Roebuck Bay, benthos and sediment cores were taken at more than 500 stations laid out in a gridlike fashion with intersections every 200 m. Each sampling station yielded a list of invertebrate species, along with their number and sizes, and a value for median grain size of the sediment. Most molluscs and many crustaceans were sorted to species (even though many of these species are presently unknown to science and need formal description). All worms (including the polychaetes, but also groups such as phoronids, nemertines and sipunculids) were sorted and counted to family level (polychaetes) or at least to the phylum level (e.g. phoronids and nemertines). A total of 161 taxa were identified from the quantitative samples; another 30 taxa were identified qualitatively. The actual number of species within the different habitats of Roebuck Bay will be much higher, because first of all, most of the animals were identified to higher taxonomic levels, and secondly, no samples were taken from rocky habitats and within the mangroves. About a quarter of the intertidal area was eventually quantitatively sampled. To the best of our knowledge, this is the first detailed mapping of benthic biodiversity on tropical intertidal mudflats.

The total density of macrobenthic animals retained on a 1-mm sieve was 1,287 ind. m^{-2}. The polychaete families Chaetopteridae and Oweniidae dominated the fauna in terms of abundance and biomass. The 20 most abundant taxa made up more than 90% of the total numbers. Many rare taxa occurring at less than 2% of the stations were found. The macrobenthic invertebrate fauna is very diverse, a feature quite typical for biota in the Indo-Pacific region. However, only 10% of the taxa could be confidently assigned a species name within the three months of volunteer specialist's work allotted to this aspect. This large proportion of still unidentified species implies that we have only scratched the surface of describing true biodiversity in Roebuck Bay.

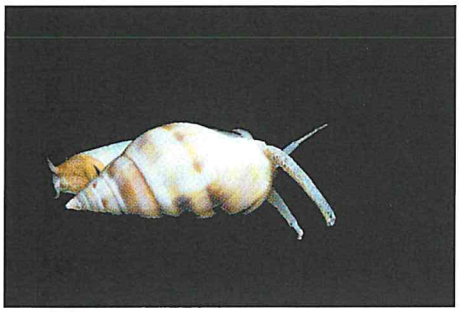
In spite of the wide spatial and temporal variation in emersion time of the Roebuck Bay intertidal flats, an effect that is enhanced by the enormous difference in tidal amplitude between spring (10 m) and neap (1.5 m) tides, vertical zonation patterns of faunal assemblages were not very obvious. Nevertheless, gastropods and bivalves were characteristic of the upper intertidal areas independent of grain size. The mid- and lower-intertidal areas were numerically dominated by polychaetes in the sandier regions, but bivalves prevailed in muddy substrates. For shorebird species following the tideline, such as the two knot species (Red Knot *Calidris canutus* and Great Knot *C. tenuirostris*) and the two godwit species (Bar-tailed Godwit *Limosa lapponica* and Black-tailed Godwit *L. limosa*), it was rather difficult to find associations between their occurrence and the densities of preferred prey. Presumably these prey behave in ways that make them more easily detectable near the sea-edge than elsewhere. Studies on the burying behaviour of three bivalve species demonstrated that behavioural features linked to seawater movements may indeed be important in determining their availability as shorebird-food. The concentration of species specialized in feeding on large crabs and mudskippers (Eastern Curlew *Numenius madagascariensis*, Whimbrel *Numenius phaeopus*, and to a lesser extent Greenshank *Tringa nebularia*) on the soft and muddy sediments in the northeast corner of Roebuck Bay coincided nicely with the distribution of their presumed prey.



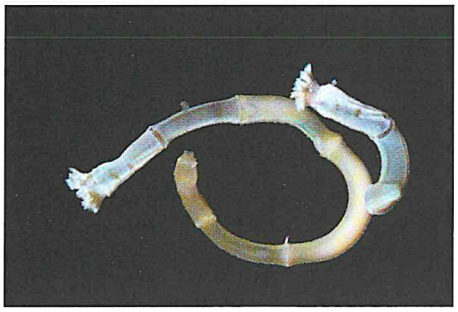




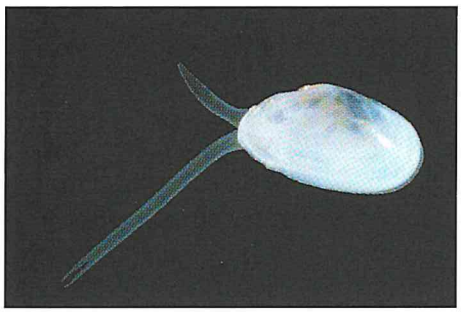
(A) Map of the the northern parts of Roebuck Bay showing the town of Broome and the intertidal stations that were visited in June 1997 (dots) covering about a quarter of the intertidal area. The inset shows the approximate location within Australia. (B) Sedimentary characteristics of the intertidal study area as shown by the distribution of median grain size values. Based on this characteristic, three distinct sedimentary types could be characterized. (C) Distribution of biomass densities of bivalves over the intertidal flats in relation to zone of emersion during neap tides.



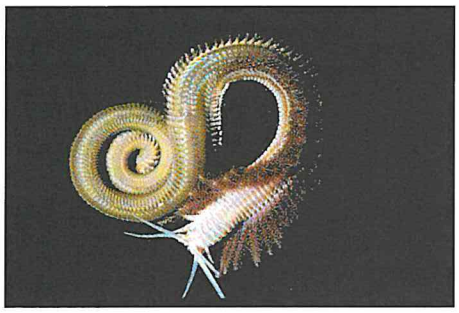
The most common scavenging gastropod, *Nassacius dorsatus*



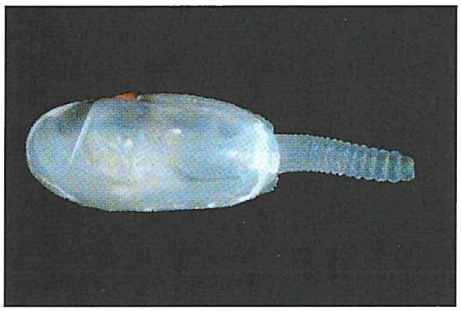
Oweniidae: Oweniids, with chaetopterid tubeworms, numerically dominated the fauna in Roebuck Bay.



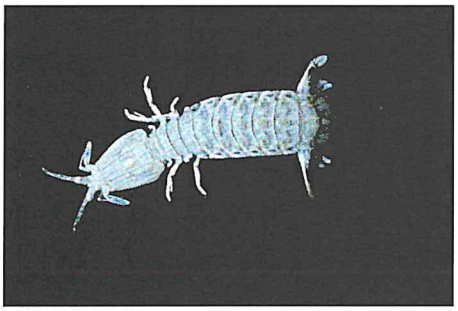
Tellina amboyensis: One species of the very diverse familie Tellinidae



Onuphidae: The largest of the tube-building worms found

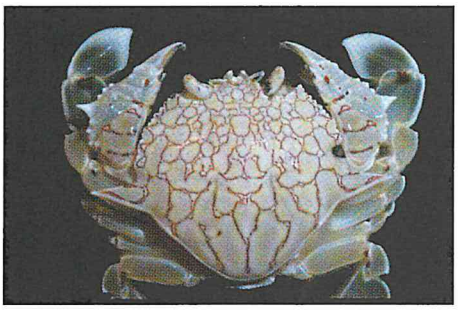


Siliqua cf. *winteriana*: One of the most abundant bivlaves in Roebuck Bay



A deep burowing mantis shrimp of the family Squillidae

Lingula spec., a brachiopod adapted to muddy substrates



Matuta spec., a burrowing sand crab

Photographic 'samples' of the dazzling macrozoobenthic biodiversity of Roebuck Bay (all photo's by Marc Lavaleye). Polychaetes were most abundant with 70% of the individuals, followed by bivalves (12.5%), crustaceans (8%), brittle stars (4.2%), and gastropods (2.5%). All the remaining taxa amounted to only 2%. In terms of biomass (overal average estimated at 12.5 g ash-free dry mass.m^{-2}), polychaetes contributed a lower proportion (45.4%) than in numerical terms. The few large sipunculids made up 23%, followed by bivalves (16.3%), crustaceans (10.5%), and gastropods (3%). Brittle stars, though high in number, made up only 0.4 % of the biomass.

EXTERNAL PROJECTS OF THE DEPARTMENT OF MARINE ECOLOGY

- Evolutionary arms race in intertidal mudflats (NWO-PIONIER)
  T. Piersma
- Differentation in Caribbian reef-building coral populations (NWO)
  R.P.M. Bak
- Population dynamics of groupers (Serannidae) at Banten Bay; Coral community dynamics of an Indonesian coral reef under stress; and Population dynamics of some selected bird species, their food requirements and the changing environment - Teluk Banten II (NWO)
  H.J. Lindeboom, R.P.M. Bak, E.H. Meesters, Yus Rusila Noor, Siti Nuraini
- Dynamics through natural and anthropogenic causes of marine organisms: effects of large scale ecological changes on fish and fisheries (EU)
  H.J. Lindeboom, C.J.M. Philippart, C. Winter, J.W. De Leeuw, J.J. Beukema, J. Van Der Meer
- Damage of coral reefs by recreational activities: Strategies and the development of novel markers for environmental stress (EU)
  R.P.M. Bak, G. Nieuwland
- Autonomous lander instrument packages for oceanographic research (EU)
  G.C.A. Duineveld, P.A.W.J. De Wilde, E. Berghuis, R. Witbaard
- Ocean margin exchange II - Phase II (EU)
  G.C.A. Duineveld, E. Berghuis, A. Kok, J. Van Der Weele, M. Lavaleye, P.A.W.J. De Wilde
- Onderzoek effects of subsidense on macrobenthos (NAM)
  J.J. Beukema
- Biological monitoring programme North Sea and Outer Delta (RWS)
  R. Daan, S. Holtman, M. Mulder
- Bilogical monitoring programme macrozoöbenthos, Wadden Sea, Balgzand en Ems-Dollard (RWS)
  R. Dekker
- Sampling and analyses of larger benthic organisms near dredge dump sites in the North Sea 1999. (RIKZ) *M.J.N. Bergman, R. Daan*
- Multivariate analysis of marine biological spatio-temporal data
  H.J. Lindeboom, A.F. Zuur
- Effects of climate change on reproduction of intertidal bivalves (NOP II)
  J.J. Beukema
- Evaluation RWS monitoringsprogrammes (RWS-RIKZ)
  J. Van Der Meer
- Limiting the ecological effects of beamtrawl gears; REDUCE (EU)
  M.J.N. Bergman, M. Fonds
- Parameters for Ecosystem Quality in the North Sea (GONZ-II)
  H.J. Lindeboom, C.J.M. Philippart, M. Lavaleye
- The tree of the sea: climate reconstructions on basis of the bivalve Arctica islandica (CLIVARNET)
  H.J. Lindeboom, R. Witbaard
- Decadal variability in marine ecosystems: climate history in corals.
  H.J. Lindeboom, C.J.M. Philippart, R.P.M. Bak, C. Meyer
- Sustainable use and management of marine ecosystems.
  C.J.M. Philippart, O. Bos, H.J. Lindeboom
- Birds and macrofauna, A prewstudy for E.I.A.-O4, (Oranjewoud).
  C.J. Camphuijsen, M. Lavaleye
- Ecosystem targets in the North Sea: File data (LNV).
  H.J. Lindeboom, M. Lavaleye, H. v.d. Veer
- Standarts for nature development North Sea, GONZ (RWS).
  H.J. Lindeboom, S. Holtman, M. Lavaleye
- Benthos Western Wadden Sea (Waddenvereniging).
  T.L. Piersma, C. Raaymakers
- Fisheries impact on seabirds. (EU).
  J. v.d. Meer, C.J. Camphuijsen
- Mediterranean Target Project II: Masstransfer and benthic response.
  S. Duineveld, E. Berghuis, J. v.d. Weele

THE NETHERLANDS MARINE RESEARCH FACILITIES (MRF)

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, and Moored instrumentation systems. In these advisory committees scientists and technicians from all Dutch scientific groups involved in sea-going research participate.

In 1999 an international peer-review panel reviewed the NIOZ-MRF organisation and its performance. The outcome was positive, stating that on the working level the performance of MRF has been very good over the past period, and MRF was complimented for the dedication of its personnel, even though they faced a number of budgetary and organisation problems. The outcome envisages a restructured organisation aiming at the greatest possible objectivity when advising ALW on the National Programma, ultimate cost-efficiency in operations, direct funding via NWO/CP according to the new organisational structure of NWO, and clear financial lines of authority and responsibilities. Discussions with NWO on this issue are still in progress.

This year the National Programme for sea research consisted of:

1. Carbon Uptake (LABEL), uptake and mixing of algal carbon by benthic organisms in contrasting marine environments. Project manager Prof.Dr. C.H.R. Heip (NIOO-CEMO); chief scientist Dr. L. Moodley (NIOO-CEMO). The work at sea was done during three different cruises, two with RV PELAGIA in the Southern North Sea and on the Iberian Margin respectively, the latter in combination with the OMEX-2 cruise, and one as part of the combined programme MEDINETH (see under 5).
2. Processes on the Continental Slope (PROCS), a programme which aims at improving the knowledge on the mechanisms for spatially varying mixing near continental slopes. Programme manager Dr. Ir. H. Ridderinkhof (NIOZ). Fieldwork at a transect on the continental slope at the border between the northern North Sea and the Faeroe-Shetland channel. Two cruises with RV PELAGIA, one cruise in spring; cruise leader Dr. J.J.M. van Haren (NIOZ); the second cruise took place in early autumn; cruise leader Dr.Ir. H. Ridderinkhof (NIOZ).
3. Decadal climatic changes in the Holecene as revealed by biomarker record in finely laminated marine sediments (HOLOCENE). Project manager Dr.Ir. J.S. Sinninghe Damsté (NIOZ) and cruise leader Drs. H.J. Smittenberg. Field work on board RV PELAGIA took place in the Drammensfjord end of October/beginning of November.
4. TEST cruise: J. Schilling (NIOZ-MRF) was leader of the bottom sampling test operations performed in combination with the HOLOCENE fieldwork. Tests were performed with a new mooring winch, different over-the-side instrumentation (Multinet, CTD), coring techniques (boxcorer, pistoncorer, gravity-corer, vibrocorer) and the ALBEX lander.

Testing the vibrocorer
Drammensfjord 1 November 1999.
(photo: Jack Schilling)

5. MEDINETH : a combination of four different programmes/projects. MEDINAUT, SMILE, the Mediterranean part of LABEL (SMILE and LABEL integrated as SMILABLE), and mooring deployment for PASS-2. MEDINETH was executed during a 53 day cruise from end of July til mid September on the R/V Professor Logachev chartered from the Russian Polar Marine Geosurvey Expedition (PMGE) in St. Petersburg. There were two legs, MEDINETH-1: Valencia (Spain) - Antalya (Turkey); cruise leader Dr. J.M. Woodside for the MEDINAUT programme, and MEDINETH-2: Antalya (Turkey) – Catania (Italy); cruise leader Dr. G.J. de Lange for SMILABLE and PASS-2.

Loading RV Professor Logachev, Den Helder harbour 10 June 1999 (photo: Bert Aggenbach)

MEDINAUT: Multi-disciplinary Study of Mud Volcanism in the Eastern Mediterranean; programme manager and chief scientist Dr. J.M. Woodside (VU-IvA). The programme aims at studying processes and products of mud volcanoes and fluid vents in different settings in the eastern Mediterranean Sea.

SMILE: Sedimentary manganese and iron cycles: their role in organic carbon oxidation and recycling of nutrients and trace elements; programme manager Dr. J.B.M. Middelburg (NIOO-CEMO), chief scientist and cruise leader Dr. G.J. de Lange (UU- IvA). SMILE studies the processes involved in the cycling of iron and manganese in sediments.

LABEL (see under 1), for its oligotrophic studies in the Mediterranean.

PASS-2: Palaeoceanographic, Palaeoclimatic, Palaeo-environmental and diagenetic Aspects of Sapropel formation in the eastern Mediterranean on the most recent S1; project manager and chief scientist Dr. G.J. de Lange (UU-IvA).

Advice to GB-ALW for the National Programme 2000:

For the execution of the 2000 programme for the CLIVARNET programme MARE (programme manager Prof.dr. W.P.M. de Ruijter, UU-IMAU), PASS-2 (project manager Dr. G.J. de Lange, UU-IvA), MRF advised the use of RV PELAGIA in an ambitious and cost-effective cruise programme "Pelagia Around Africa 2000". This major cruise where R/V PELAGIA makes a circumvoyage around Africa in the first half of 2000 could be achieved by combining MARE and PASS-2 with several other projects during transit and in underway areas in the North and South Atlantic, the Indian Ocean, the Red Sea and the Eastern Mediterranean.

For the second MARE cruise in summer 2000 another research ship to be chartered.

For the project PLUME & BLOOM (project manager Dr. M. Baars, NIOZ) the use of RV PELAGIA was advised for two cruises in the Southern North Sea.

M.J. Rietveld, member and acting secretary ISOM, took part in the 13th meeting of the International research Ship Operators Meeting (ISOM), at the Japan Marine Science and Technology Center (JAMSTEC) in Mutsu City and Yokosuka, Japan

Project		ship days	scientists	students	MRF	others
1	LABEL NSea/NAtl	9	7	2	2	
2	PROCS					
	- PROCS-1	25	10	1	4	
	- PROCS-2	26	8	1	6	
3	HOLOCENE	8	2	2	7	
4	TEST	4				
5	MEDINETH					
	- leg 1	25	11	5	6	1
	- leg 2	28	17	1	6	
Total		125	55	12	31	1

LAND-OCEAN INTERACTIONS IN THE COASTAL ZONE (LOIZC)

Contributors: *C. Crossland, H.H. Kremer, H.J. Lindeboom*

The IGBP core project - Land-Ocean Interactions in the Coastal Zone (LOICZ) - in the second year of its second funding period continued to study this relatively small but highly productive, dynamic and sensitive three dimensional boundary between land and open ocean at various scales. While the major questions to be answered for global synthesis remain the same, spatial focus has been continuously extended to the coastal zone in the wider sense of the water continuum in order to better take the human dimensions of changes into account. Location of the LOICZ International Project Office (IPO) at the NIOZ and the continued support by the Netherlands government have strengthened the links into the Dutch science community.

Major questions that LOICZ addresses on a global scale

- Is the coastal zone a sink or source of CO2?
- What are the mass balances of carbon, nitrogen and phosphorus in the coastal zone?
- How are humans altering these mass balances, and what are the consequences?
- How do changes in land use, climate and sea level alter the fluxes and retention of water and particulate matter in the coastal zone, and affect coastal morphodynamics?
- What is the role of the coastal zone in trace gas (e.g., DMS, NO_X) emissions?
- How can knowledge of the processes and impacts of biogeochemical and socio-economic changes be applied to improve integrated management of the coastal environment?

A major thrust for LOICZ research remained to capture most comprehensive sets of horizontal biogeochemical flux models on a global scale. However, increasing effort is directed towards scaling of flux processes using and integrating the results of environmental and socio-economic science. LOICZ successfully broadened contributions from national programs of research and individual scientists, and focussed on its collaboration with multidisciplinary science to improve the understanding of the human dimensions of global environmental change. Regional projects in Morocco, Singapore and the South American region were added and the EU-ELOISE programme became an official core project of LOICZ. This provided a closer involvement with the European science community. Directed research was initiated to answer specific questions along with focussed regional workshops of experts.

LOICZ has moved towards greater delivery of integrated science products and scientific information and key parameters for monitoring and management purposes. The target remains to provide a first global synthesis by end of the year 2002.

Activities

LOICZ continued to set priority on workshops and research that develops regional biogeochemical budgets, coastal typology methodologies, interaction of people and river process and discharges. The biogeochemical flux budgets work received major impetus from funding support by UNEP-GEF. Regional workshops and research in Central America, South America, Asia and the South China Sea region saw the development of tools and information for coastal modeling and scaling, especially through new approaches in coastal typology. Regular training and capacity building elements were aimed at spreading the scientific know-how and establishing a network of regional mentors.

In the field of catchment/coastal sea interaction and associated human dimensions of global change, stronger links and collaborative activities have been established with other IGBP projects and the European Commission. Expert workshops in Norway, Argentina and the Netherlands (IVM) addressed LOICZ coastal zone questions and science-user relationships. Further collaboration with IGBP projects has provided joint synthesis on nutrient transfer processes across the continental margins (JGOFS, CMTT) and joint work with BAHC on typology approaches and databases. Links have also been strengthened with PAGES on sea level questions and the GLOBEC project in the area of flux change processes interacting with biological system productivity. Collaborative actions have been enhanced especially with IOC (including GOOS and ICAM programs) and START, and co-operation and support in particular for the 4th LOICZ Open Science Meeting have been established with IAI and APN. In both areas – interacting with IOC as well as in the regional topical workshops - LOICZ has extended its operational liaison with the Netherlands Coastal Zone Management Centre (RIKZ).

A major activity was the 4th LOICZ Open Science Meeting held in Bahia Blanca, Argentina. More than 170 key people attended from all global regions and contributed more than 120 topical presentations and posters addressing the different LOICZ issues. The Meeting not only provided a status review of the LOICZ programme and recommendations on directions for further research, but also outlined the directions for the LOICZ synthesis process, built relationships with potential users of the LOICZ products, and enhanced mechanisms for the transfer of sci-

ence to policy and other decision-making. As a hot issue, the human dimension of coastal change regimes provided a vital strand in the discussions, working groups and the three preceding workshops. Understanding processes and derivation of models and budgets for materials (especially C, N, P and sediments) across the whole coastal water continuum, including the catchments, estuaries and coastal seas, was a second vital strand. The scaling of findings and modelling from local-to-global continues to be a crucial issue, as is the fluxes of groundwater into the coastal seas. The final synthesis of the integrated South East Asian core project of SARCS/WOTRO/LOICZ (SWOL) was achieved and new activities established encompassing small island and adjacent states (Caribbean and Oceania).

Two examples of our science activities in 1999 are given below, including: global calcification processes and their influence on the health of coral reefs and a German study modelling flux and retention processes in material transport through river catchments.

Funding:

In addition to core funding support for the IPO from the Netherlands government, LOICZ has gained significant project funding from WOTRO and UNEP-GEF. Further support was recieved from the European Union, the Inter-American Institute, the Asia Pacific Network, NSF, IOC, START and from the Dutch Academy of Sciences (KNAW). The strong agency support for the LOICZ Open Science Meeting ensured that more than 110 scientists were able to attend and to contribute to the meeting. Vital in-kind support has continuously been provided, especially through NIOZ and RIKZ, and by many national government agencies.

CORAL REEFS AND INCREASING CO_2

Contributors: *J.A. Kleypas (National Centre of Atmospheric Research, USA), R.W. Buddemeier (Kansas Geological Survey, USA), D. Archer (University of Chicago, USA), J-P. Gattuso (CNRS, France), C. Langdon (Lamont-Doherty Earth Observatory, USA) and B. Opdyke (ANU, Australia)*

Coral reefs are the result of net accumulation of calcium carbonate by constituent corals and calcifying organisms. As calcification declines, so does the reef-building capacity. The rate of coral calcification depends on the saturation state of the carbonate mineral aragonite of surface waters.

Recent work by the LOICZ calcification group showed that by the middle of next century and with the current trends in increased concentration of carbon dioxide, the aragonite concentration state in the tropics will decrease by 30% and the biogenic aragonite precipitation by between 14% and 30%. Over the last 100 years (since pre-industrial time) aragonite and calcite deposition was estimated to have decreased by 6-11% and, under doubled CO_2 concentrations (expected by 2065) would be expected to fall by a further 8-17%.

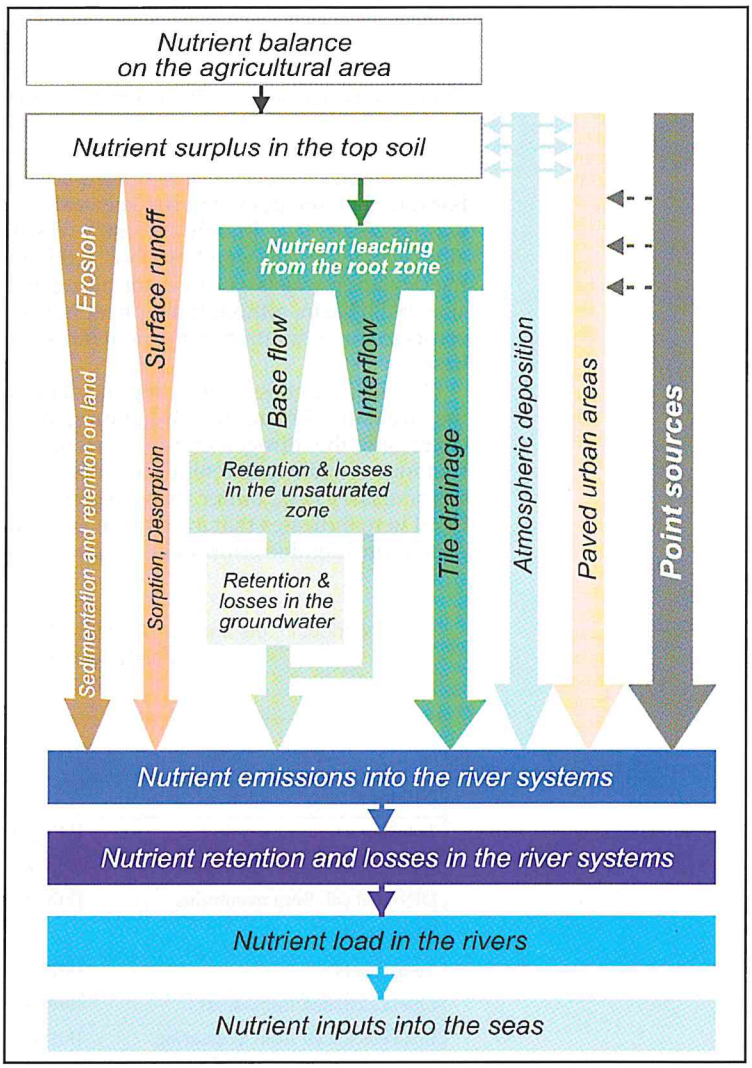
These trends and estimates for CO_2 effects have enormous ramifications for the well-being of coral reefs. Reefs in the Red Sea, west central Pacific and Caribbean were projected to be at most risk of changed calcification rates as they are in high saturation conditions. Under greatest risk are those reefs which are functioning with a balanced calcium carbonate budget (i.e., where $CaCO_3$ production equals destruction). These include high latitude reefs, (e.g., Bermuda), reefs in upwelling regions (e.g., Galapagos) and many experiencing anthropogenic pressures. The biogeochemistry of shallow marine carbonate secretors and other calcifying marine ecosystems are being evaluated for consequences of these global environmental changes.

ESTIMATING NUTRIENT INPUTS INTO MEDIUM AND LARGE RIVER BASINS

Contributor: *Horst Behrendt (Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany)*

As most of the material fluxes to the coastal zone LOICZ is aiming to describe are caused by medium and large rivers, there is a need for tools to estimate the nutrient load from such river basins into the coastal zones, evaluation of how they depend on the human use of nutrients on the land, and on measurement of inputs reaching the river system through different point and diffuse pathways.

The model MONERIS (Modelling Nutrient Emissions in River Systems) was developed and applied in a case study for German rivers to estimate the nutrient inputs into river basins from point sources and various diffuse pathways (Figure 1). The model is based on data for river flow and water quality as well as a geographical information system (GIS), which includes digital maps and extensive statistical information.



Pathways and processes within MONERIS.

The use of a GIS enabled a regionally differentiated quantification of nutrient emissions into river systems. Thus, estimations not only comprised large river basins but allowed application of the MONERIS model to 300 different river basins for the two time periods: 1983-1987 and 1993-1997. The temporal changes in nutrient emissions were calculated from the difference in hydrological conditions between each time period as well as those changes caused by human factors, and assuming stable hydrological conditions. The results of the calculations of the nutrient emissions for the basins of the most down-stream German monitoring station for the largest German rivers - Rhine (159,700 km² upstream of the monitoring station, Lobith), Elbe (134,900 km² upstream of the monitoring station, Zollenspeaker) - are presented in Figures 2 and 3.

A 46% reduction of nitrogen discharges from point sources was the main cause for the decrease of the nitrogen emissions into the river systems. By comparison, the estimated decrease of diffuse emission pathways was only about 10%. Despite the substantial decrease in the nitrogen surplus in agricultural areas, only for the Rhine basin is this reflected in reduced estimate of nitrogen emissions to the groundwater path. In other river basins, it is expected that N emissions along this pathway will continue to increase during the 1990's due to long residence times of water in the unsaturated zone and in the aquifer. However, after the year 2000 the reduced nitrogen surplus will most likely be manifested in a slow reduction of the nitrogen inputs through groundwater and the total nitrogen emissions.

In general, decreasing phosphorus emissions are again mainly caused by reduction of point sources (up to 80%). Comparing the two nutrients, the decrease of diffuse P-inputs was larger than for N due to a 56% reduction of emissions from urban areas. However, among the basins of the large rivers and seas, the changes of nutrient emissions as well as the contribution of the individual pathways to the total emissions vary over a wide range.

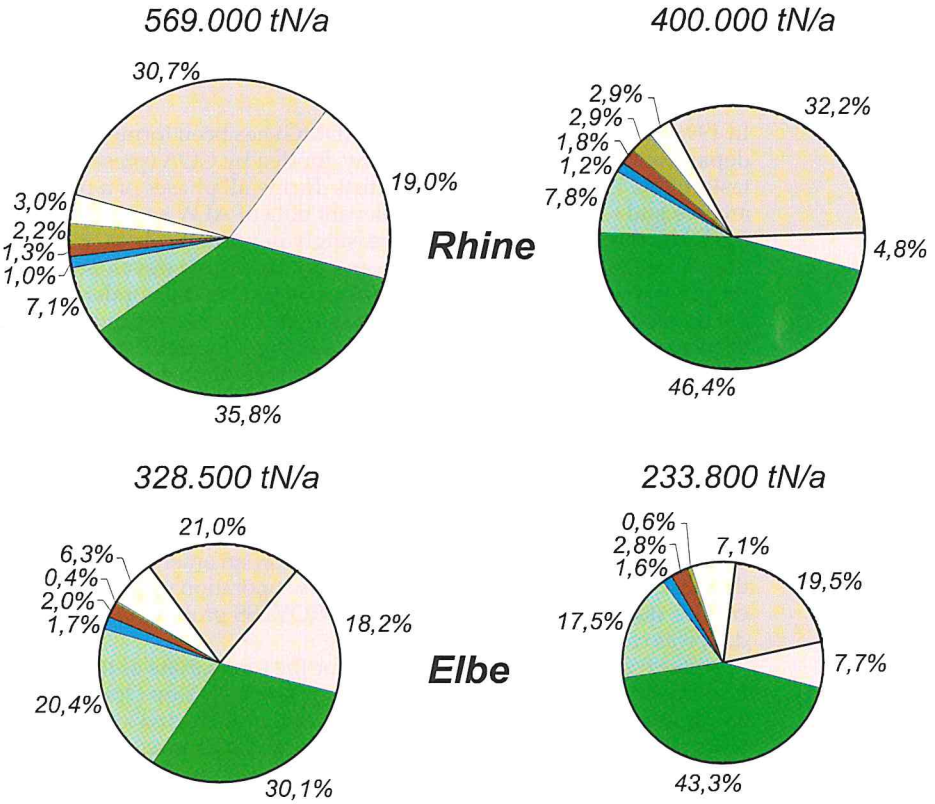
From a process perspective (see table), the observed N and P loads into the Rhine and Elbe are significantly lower. The reason is retention and loss processes (for nitrogen mainly denitrification; for phosphorus mainly sedimentation and adsorption) within the surface waters of the river basins. The level of the nutrient retention within the river system of the Elbe is much higher than in the Rhine and is attributed to their different hydrological and morphological basin conditions. Nutrient loads (calculated from measured flow and nutrient concentrations) show similar changes as the nutrient emissions for the time period.
For nitrogen, the deviation between calculated and observed loads for 148 of 168 river basins was less than 30%. In only 13 basins was the deviation larger than 40%; these basins are generally smaller and showed low observed loads of dissolved inorganic nitrogen. For phosphorus, the deviation was larger than for nitrogen, but the deviation tended to increase with decreasing size of the basin, although the phosphorus load remained similar. This may reflect the larger errors in the estimation of nutrient emissions as well as in the observed loads for smaller basins.

Considering ecosystem and policy implications, calculation of different scenarios shows that the target of a 50% reduction in nitrogen load into the coastal seas can not be reached by decreasing the nitrogen emissions from point and diffuse sources alone. Additional measures that increase nitrogen retention and losses close to or within the surface waters of river systems are necessary (e.g., buffer strips, reconstruction of wetlands, small reservoirs). The work outlined here indicates that a comprehensive modelling of residual fluxes through coastal seas needs considerable effort to be placed on upstream processes.

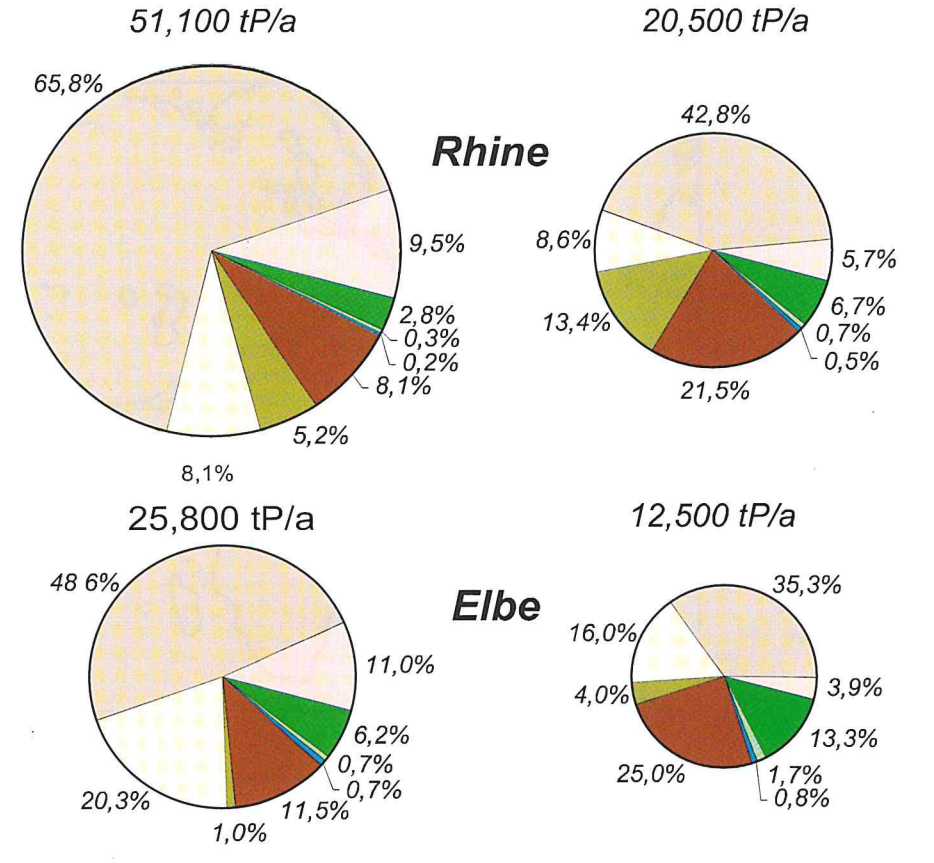
Nutrient inputs and calculated loads of total phosphorus and dissolved inorganic nitrogen ($DIN=NO_3+NH_4+NO_2$) for the Rhine and the Elbe

		Rhine		Elbe	
		1983-1987	1993-1997	1983-1987	1993-1997
Nitrogen					
Total inputs	[ktN/yr]	569.0	400.0	328.5	233.8
DIN-load calculated from inputs	[ktN/yr]	382.6	259.9	159.3	107.6
DIN-load cal. from monitoring	[ktN/yr]	355.2	292.5*	145.1	111.7
Phosphorus					
Total inputs	[ktP/yr]	51.1	20.5	25.8	12.5
Load calculated from inputs	[ktP/yr]	36.5	14.1	10.2	4.7
Load calculated from monitoring	[ktP/yr]	35.3	14.5*	11.7	4.6

* average load for the years 1993-1995 only



Nitrogen emissions from the different pathways into two German river basins in the time periods 1983-1987 (left) and 1993-1997 (right).



Phosphorus emissions from the different pathways into German river basins in the time periods 1983-1987 (left) and 1993-1997 (right).

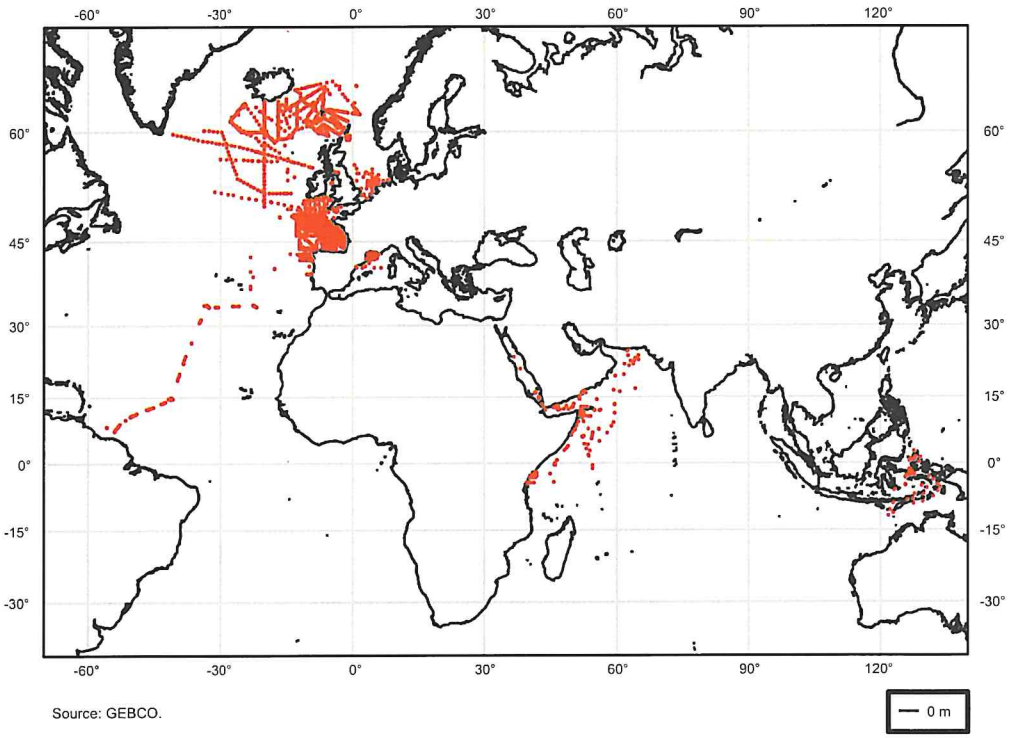
DATA MANAGEMENT GROUP

Contributors: *T.F. de Bruin, H. Ridderinkhof*

In 1996 the Data Management Group (DMG) has been formed as a separate group within the department of Physical Oceanography, funded by GOA (presently ALW) and NIOZ. The main tasks of the DMG are to assist scientists during all phases of a project with datahandling and to archive and to keep available all relevant data of ALW and NIOZ cruises. In the philosophy of the DMG the Internet plays an increasingly important role in the exchange of data and information. Therefore much emphasis was put on the further development of the DMG website (http://www.nioz.nl/en/facilities/dmg/meta/) and its underlying databases.These databases are dynamically linked to these webpages. In 1999 the information from 12 new cruises has been added to the databases. The CTD database, for instance, now contains more than 3500 CTD profiles, starting in 1983 and covering several oceans. The DMG website is visited 6 times a day on average and the database with the actual data is consulted every two days. Also the data and meta-information of several major research projects were presented in the form of a series of dedicated websites. Through these websites users have access to the information of the Mixing Agulhas Rings Experiment (MARE) and the Frisian Front Project (FFP) . The MERLIM website was completely revised.

All relevant digital data, collected during the Pelagia cruises, have been archived on CD-ROM and are stored in a safe, for use in case of an emergency. Dedicated software for archiving these CD-ROMs was developed and is now operational. Staff of the DMG participated in four cruises, notably in the PROCS and the PROVESS projects. Part of the postprocessing of the CTD data was carried out by the DMG.

Apart from these projects, websites for the secretariats of the National Oceanographic Data Committee (NODC) and the International Research Ship Operators' Meeting (ISOM) were administered by the DMG. One member of the staff acted as secretary for the NODC. The subtasks of the DMG include the development and maintenance of an Antarctica data inventory for the Antarctic research projects in the Netherlands. One member of the staff represented the Netherlands in the annual meeting of the Joint Committee on Antarctic Data Management.



Areal coverage of the more than 3500 CTD profiles in the CTD database from the period 1983-present.

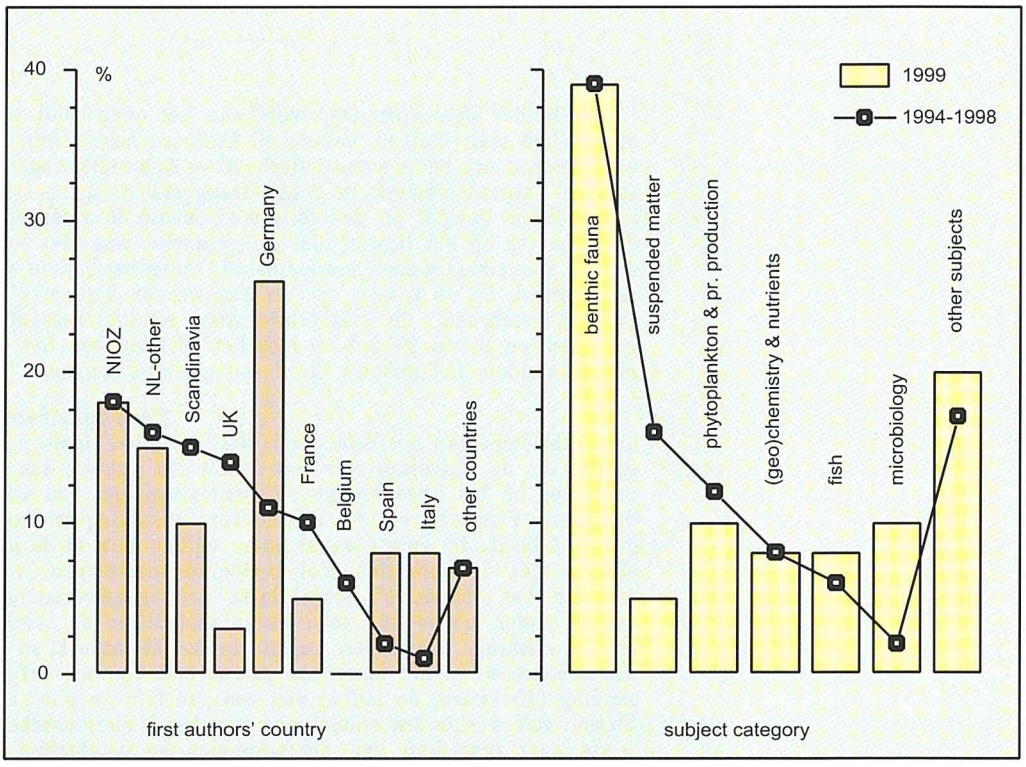
THE EDITORIAL OFFICE

Starting from 1997, the Journal of Sea Research (JSR) is published by Elsevier Science in collaboration with the Netherlands Institute for Sea Research. The content of JSR is the exclusive responsibility of the Institute. Five staff members are engaged in the editorial work, viz. J.J. Beukema, G.C. Cadée, C.J.M. Philippart and W. van Raaphorst as editors and B. Bak-Gade as assistant-editor. In addition, a 25-member Editorial Board assist in such tasks as evaluation of submitted manuscripts. Several new members joined the Board in 1999. The renewal of the Board reinforced its international character.

During the last few years, eight issues appeared annually. In 1999, six regular issues were published and one double special issue entitled 'Fine particles in the sea; pathways, processes, puzzles. A tribute to Doeke Eisma'. It appeared on the occasion of the recent retirement of Dr D. Eisma and was edited by Johan van Bennekom and Tjeerd van Weering.

The scope of JSR has recently been accentuated. Papers can be accepted from a wide field of marine research (including marine biology, marine geology, marine chemistry, and physical oceanography), but should contribute to the understanding of the functioning of marine systems. Manuscripts that are merely descriptive will not be considered for publication.

JSR flourishes. Papers can now be published within four or five months of acceptance. The reviewing procedure has also been speeded up. The most recent (1998) Journal Impact Factor amounted to over 1.5, resulting in a 6th place in the Oceanography category and a 14th place in the list of periodical on Marine and Freshwater Biology (Journal Citation Reports for 1998, Science edition).



In 1999, 39 papers were published in six regular issues of the JSR and an additional 12 in the double special issue dedicated to Doeke Eisma. The figure shows the home countries of the first authors (left-hand panel) and the subject categories (right-hand panel) of the 39 regular papers. For comparison, similar data for the period 1994-1998 are added (90 regular papers). Although, given the small total numbers, some caution should be taken in interpreting the data, the figure underlines the international albeit European character of the JSR as well as its broad ecological scope.

(*Overdruk uit: Tijdschrift der Ned. Dierk. Ver.* (2). *VI.* 4).

HET ZOÖLOGISCH STATION

DER

NEDERLANDSCHE DIERKUNDIGE VEREENIGING

in 1899

Ook in het afgeloopen jaar werd aan het onderhoud van het gebouw de noodige zorg besteed. Groote en kostbare herstellingen kwamen niet voor, zoodat aan het gewone onderhoud — waaronder begrepen het verwen van het stucadoorswerk in gang, trapportalen enz. — meer aandacht kon worden gewijd. In de bibliotbeek moest de vloer opgebroken worden, daar er bij het leggen niet op gerekend was, dat juist de randgedeelten zeer zwaar zouden worden belast; onder het balkon werden stempels aangebracht, op de treden van de trap werden koperen platen (z. g. traproeden) geschroefd, de klinkerbestrating rondom het gebouw werd opgenomen en nieuw gelegd en met het silicaten van het cementwerk in de pui rondom het gebouw werd een aanvang gemaakt.

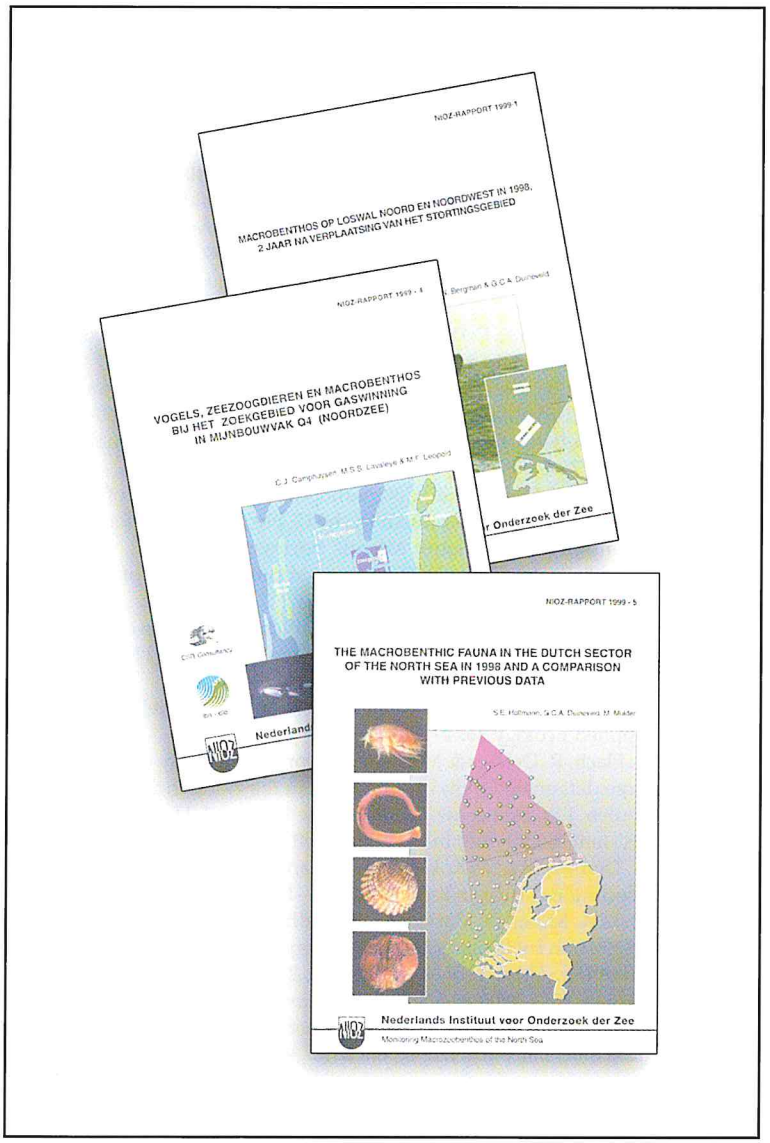
Eene bijzondere vermelding in de geschiedenis van net Zoölogische Station in het afgeloopen jaar verdient de rol, die de inrichting zelve en verder het geheele daaraan verbonden personeel bij het bijeenbrengen, gereedmaken enz. van voorwerpen voor de klasse Visscherij op de Wereld-Tentoonstelling te Parijs in dit jaar gespeeld heeft. De ruime werkkamers vulden zich in de najaarsmaanden allengs met de voor dat doel bestemde voorwerpen, voor een deel [1]) waarvan het Station als stapelplaats was aangewezen. In Maart werd een en ander verzonden: toen waren niet alleen die werkkamers, maar ook de daarvoor beschikbare ruimte in de bibliotheek, in de gangen van het gebouw en in het aquarium geheel met de voor Parijs bestemde bezending (45 kisten, de lading van een grooten waggon) aangevuld. Het Station zelf werkte tot opluistering van het Nederlandsche visscherijbeeld mede, door inzending van photographien en geschriften, en verder ook door eene kleine verzameling van visschen, schaal- en schelpdieren voor de tentoonstelling gereed te maken.

Omtrent hetgeen verder nog in het Station verricht werd moge het volgende door mij vermeld worden:

Gedurende een goed deel van het jaar, namelijk van af het begin van Januari tot eind September werden, in aansluiting aan de gedurende het voorafgaande jaar verzamelde gegevens, onafgebroken wekelijks plank ton-monsters gevischt ten behoeve van Prof. P. T. Cleve te Upsala. Hierbij werd voor het eerst gebruik gemaakt van een pelagisch netje, geconstrueerd als het door Apstein beschreven qualitatieve planktonnet, doch, met het oog op het werk in zee, op dubbele grootte vervaardigd. Dit netje voldoet bijzonder goed: het vischt voldoende scherp en men heeft, dank zij den betrekkelijk wijden beugel en het zwaardere emmertje, geen last van luchtbellen in den zak.

Ik eindig hiermede mijn verslag; uit de Rekening en Verantwoording blijkt, dat nog geene bestemming is gegeven aan de *f* 250, het bedrag van een uitgeloot aandeel in de leening 1889 voor de stichting van het Zoölogisch Station, aan de Vereeniging geschonken door den Heer W. Baartz, welk bedrag volgens besluit van de vergadering van Juni 1899 ter beschikking van het Station is gesteld en wil ten slotte nog mededeelen, dat op mijn desbetreffend verzoek door Burgemeester en Wethouders van Helder aan het Station vrijstelling is verleend van plaatselijke belasting, voor het gedistilleerd, dat in het Station voor de onderzoekingen gebruikt wordt.

2. Publications and Presentations



4 Publications

Dissertations

Aerts, L.A.M. Sponge-coral interactions on Caribbean reefs. UvA, Amsterdam: 157 pp.
De Wilde, H.P.J. Nitrous oxide and methane in marine systems. RUG, Groningen, 122 pp.
Koski, M. Feeding and production of common planktonic copepods: the effect of food and temperature. University of Helsinki, Finland, 156 pp.
Löscher, B.M. Trace metal distributions in the Southern Ocean. Influence of hydrographic and biologic processes. RUU, Utrecht: 169 pp.
Mensink B., Imposex in the common whelk, *Buccinum undatum*. LUW Wageningen: 125 pp.
Weber, A. The importance of info chemicals and clone-specific phenotypic plasticity in Daphnia ecology. RUU, Utrecht: 169 pp.
Wiebinga, C.J. Process studies of dissolved organic carbon and bacterioplankton in the ocean. RUG, Groningen: 173 pp.

Refereed papers and books

1 Abrantes, F., J. Baas, H. Haflidason, T. Rasmussen, D. Klitgaard, N. Loncaric & L. Gaspar. Sediment fluxes along the northeastern European Margin: inferring hydrological changes between 20 and 8 kyr. –Mar. Geol. **152**: 7-23.

2 Baars, M.A. On the paradox of high mesozooplankton biomass, throughout the year in the western Arabian Sea: re-analysis of IIOE data and comparison with newer data.—Ind. J. Mar. Sci. **28:** 125-137.

3 Baars, M.A., P.H. Schalk & M.J.W. Veldhuis. Seasonal fluctuations in plankton biomass and productivity in the ecosystems of the Somali Current, Gulf of Aden and southern Red Sea. In: K. Sherman, E. N. Okemwa & M. J. Ntiba Large Marine Ecosystems of the Indian Ocean: Assessment, Sustainability, and Management. Blackwell, Malden, pp. 143-173.

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Foucher, J. P., G. De Lange & the MEDINAUT Shipboard Scientific Party. Submersible observations of cold seeps on Eastern Mediterranean mud volcanoes. Meeting of the European Union of Geologists, Strasbourg, France, 28 March – 1 April.

Frost, R.L., S.J. Van Der Gaast, G.N. Paroz & M. Zbik. Why does Birdwood kaolinite (South Australia) not intercalate easily with acetamide and formamide? Euroclay Conf., Krakow, Poland, 5-9 September.

Gehlen, M., L. Beck, A.J. van Bennekom, J.E.E. van Beusekom & A.L. Flank. Unraveling the structure of biogenic opal. Gordon Research Conference Chemical Oceanography, Meriden, NH, USA, 8-13 August.

Grutters, M., W. Van Raaphorst & W. Helder. Total hydrolysable amino acid mineralisation in sediments across the N.E. Atlantic Continental Slope (Goban Spur). 19th Internat. Meeting on Organic Geochem. Istanbul, Turkey, 6-10 September.

Höld, I.M., S. Schouten, J. Jellema & J.S. Sinninghe Damsté. Origin of free and bound mid-chain methyl alkanes in marine Infra-Cambrian oils, bitumens and kerogens. 19th International Meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

Jansen, J.H.F. & J.-B. Stuut. Late Cenozoic movements of the South Atlantic and African climatic system. Dutch Ocean Drilling Program and IMAGES Workshop, Amsterdam, 19 February, and 7th European Consortium for the Ocean Drilling Program (ECOD) Workshop, Amsterdam, 29 September - 2 October.

Kinkel, H., J.S. Sinninghe Damsté, K.-H. Baumann, C. Klaas & I. Probert. Present and past productivity of coccolithophores and alkenones. 19th International meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

Koopmans, M.P. & J.S. Sinninghe Damsté. Biodegradation of organic sulphur compounds in crude oils from Oman. 19th International Meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

Kühnel, R.A., A.J. Vaars, R.L. Frost & S.J. Van Der Gaast. Effect of some bivalent cations on arrangement of water molecules in the interlayer space of montmorillonite at variable relative humidity. Euroclay Conf., Krakow, Poland, 5-9 September.

Kuypers, M.M.M., M. Baas, W. Reints, S. Schouten & J.S. Sinninghe Damsté. The Cenomanian/Turonian Oceanic Anoxic Event: Response of the atmospheric CO_2 level. Dutch ODP/IMAGES-meeting, KNAW, Amsterdam, 19 Februari.

Kuypers, M.M.M., P.D. Pancost & J.S. Sinninghe Damsté. Enhanced organic matter preservation in the Middle-Cretaceous euxinic North Atlantic caused p CO_2 to drop 40-80%. 19th International Meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

Lavaleye, M.S.S., G.C.A. Duineveld & E. Berghuis. Megafauna and phytopigments of two transects off NW Spain. OMEX-II workshop, Plymouth, UK, 24-27 April

Loncaric, N. & J.H.F. Jansen. Mid Pleistocene Revolution in the Cape Basin, ODP leg 175 site 1085. 7th European Consortium for the Ocean Drilling Program (ECOD) Workshop, Amsterdam, 29 September - 2 October.

Loncaric, N. & J.H.F. Jansen. Paleoceanographic implications of planktic foraminiferal assemblages from the Mid Cape Basin, SE Atlantic (study perspectives and the first results). Dutch ODP – IMAGES meeting, Amsterdam, 19 February.

Loncaric, N., G.A. Auffret, F. Abrantes, J.H. Baas, L. Gaspar & C. Pujol. Paleoceanographic implications of the Late Quaternary high-resolution sedimentary record from a Meriadzek Terrace site (Bay of Biscay, NE Atlantic). INQUA 15th Intern. congress, Durban, South Africa, 3-11 August.

Luttikhuizen, P.C. & L.P. Pijnacker. Additional sperm siring haploid cells in mosaic haploid-diploid bivalve embryos: possible connection with non-standard heterozygosities and mitochondrial inheritance? Seventh congress European Society for Evolutionary Biology, Barcelona, Spain, 24-28 August.

Marret, F., J.D. Scourse, J.H.F. Jansen & G.J.M. Versteegh. A high-resolution record of terrestrial aridity, relative sea-level change and oceanic productivity from the Congo fan over the past 30,000 years. INQUA (International Union for Quaternary Research), 15th International Congress, Durban, South Africa, August 3-11.

Pancost, R.D., M. Baas, M. Schenk, B. Van Geel, E. Heijna & J.S. Sinninghe Damsté. Distributions and carbon isotope abundances of biomarkers in a Subboreal raised bog: Evidence for climatic and biological change. 19th International Meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

Pancost, R.D., N. Telnæs & J.S. Sinninghe Damsté. Source *vs.* environmental controls on the carbon isotopic composition of an isoprenoid-rich oil. 19th International Meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

Prins, M.A., J.-B.W. Stuut, F. Lamy & G.J. Weltje. End-member modelling of grain-size distributions of deep-sea terrigenous sediments and its paleoclimatic significance: examples from the NW Indian, E Atlantic and SE Pacific oceans. EGS (European Geophysical Society), 24th General Assembly, Den Haag, April 19-23.

Prins, M.A., J.-B. Stuut, F. Lamy & G.J. Weltje. End-member modelling of grain-size distributions of deep-sea terrigenous sediments and its paleoclimatic significance: examples from the NW Indian, E Atlantic and SE Pacific oceans. 6th Annual NSG (Netherlands Research School of Sedimentary Geology) Symposium, Amsterdam, November 25.

Ridderinkhof, H. Continuous ferry observations in a tidal inlet between the North Sea and the Wadden Sea. Second International Conference on EuroGOOS, Rome, Italy, 10-13 March.

Schefuß, E., G.J.M. Versteegh, J.H.F. Jansen & J.S. Sinninghe Damsté. Organic Geochemistry of ODP Leg 175 samples. Dutch ODP/IMAGES-meeting, KNAW, Amsterdam, 19 February.

Schefuß, E., G.J.M. Versteegh, R.D. Pancost, J.H.F. Jansen & J.S. Sinninghe Damsté. Mid-Pleistocene changes in biomarker composition of Congo Fan sediments: climatic implications. 19th International Meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September and 7th ECOD (ESF Consortium for Ocean Drilling) workshop, KNAW, Amsterdam, NL, 29 September – 1 October.

Schefuss, E., R. Pancost, J.H.F. Jansen & J.W. De Leeuw. Organic geochemistry of the Mid-Pleistocene Transition in Congo Fan sediments (ODP site 1077). 7th European Consortium for the Ocean Drilling Program (ECOD) Workshop, Amsterdam, 29 September - 2 October.

Schmidt, S., H. De Stigter, T.C.E. Van Weering, & J.-L. Reyss. Evidence of rapid sediment pathway within the Nazare Canyon. ELOISE/LOICZ Meeting, Noordwijkerhout, December 1-4.

Schouten, S., M.J.L Hoefs & J.S. Sinninghe Damsté. A molecular and stable carbon isotopic study of lipids in Late Quarternary sediments from the Arabian Sea. 19th International Meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

Sinninghe Damsté, J.S., M.J.L. Hoefs & W.I.C. Rijpstra. Different rates of oxic degradation of biomarkers as revealed by analysis of organic matter-rich turbidites recovered by ODP Leg 157. Dutch OPD/IMAGES-meeting, KNAW, Amsterdam, 19 February.

Sinninghe Damsté, J.S., W.I.C. Rijpstra. & G.-J. Reichart. Bias of the sedimentary biomarker record throgh oxic degradation at different rates. II. Evidence from Arabian Sea sediments. 19th International Meeting on Organic Geochemistry, Istanbul, Turkey, 6–10 September.

Smittenberg, R.H., R.D. Pancost, M. Paetzel & J.S. Sinninghe Damsté. Biomarkers in varved, late Holocene fjord sediments: a study of the anoxic Kyllaren fjord, Norway. 19th International meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

Stuut, J.-B., N. Shi, J.H.F. Jansen & G. Postma. Late Quaternary SW African terrestrial-climate signals in the marine record of Walvis Ridge, SE Atlantic Ocean. Dutch Ocean Drilling Program Workshop, KNAW, Amsterdam, 19 February.

Stuut, J.-B., N. Shi, J.H.F. Jansen & G. Postma. Late Quaternary SW African terrestrial-climate signals in the marine record of Walvis Ridge, SE Atlantic Ocean. INQUA (International Union for Quaternary Research), 15th International Congress, Durban, South Africa, August 3-11.

Stuut, J.-B., N. Shi, J.H.F. Jansen & G. Postma. Late Quaternary SW African terrestrial-climate signals in the marine record of Walvis Ridge, SE Atlantic Ocean. 7th European Consortium for the Ocean Drilling Program (ECOD) Workshop, Amsterdam, 29 September - 2 October.

Stuut, J.-B., N. Shi, J.H.F. Jansen & G. Postma. A high-frequency climate record from southwestern Africa in sediments on Walvis Ridge (SE Atlantic). 6th Annual NSG (Netherlands Research School of Sedimentary Geology) Symposium, Amsterdam, November 25.

Van Aken, H.M. Inter-annual to decadal variability of Eastern North Atlantic Central Water along the European Ocean Margin (repeat areas AR12 and AR16). WOCE North Atlantic Workshop, Kiel, Germany, 23-27 August.

Van Der Gaast, S.J., A.J. Vaars, R.L. Frost & R.A. Kühnel. Two phases with different types of water arrangement in Mg-Wyoming montmorillonite. Euroclay Conf., Krakow, Poland, 5-9 September.

Van Der Hage, J.C.H. & T. F. De Bruin. The atmospheric electric fog effect. 11th International Conference on Atmospheric Electricity, Guntersville, Alabama, USA, 7-11 June.

Van Der Zee, C. & W. Van Raaphorst. The role of Mn and Fe reduction in a marine sediment. Gordon Research Conference on Chemical Oceanography, Meriden, USA, August 8-13.

Van Dongen, B.E., W.I.C Rijpstra, C.J.M Philippart, J.W. De Leeuw & J.S. Sinninghe Damsté. Biomarkers in upper Holocene North Sea and Wadden Sea sediments, 2nd NEBROC workshop, Texel, 2-4 February and 19th International Meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

Van Duyl, F.C. & B. De Winder. Tidal coupling between carbohydrate concentrations and bacterial activities in diatom-inhabited intertidal mudflats. International Conference on Intertidal Mudflats: Properties and Processes, Plymouth, UK, 12-16 April.

Versteegh, G.J.M., J.H.F. Jansen, E. Ufkes, R. Pancost, J.W. De Leeuw & R.R. Schneider. A high-resolution study of marine and continental environmental changes on Atlantic deep- sea sediments off Congo. INQUA (International Union for Quaternary Research), 15th International Congress, Durban, South Africa, August 3-11.

Wernand, M.R., H. Van Aken, & S. Shimwell. Spectral behaviour of the remote sensing reflectance of coastal and oceanic waters'. SOMARE International Meeting: Understanding and modelling ecosystem change. KNAW, Amsterdam, 3-5 March.

Werne, J.P., D.J. Hollander, T.W. Lyons & J.S. Sinninghe Damsté. Organic and inorganic carbon/sulfur interactions in the Anoxic Cariaco Basin: Implications for diagenetic formation of organic sulfur compounds. 19th International meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

West, S. & J.H.F. Jansen. ODP leg 175: Planktonic foraminifera in sediment cores from the SE Atlantic. Dutch ODP & IMAGES meeting, Amsterdam, 19 February.

West, S. & J.H.F. Jansen. Planktonic foraminifera as tracers of the position of the Angola Benguela Front. 7th European Consortium for the Ocean Drilling Program (ECOD) Workshop, Amsterdam, 29 September - 2 October.

Woodside, J. M., J. Mascle & the MEDINAUT Shipboard(incl. R.D. Pancost). Scientific Party. Submersible observations of tectonic control of Eastern Mediterranean mud volcanism and fluid seeps. Meeting of the European Union of Geologists, Strasbourg, France, 28 March – 1 April.

Oral presentations

Arrieta, J.M. & G.J. Herndl. Development of a new method to determine different beta-glucosidases using capillary electrophoresis. Symposium 'Mini-bugs in the big organic ocean'. NIOZ, 23 September.

Baars, M.A. On the paradox of high mesozooplankton biomass in the western Arabian Sea throughout the year: re-analysis of IIOE data and comparison with newer data. Bangalore, India, 19 January.

Bak, R.P.M. Coral Reef Tropical Marine Biology. UvA, Amsterdam, January.

Bak, R.P.M. Coral reefs and pollution. RUG, Groningen, 20 May.

Bak, R.P.M. Coral reefs biogeography (Mariene Biogeografie). RUG, Groningen, 18 January.

Bergman, M.J.N. Fishing mortality in invertebrate megafaunal populations in the south-eastern North Sea: is abundance and species composition related to beam trawl effort? ICES/SCOR Symposium 'Ecosystem effects of Fishing', Montpellier, France, 18 March.

Bergman, M.J.N. Impact of trawl fisheries on the benthic ecosystem in the North sea. IHE-Delft, course 'Water and environmental resources management', NIOZ, 19 May.

Beukema, J.J. & P.J.C. Honkoop. Reproductive output in *Macoma balthica* in the Wadden Sea: do they follow an optimal strategy? 'Biology and Evolution of the Bivalvia' Malacological Society of London, Cambridge, UK, 14-17 September.

Booij, K. Measure your measure. Undergraduate course 'Environmental Chemistry', Faculty of Earth Sciences, University of Utrecht, 2 February.

Booij, K. Time integrative sampling of organics in water and atmosphere. TRACCS workshop, Bergen, Norway, 25-28 September.

Booij, K., B.L. Van Drooge, H.E. Hofmans, E.M. Van Weerlee & C.V. Fischer. Temperature and flow dependent exchange of organic contaminants by Semipermeable Membrane Devices. SETAC Europe Meeting, Leipzig, Germany, 25-28 May.

Boom, A., J.S. Sinninghe Damsté, J.W. De Leeuw, J.J. Boon & H. Hooghiemstra. pCO_2 and temperature controlled changes in Quaternary altitudinal vegetation distribution in Colombia; A geochemical approach. International Union for Quaternary Research XV International Congress, Durban, S. Africa, 10 August and ICG-symposium: Interactions between Physical and Biological Components of Landscape and Environment, Utrecht, 8 October.

Boom, A., J.S. Sinninghe Damsté, J.W. De Leeuw, J.J. Boon & H. Hooghiemstra. pCO_2 and temperature controlled changes in a tropical mountain environment in Colombia; a compound specific $d^{13}C$ approach., 19th International Meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

Boon, J.P. Ecotoxicological research at NIOZ. Rotary club Bergen, 1 June.

Boon, J.P. Microcontaminants in marine ecosystems. Students Groenoord college, NIOZ, Texel, 23 June.

Boon, J.P. New compounds in marine ecotoxicology; how do they look and where do they come from? EU-symposium on the transport, fate, and impact of the trace chemical pollution load in the marine environment. Barcelona, Spain, 29 September – 1 October.

Boon, J.P. The influence of biotransformation on the bioaccumulation and toxicity of organic contaminants. Course Environmental Biogeochemistry, University of Utrecht, 16 April.

Boon, J.P., Interaction of organic micropollutants with biological systems. Course Marine Environment, University of Groningen, 18 May.

Boon, J.P., Possible influences of commercial shipping on the marine environment; scientific aspects of ISM/MARPOL, Course of the 'Hoge School van Amsterdam', Institute for Maritime Technology, NIOZ and Ecomare, Texel, 26-29 January.

Boon, J.P., W.E. Lewis & A. Goksøyr. Immunochemical and catalytic and characterization of hepatic microsomal cytochromes P450 in sperm whale (*Physeter macrocephalus*) in comparison to some other marine mammal species. 10th Symposium on Pollutant Responses in Marine Organisms (PRIMO 10), Williamsburg, Virginia, USA, 26-29 April.

Brugger, A., B. Reitner, I. Kolar, N.V. Queric & G.J. Herndl. Dynamics of bacteria and organic carbon in river sediments: importance of particulate organic carbon. ASLO meeting, Santa Fe, USA, 1-5 February.

Brummer, G.-J.A. Coccolithophorid contribution of mass fluxes as intercepted by sediment traps. CODENET spring 1999 workshop, NIOZ, 19-21 March.

Brummer, G.-J.A. Monsoonal contrast in particle fluxes and the sedimentary record off Somalia. SCOR-SEAMONS work group meeting, KNAW, Amsterdam, 17-20 May, and ^{13}C-DIC. Workshop on the ^{13}C of the DIC in the oceans, Hanse-Wissenschaftskollege, Delmenhorst, Germany, 12-15 July.

Brummer, G.-J.A. Planktonic foraminifera in modern and past oceans: perspectives from growth stage analysis. NIOZ, 1 April.

Cadée, G.C. Damaged molluscan shells – a rich information source for paleoecologists. Granada, Spain, 29 April.

Cadée, G.C. Sediment dynamics by bioturbating organisms. Intercoast on Sylt, Germany, 11-15 October, and NIOZ, 3 December.

Camphuysen, C.J. Our plundered oceans: a review. Voorlichtingsbijeenkomst effecten visserij op het ecosysteem van het wad voor de Vaste Tweede Kamercommissie voor de Visserij.NIOZ,Texel. 25 January.

Camphuysen, C.J. A scottish armada: the Dutch North Sea as nursery for common murres. 'Landelijke dag ', Amersfoort, 27 November .

Camphuysen, C.J. Oiled seabirds in the Netherlands: recent trends. Voorlichtingsbijeenkomsten Schouwen-Duiveland en Texel.

Daan, R. Macrobenthos at Loswal Noord and Noordwest. Studiedag Loswal. RIKZ, The Hague, 9 March.

Daan, R. Overview of the OBM monitoring exercises performed over the past number of years by the Netherlands Institute for Sea Research. NOGEPA Seminar, The Hague, 26 August.

De Baar, H.J.W, E.T. Buitenhuis & M.J.W. Veldhuis. Photosynthesis and calcification by *Emiliania huxleyi* (Prymnesiophyceae) as a function of inorganic carbon species. Symposium CO_2 in the Oceans, Tsukuba, Japan, 19 February.

De Baar, H.J.W. Carbon dioxide uptake by the Southern Ocean. Gordon Research Conference on Polar Oceans, Ventura, USA, 7 March.

De Baar, H.J.W. Carbondioxide from fossil fuels and the greenhouse problem. ISM Marpol cursus, NIOZ, 15 December.

De Baar, H.J.W. Global cycling of Marine Dissolved Organic Carbon, analyzed with Radiocarbon, DOC Concentration Profiles and an Ocean Circulation Model. Micro-symposium 'Mini-bugs in the big organic ocean, NIOZ, 23 September.

De Baar, H.J.W. Highlights and prospects of research on iron limitation in the Antarctic Ocean, 1994-2004. International peer review of Netherlands Antarctic Program, Utrecht, 27 September.

De Baar, H.J.W. Iron Resources and Oceanic Nutrients - Advancemnet of Global Environment Simulations. Ironages workshop, Paris, France, 21 April.
De Baar, H.J.W. Pollutant metals; Greenhouse Gases. Lecture Series in course Marine Environment, RUG, Groningen, 26 May.
De Baar, H.J.W. The CARUSO *in situ* Iron Enrichment Experiment. Planning workshop, Bremerhaven, Germany, 4 November.
De Baar, H.J.W. Zinc and bicarbonate co-limitation of *Emiliania huxleyi*. Workshop EU CODENET project, NIOZ, 19 March.
De Baar, H.J.W., Lecture series Introductory Oceanography, Department of Marine Biology, RUG, Groningen, February.
De Baar, H.J.W., M.H.C. Stoll & L. Fiedler. Delta-T parameterization and its influence on air/sea gas exchange. Symposium CO_2 in the Oceans, Tsukuba, Japan, 21 January.
De Haas, H., H.C. De Stigter, T.C.E. Van Weering & T. Richter. Heinrich layers as a tool for sedimentation rate determinations in the North Atlantic Ocean. Meeting North East Atlantic Slope Processes, IGCP Workshop 432 Southampton, UK, 24-27 January.
De Haas, H., T.C.E. Van Weering, H.C. De Stigter, M. Stoker, T. Svaerdborg & T. Richter. Seismic stratigraphy and sedimentary processes in the Rockall Trough ENAM II Final meeting, Tromsø, Norway, 7-8 December.
De Leeuw, J.W. Biogeologie. Akademie (KNAW). Amsterdam, 31 May.
De Leeuw, J.W., P.F. Van Bergen, P. Blokker & J.S. Sinninghe Damsté. The third pathway of OM preservation. Hanse Round Table, Delmenhorst, Germany, 21 June.
De Leeuw, R. & H. Ridderinkhof. Tidal asymmetry and sediment transport in the Texel inlet. NCK, Zandvoort, 25 February.
Drent, J. Geographic variation in *Macoma balthica*. Department of Marine Biology, RUG, Groningen, 29 March.
Dupont, L., J.-B. Stuut & J.H.F. Jansen. African climate development as recorded in South Atlantic sediments. NIOZ, 10 June.
Edelaar, P. & D. Welink. Burying depth of *Macoma balthica* represents a flexible anti-predation behaviour. Symposium 'Biology and Evolution of the Bivalvia', Cambridge, UK, 14-17 September.
Edelaar, P. Anti-predatory behaviour of *Macoma balthica*. Verweij-dagen, NIOZ, 26-27 January.
Edelaar, P. Ecology and evolution of anti-predation behaviour in *Macoma balthica*, University of Bangor, Wales, UK, 21 September.
Edelaar, P. Fragmentation and the loss of biodiversity. Evolution in the sea. UvA, Amsterdam, 3 June.
Edelaar, P. Living in a world with predators: how do individuals cope? *Macoma* workshop, NIOZ, 6 May.
Edelaar, P., P. Triplet, C. Fagot & B. Groeneveld. Anti-predator behaviour of prey cannot be ingnored in predictive studies of shorebird distribution. Wader Study Group-meeting, Vannes, France, 24-27 September.
Fransz, H.G. GLOBEC-related projects in the Netherlands. International GLOBEC meeting to discuss initiatives for North Sea and Baltic, Warnemünde, Germany, 22 January.
Fransz, H.G. On the space-time succession of Calanus along the depth gradient of the North Sea, ICES Symposium Population Dynamics of Calanus in the North Atlantic, Tromsø, Norway, 27 August.
Fransz, H.G. Zooplankton. Course on estuarine ecology of the graduate school Functional Ecology, Yerseke, 14 June.
Fransz, H.G. Identification of copepods. Course on identification of marine zooplankton, Zoological Museum University of Amsterdam, Amsterdam, 5 November.
Gemmrich, J. & H. Van Haren. Heat and momentum fluxes above a sloping bottom. EGS, XXIV General Assembly, Den Haag, 19-23 April.
Gemmrich, J. & H. Van Haren. Internal wave band eddy fluxes in the Southern North Sea. PROVESS meeting, Marseille, France, 30 September – 1 October.
Gerkema, T. Internal-wave generation by eddies over topography. MARE-meeting IMAU - UU, Utrecht, 14 June.
Gerkema, T. Role of internal waves in large-scale circulation. New Ocean Model Meeting, Southampton Oceanography Centre, Southampton, UK, 27-29 September.
Gerkema, T. Stokes drift in internal-tide beams. EGS, XXIV General Assembly, Den Haag, 19-23 April.
Gerringa, L.J.A., H.J.W. De Baar & K.R. Timmermans. A comparison of iron limitation due to organic ligands in natural waters versus conditioning with EDTA of laboratory media. Mini-symposium Mini bugs in the big organic ocean, NIOZ, 23 September.
Grutters, M., W. Van Raaphorst & W. Helder. Mineralisation of amino acids in sediments across the slope of the N.W. European Continental Margin. Symp. 'Decennium Regnum', Institute for Earth Sciences, Utrecht, 26 February.
Herndl, G.J. & K.E. Stoderegger. Production of semi-labile DOM and transparent exopolymer particles by marine bacterioplankton. ASLO meeting, Santa Fe, USA, 1-5 February.
Herndl, G.J. Biogeochemistry below the euphotic zone of the Atlantic Ocean. French JGOFS-SOMARE joint meeting, Toulouse, France, 20-23 September.
Herndl, G.J. Microbial ecology: new challenges beyond the molecular biology approach. Alfred-Wegener-Institute for Polar and Marine Research, Bremerhaven, Germany, 24 November.
Herndl, G.J. New aspects in bacterioplankton ecology. SOMARE symposium, Amsterdam, 3 - 5 March.
Herndl, G.J. Role of bacterioplankton ectoenzymatic activity in turnover of dissolved organic matter. Enzymes in the environment, Granada, Spain, 12-15 July.
Herndl, G.J. Role of bacterioplankton in the sea: some novel aspects. RUG, Groningen, 27 April.
Herndl, G.J. Role of ultraviolet radiation on the carbon flux through marine bacterioplankton. Environmental Protection Agency, Athens, Georgia, USA, 28 January.
Herndl, G.J. The bacterioplankton exopolymer production: a significant source of oceanic DOM? University of Georgia, Athens, Georgia, USA, 29 January.

Herndl, G.J. The interaction between photochemistry and microbobiology in the air-sea interface. CIESM workshop on the role of sea surface microlayer processes in the biogeochemistry of the Mediterranean Sea, Paris, 8-11 December.

Herndl, G.J. The role of ultraviolet radiation on the transfomation of dissolved organic matter. Max-Planck-Institute for Limnology, Plön, Germany, 4 March.

Jansen, J.H.F. Front movements in the SE Atlantic Ocean (and Agulhas leakage) during the last 8 million years. KNMI, De Bilt, 8 June.

Jansen, J.H.F. Late Cenozoic movements of the South Atlantic and African climatic system. ODP Leg 175 2nd Post-cruise Meeting, Ventura CA, USA, 17-19 May.

Jansen, J.H.F. Paleoceanography, general circulation. NEBROC Introductory Course in Marine Sciences. University Bremen, Bremen, Germany, 29 September.

Jansen, J.H.F. Terrigenous proxies. NEBROC Introductory Course in Marine Sciences. University Bremen, Bremen, Germany, 29 September.

Jansen, J.H.F., G.J.M. Versteegh & R. R. Schneider. A high-resolution record of the Congo freshwater outflow. Workshop on paleodata and climate models, KNMI, De Bilt, 8 March.

Kinkel, H. CODENET - Coccolithophorid Evolutionary Biodiversity and Ecology Network: A multidisciplinary approach to integrate Biology, Paleontology and Biogeochemistry of a major phytoplankton group. Invited Lecture at Lamont Doherty Earth Observatory, USA, 8 April.

Kinkel, H. Evolution of coccolithophores and their biomarkers: Implications for paleoclimate reconstructions. 2nd Annual CODENET Meeting, Chateau de Blagnac, France, 2-7 September.

Kinkel, H., C. Klaas & I. Probert. Calibration of in *Gephyrocapsa oceanica*. CODENET Spring Workshop, NIOZ, 18-21 March.

Klein Breteler, W.C.M. Growth and development of pelagic copepods in relation to temperature and food: past and present laboratory results. Workshop on Experimental Zooplankton Ecology, Tvarminne Zoological Station, Finland, 31 May.

Kolar, I., A. Brugger, B. Reitner, N.V. Queric & G.J. Herndl. Temporal and spatial distribution of biodegradable DOC in the hyporheic zone of an oligotrophic river and its adjacent groundwater. ASLO meeting, Santa Fe, USA, 1-5 February.

Koopmans, M.P., J.S. Sinninghe Damsté & M.D. Lewan. Release of biomarkers from sulfur-rich kerogens with hydrous pyrolysis. ACS Meeting, Anaheim, USA, 24-25 March.

Kuipers, B.R & P. Ruardij. Profiles, food chain and diffusion in the tropical North Atlantic. NIOZ colloquium, 20 May.

Kuypers, M.M.M., P.D. Pancost & J.S. Sinninghe Damsté. Enhanced organic matter preservation in the Middle-Cretaceous euxinic North Atlantic caused pCO_2 to drop 40-80%. 19th International Meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

Lavaleye, M.S.S., G.C.A. Duineveld & E. Berghuis. Megabenthos, phytopigments, SCOC and bottom features of two transects off NW Spain. OMEX II-II workshop, Plymouth, UK, 24-27 April.

Lavaleye, M.S.S., G.C.A. Duineveld & E. Berghuis. Megafauna off NW Spain, and longterm near-bottom data on pulses of phytopigments at the main OMEX station. OMEX II-II workshop, Brussel, Belgium, 10-12 December.

Lindeboom, H.J. Biodiversity of benthic macrofauna. Workshop on 'Ecological targets in the North Sea', Utrecht, 9 December.

Lindeboom, H.J. Changes in coastal zone ecosystems. Hanse Conference on 'Past climate and its significance for human histiry in NW Europe, the last 10,000 years', Delmenhorst, Germany, 11 Ocotober.

Lindeboom, H.J. Coastal research in Teluk Banten: Integrated science for management. Research Program Indonesia 1995-2000. International conference on interactive North-South research for development, KNAW, Amsterdam, 16 December.

Lindeboom, H.J. Indonesian-Dutch research: The Teluk Banten project. MARUM workshop on tropical marine and coastal research, Bremen, Germany, 14 January.

Lindeboom, H.J. LOICZ opening address and presentation 'The LOICZ Future'. LOICZ Open Science Meeting, Bahia Blanca, Argentina, 15 November.

Lindeboom, H.J. LOICZ, present and future. IGBP congress, Shonan Village, Japan, 10 May.

Lindeboom, H.J. Long-term variability of marine ecosystems and the effects of fisheries. Lecture for students RUG, Groningen, 21 June.

Lindeboom, H.J. Long-term variability of marine ecosystems and the effects of fisheries. Lecture at NEBROC-PhD course, Bremen, Germany, 1 October.

Lindeboom, H.J. Natural variability of the North Sea ecosystem and implications for management. North Sea days on biodiversity, Egmond, 23 September.

Lindeboom, H.J. The Coastal Zone: An ecosystem under pressure. At 'Oceans 2020: Science for future needs', Potsdam, Germany, 4 October.

Lindeboom, H.J. The effects of different types of fisheries on the North Sea ecosystem and future management. Marine Environmental Management, review meeting, London, UK, 21 January.

Loncaric, N. & J.H.F. Jansen. Mid Pleistocene paleoceanography in the Cape Basin, ODP leg 175 site 1085. ODP Leg 175 2nd Post-cruise Meeting, Ventura CA, USA, 17-19 May.

Luttikhuizen, P.C. Adaptive genetic population structuring in free-spawning bivalves: myth or miracle? Verwey-dagen, NIOZ, 26 January.

Luttikhuizen, P.C. Gene flow and selection in marine invertebrates with free swimming larvae; the bivalve *Macoma balthica* as an example. Workshop 'Population Structure and Breeding Systems', Centre for Evolutionary and Ecological Studies, RUG, Groningen, 27 May.

Maas, L.R.M. Chaotic tides, EGS, Den Haag, 23 April.

Maas, L.R.M. Mean-flow generation by geometrically focused gyroscopic waves. NIOZ, 11 Februari, HYDRALAB, Hannover, Germany, 17 februari, EGS, XXIV General Assembly, Den Haag, 23 April, IUGG, Birmingham, 29 July.

Maas, L.R.M. Surprising behaviour of waves in stratified and rotating fluids. Institut Universitaire de France Laboratoire d'Astrophysique Observatoire Midi-Pyrenees. Toulouse, France, 31 March.

Muyzer, G. Application of molecular methods in microbial ecology. Ocean Research Institute. University of Tokyo, Tokyo, Japan, 2 March.

Muyzer, G. Integrated approaches to study the organization of microbial communities. NIOO-Heteren, 16 March.

Muyzer, G. & H. Schäfer. Microbial community dynamics in Mediterranean nutrient-enriched seawater mesocosms. Symposium 'Mini-bugs in the big organic ocean'. NIOZ, 23 September.

Muyzer, G. Structure, function, and dynamics of microbial communities in aquatic environments. International Workshop on Quantitative Microbiology and Risk Assessment – Water Quality Management for Human Health. Tokyo, Japan, 3-4 March.

Muyzer, G., F. Garcia-Pichel, U. Nübel & M. Kühl. Microbial mats: model systems for ecological studies. ASLO-meeting, Santa Fe, USA, 1-5 February.

Pancost, R.D. Initial Results of the 1998 MEDINAUT Expedition: Organic Geochemistry of Mud Volcano Sediments. NIOZ, 29 April.

Pancost, R.D. & J.S. Sinninghe Damsté. Compound-Specific Isotope Analyses of Carbon-Isotope Excursions. Universität Erlangen, Germany, 8-February.

Pancost, R.D. & J.S. Sinninghe Damsté. Initial Results of the 1998 MEDINAUT Expedition: Organic geochemistry of mud volcano sediments. 1999 MEDINAUT post-cruise meeting, Amsterdam, 22 April.

Pancost, R.D. Processes in modern and ancient environments revealed by molecular biogeochemistry. University of Bristol, Bristol, UK, 30 September.

Pancost, R.D., J.S. Sinninghe Damsté & the MEDINAUT Scientific Party. Anaerobic methane consumption in mediterranean cold seeps: Evidence from isotopic and molecular proxies for a consortium of archaea and bacteria. Symposium 'Mini-bugs in the organic ocean', NIOZ, , 23 September.

Pancost, R.D., J.S. Sinninghe Damsté & the MEDINAUT Scientific Party. Anaerobic methane consumption in Mediterranean cold seeps: Evidence from isotopic proxies and implications for past and future climate change. University of Missouri at Columbia, USA, 22 October.

Pancost, R.D., J.S. Sinninghe Damsté & the MEDINAUT Scientific Party. Anaerobic methane consumption in Mediterranean cold seeps: Evidence from isotopic proxies and implications for past and future climate change. 1999 Meeting of the Geological Society of America, Denver, USA, 25-28 October.

Pancost, R.D., K.H. Freeman, M.A. Patzkowsky, G.J.M. Versteegh & J.S. Sinninghe Damsté. Can growth rate variations affect the geochemical record of climate change. 1999 Meeting of the Geological Society of America, Denver, 25-28 October.

Philippart, C.J.M. Research plans NIOZ. Kick-off meeting NWO-Prioriteit Thema 2. NIOZ, 15 December.

Philippart, C.J.M. Spatial-temporal dynamics of recruitment of bivalves. Mini-symposium on the ecology of Macoma balthica. NIOZ, 16 December.

Piersma, T. & J. Rydell. Migration and behaviour of arctic birds and insects. Seminar during Tundra NorthWest-99 Expedition, on board Louis St.-Laurent, near Jenny Lind Island, Canada, 22 July.

Piersma, T. Breeding waders along the Northwest Passage, arctic Canada, in summer 1999. Ann. Conf. of Wader Study Group, Ile de Berber, France, 26 September.

Piersma, T. Ecological effects of Dutch shell-fisheries, 'Lopende Zaken' VPRO-Television, 31 January.

Piersma, T. Evolutionary arms-race on intertidal mudflats: introduction to PIONIER-programme. Verweij-dagen NIOZ, 26 January.

Piersma, T. Knot migration in South-America. WIWO-day, Utrecht, 6 February.

Piersma, T. Long-term changes in ecosystems characteristics in the Dutch Wadden Sea. Special Symposium Nederlands-Vlaamse Ecologenvereniging, Amsterdam, 4 June.

Piersma, T. Mechanical cocklefisheries and possible effects on bivalve recruitment. Scientific Seminar, NIOZ, 10 October.

Piersma, T. Phenotypic flexibility of avian migrants. RUG, Groningen, 13 April.

Piersma, T. Systems behind ecosystems: do food-pyramids have to be turned upside down? Studium Generale series on new developments in biology, UvA, Amsterdam, 30 November.

Piersma, T. The incredible journeys of migrating waders. VI Convegno Nazionale degli Inanellatori Italiani, Cattolica, Italy, 30 January.

Piersma, T. Wader-sex and mechanical shell-fisheries: what is the connection? National Bird Day, Amersfoort, 27 November.

Piersma,T. Shell-fisheries and consequences for benthos and shorebirds in the Dutch Wadden Sea. Informative meeting for Members of Parliament, NIOZ, 25 January.

Piersma, T. Sexual selected plumages and the conservation biology of long-distance migrant shorebirds. Voordracht Landelijke Vogeldag, 27 November.

Piersma, T. Endogenously regulated organ size changes in long-distance migrant shorebirds. Seminar Max-Planck Gesellschaft, Seewiesen, 14 December.

Piersma, T. Adaptive phenotypic flexibility in long-distance migrating shorebirds. Seminar Institut für Spezielle Zoologie und Evolutionsbiologie, Fredrich-Schiller-Universität, Jena, 15 December.

Piersma, T. Ecology of the Wadden Sea birds. Fryske Akademy, Leeuwarden, 21 December.

Rasmussen, T., E. Thomsen and T.C.E.Van Weering. 150 000 years of climate and circulation changes at the faeroe margin; foraminifera, isotope and IRD records. Meeting North East Atlantic Slope Processes, IGCP Workshop 432 Southampton, UK, 24-27 January.

Reitner, B., A. Herzig & G.J. Herndl. Dynamics in bacterioplankton production in a shallow, temperate lake (Lake Neusiedl, Austria): leucine versus thymidine incorporation and their relation to temperature. ASLO meeting, Santa Fe, USA, 1-5 February.

Richter, T. High resolution X-ray fluorescence logging with the CORTEX core scanner: principle and palaeoceanographic application to North Atlantic sediment cores. Geological Institute, University of Bergen, Norway, 14 December.

Richter, T., T.CE. van Weering, A. Stadnitskaya, H. de Haas, A.Vaars & S.J. van der Gaast. Mineralogy of carbonate concretions in a sediment core at a cold water coral mound (Porcupine Margin, NE Atlantic), NEBROC Course, University of Bremen, Germany, 29 September.

Ridderinkhof, H. , R. Van Der Ham & W. Van Der Lee. Temporal variations in suspended sediment concentrations and current velocities above a tidal flat in the Ems-Dollard estuary: variability on different time scales. Intertidal Mudflats: Properties and Processes. Plymouth, UK, 13-16 April.

Ridderinkhof, H. ADCP observations from a ferry on the transect den Helder – Texel. NCK workshop on 'Observational Techniques', Delft, 27 January.

Ridderinkhof, H. Hydrodynamics and sediment transport in the Marsdiep inlet in the Wadden Sea. Congress on Coastal Barriers, NIOZ, 26 March.

Ridderinkhof, H. Oceanographic observations from a ferry in the Texel inlet. RvO-WST, den Haag, 29 April, IMAU-UU, Utrecht, 21 May.

Ridderinkhof, H. Physics in sea research: current observations from a ferry. Congress for teachers in Physics, Noordwijkerhout, 12 December.

Riegman, R. Algal lysis as carbon source for the microbial loop. Symposium 'Mini-bugs in the big organic ocean'. NIOZ, 23 September.

Riegman, R. Examples of the impact of biota on the element cycling in marine ecosystems. SENSE research school: AIO course Interactions between element cycles and ecosystems. Wageningen, 12 April.

Riegman, R. The consequence of the ecophysiology of *Emiliania huxleyi* for its global distribution. Codenet workshop. NIOZ, 19 March.

Rospondek, M.J., J. Köster & J.S. Sinninghe Damsté. Organic molecular fossils of diatoms. Workshop on the Origin and Early Evolution of Diatoms: Fossil, Molecular and Biogeographical Approach, Institute of Marine Sciences, University of Szczecin, Chair of Botany, Agricultural Academy Szczecin in co-operation with Diatom Collection of California Academy of Sciences, Baltic seaside, Poland, 24-27 October.

Schefuß, E. Organic geochemical signals of the Mid-Pleistocene Transition in Congo Fan sediments (ODP site 1077). 2nd Postcruise Meeting ODP Leg 175, Ventura, USA, 18 May.

Schefuß, E., G. Versteegh, R. Pancost, J.S. Sinninghe Damsté, J.H.F. Jansen & J. De Leeuw. Organic geochemical signals of the Mid-Pleistocene Transition in Congo Fan sediments (ODP site 1077). ODP Leg 175 2nd Postcruise Meeting, Ventura CA, USA, 17-19 May.

Schouten, S., H. Van Kaam-Peters, W.I.C. Rijpstra & J.S. Sinninghe Damsté. Reconstructing environmental changes in a continental sea of 185 Ma ago using stable carbon isotopic compositions of sediments and cultures. Invited lecture at NIOO, Nieuwersluis, April.

Schouten, S., M.J.L. Hoefs, L.L. King, S.G. Wakeham & J.S. Sinninghe Damsté. Lipids of pelagic Archaea in the water column and sediments. Symposium 'Mini-bugs in the organic ocean', NIOZ, , 23 September.

Schouten, S., W.I.C. Rijpstra, M.D. Kok, E.C. Hopmans, R.E. Summons, J.K. Volkman & J.S. Sinninghe Damsté. Isotopic geochemistry of sedimentary biomarkers of an antartic permanently stratified lake: Evidence for past methane and sulfide generation and oxidation. 19th International Meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

Sinninghe Damsté, J.S. Molecular palaeontology of marine sediments: Results from the PIONIER project. NIOZ, 22 April.

Sinninghe Damsté, J.S. Applications of biomarkers in (palaeo)oceanography. Invited lecture at the NEBROC advanced course on proxies in (palaeo)oceanography. University of Bremen, Germany, 10 March.

Sinninghe Damsté, J.S. Formation of natural polycyclic aromatic hydrocarbons from carotenoids and other natural products during sediment burial. Invited lecture at PAC Symposium '99 'Licht op Chemie', University of Amsterdam, 4-5 March.

Sinninghe Damsté, J.S. Molecular Palaeontology: Diagenetic effects on the alkenone signal. Invited lecture at the 3rd CODENET Workshop, NIOZ, 18-21 March.

Sinninghe Damsté, J.S. The Cenomanian/Turonian Crises: Biomarker evidence for a euxinic ocean and a 50% drop in atmospheric CO_2 levels. Invited lecture at the Max Planck Institute for Marine Microbiology, Bremen, Germany, 9 March.

Sinninghe Damsté, J.S., M.D. Kok, J.P. Werne, W.I.C. Rijpstra, L. Robertson, J.K. Volkman & D.J. Hollander. Direct proof of early sulfurization of organic matter in surface sediments. 19th International Meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

Smittenberg, R.H., Short-term changes in the biomarker record in an anoxic fjord, NEBROC Introductory Course in Marine Sciences. University of Bremen, Germany, 20 September - 1 October.

Spaargaren, D.H. Aquaculture. Why and How? Instituto del Mar del Per, Callao, Peru, 21 April.

Stadnitskaya, A., T.C.E. Van Weering, T. Richter, H. De Haas & M. Ivanov. Geochemistry of a Porcupine Margin carbonate mound; preliminary results. Meeting North East Atlantic Slope Processes, IGCP Workshop 432 Southampton, UK, 24-27 January.

Stoker, M., T.C.E. Van Weering & T. Svaerdborg. Towards a unified mid-to late Cenozoic Stratigraphic framework for the Rockall Trough. Meeting North East Atlantic Slope Processes, IGCP Workshop 432 Southampton, UK, 24-27 January.

Stoker, M., T.C.E. Van Weering & T. Svaerdborg. A mid-to late Cenozoic Stratigraphic framework for the Rockall Trough. Petroleum Exploration of Irelands offshore Basins Meeting, Dublin, Ireland, April 29-30.

Stoll, M.H.C. Skin temperature of the ocean and its effect on air-sea gas exchange. NAM Velsen-Noord, 16 November.

Ten Hallers-Tjabbes, C.C. Environmental Impact of TBT from antifouling paints. ISM/MARPOL, Course of the 'Hoge School van Amsterdam', Institute for Maritime Technology, NIOZ and Ecomare, Texel, 28 January.

Ten Hallers-Tjabbes, C.C. TBT, the compound and the Marine Environment. Lecture Course Department of Chemistry, University of Groningen, 11 February.

Ten Hallers-Tjabbes, C.C. & C. Ree. Interactive Case Study in Communication between scientists and policy makers for environmental issues, Lecture course Department of Chemistry, University of Groningen, 25 February.

Ten Hallers-Tjabbes, C.C. & C. Ree. Interactive Case Study in Communication between scientists and policy makers for marine environmental issues, Lecture course Marine Environmental Biology, University of Groningen, NL, 20 May.

Ten Hallers-Tjabbes, C.C. Environmental Impact of TBT and policies for antifouling. University of Huelva, Department of Chemistry and Material Sciences, Huelva, Spain, 15 June.

Ten Hallers-Tjabbes, C.C. Environmental Impact of TBT and policies for antifouling. University of Palermo, Department of Marine Sciences, Palermo, Italy, 6 July.

Ten Hallers-Tjabbes, C.C. Environmental Impact of TBT as recognised from scientific findings. Seminar Control of TBT-based antifouling paints for environmental protection, Southampton Institute, Maritime Faculty, UK, 11 November.

Ten Hallers-Tjabbes, C.C. Toxicology, general principles and selected case studies in the marine environment, Lecture course Marine Environmental Biology, University of Groningen, Groningen, 20 May.

Ten Hallers-Tjabbes, C.C. Presentazione d'il progetto HIC-TBT (Introducing the project HIC-TBT), University of Palermo, Sicily, Italy, 5 November

Ten Hallers-Tjabbes, C.C. (Fisheries, whelks and the Environment). Signatory Meeting Agreement on phasing out TBT from fishing vessels Ministry for Transport and Water Management, MS 'Arca', The Hague, 14 December.

Ten Hallers-Tjabbes, C.C. Antifouling and the Marine Environment. Lecture Series ISM-MARPOL, NIOZ. 15 December.

Timmermans, K.R. Availability of iron for phytoplankton in the Southern Ocean: field observations and laboratory bioassays. NIOZ, 25 November.

Van Aken, H.M. Hydrographic sections occupied by the Netherlands: Bay of Biscay, Armorican slope. ICES Working Group on Oceanic Hydrography, Murmansk, Russia, 13-15 March.

Van Aken, H.M. Lectures on: Temperature and salinity, wind-driven circulation, thermohaline circulation, and marine optics. NEBROC introductory course in marine sciences, Bremen, Germany, 20 September – 1 October.

Van Aken, H.M. Water from macro-scales to micro-scales. IVN course 'watergids', Rotterdam, 11 September.

Van Bennekom, A.J. 'Notes on the history of marine Research in the Netherlands' Congress 'History of National Oceanography', Kaliningrad, Russia, 21 September

Van Bennekom, A.J. 'Silicates in rivers and river plumes', LOICZ/SCOPE workshop 'Land-Ocean Nutrient Fluxes: The changing Silica Cycle', Linköping, Sweden. 3 October

Van Bergen, P.F., I. Poole, U. Sass-Klaassen, R.D. Pancost & J.S. Sinninghe Damsté. Compound-specific stable carbon isotope analyses of wood constituents: A new technique for palaeoclimatic reconstructions. 19th International Meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

Van Den Bergh, G.D. Coastal marine sediments and sedimentation in Banten Bay, Indonesia. 2nd Workshop on the Teluk Banten Research Program, NIOZ, 3-5 November.

Van Den Bergh, G.D., J. De Vos, P.Y. Sondaar & D. Mol. Pygmy proboscideans and faunal turnovers. 2nd Internat. Mammoth Conf., Rotterdam, 16-20 May.

Van Der Gaast, S.J., J. Van Mechelen, L. Woning & A. Braam. Influence of relative humidity on XRPD measurements. Dutch XRPD meeting, Geleen, 10 December.

Van Der Meer, J. & J.J. Beukema. Long-term variability in secondary production of an intertidal bivalve population: a case of supply-driven dynamics? NIOZ, 14 January.

Van Der Meer, J. & J.J. Beukema. Natural variability in the secondary production of the Baltic clam. Special symposium Nederlands-Vlaamse Ecologenvereniging, Amsterdam, 4 June.

Van Der Meer, J. A first course in statistics, IHE, Delft, 7 January.

Van Der Meer, J. Interference and the spatial distribution of wintering waders. RUG, Groningen, 24 March.

Van Der Meer, J. Population regulation in the Baltic clam. Mini-symposium on the ecology of *Macoma balthica*, NIOZ, 16 December.

Van Der Meer, J. Science and decision making: living with uncertainties. Informative meeting for Members of Parliament, 25 January.

Van Der Meer, J. To reproduce or to survive: that is only half the question. Mini-symposium on the ecology of *Macoma balthica*, NIOZ, 2 June.

Van Der Meer, J., T. Piersma & J.J. Beukema. Population dynamics of bivalves and the role of shorebird predation. Symposium Intercoast, 75th Anniversary of the Wattenmeerstation Sylt, Sylt, 14 October.

Van Der Meer, M.T.J., S. Schouten, J.S. Sinninghe Damsté, J.W. De Leeuw & D.M. Ward. ^{13}C enriched organic matter produced by green nonsulfur bacteria: possible source of 'heavy' organic matter in the Precambrian. 19th International Meeting on Organic Geochemistry, Istanbul, Turkey, 6-10 September.

Van Der Meer, J.. Generalized linear interactive modelling. Functional ecology course, Utrecht, 2 December.

Van Der Veer, H.W. Intra- and interspecies comparison of growth and reproduction in flatfish by means of dynamic energy budgets. Fourth International Symposium on Flatfish Ecology, Moorehead City, USA, 18-23 October.

Van Dongen, B.E., W.I.C. Rijpstra, C.J.M. Philippart, J.W. De Leeuw & J.S. Sinninghe Damsté. Biomarkers in upper Holocene Eastern North Sea and Wadden Sea sediments. NEBROC Introductory Course in Marine Sciences. University of Bremen, Germany, 20 September - 1 October.

Van Duyl, F.C. Coral reefs and pollution. ISM Marpol course, NIOZ, 28 January, 15 December.

Van Gils, J. Differential patch use by bivalve-eating shorebirds, Verwey-dagen, NIOZ, 25 January.

Van Gils, J. Patch and prey choice by Knots. RUG, Groningen, 4 February.

Van Gils, J. Stopover foraging ecology of knots, PhD course, Ecology of Animal Migration, Lund, Sweden. 26 October.

Van Raaphorst, W. Is the common assumption of instantaneous sorption equilibrium valid for sandy sediments? SCOR workinggroup 114 meeting, Max Planck Institute for marine microbiology, Bremen, Germany, 20-23 September.

Van Schanke, A., Dose and time response of biliary BaP metabolites in the dab. Workshop PAH-metabolites in fish bile, Amsterdam, 16-17 September.

Van Schanke, A., Interactive effects of CB 126 and benzo[a]pyrene on biotransformation enzymes, metabolites in bile and DNA adducts in the dab (*Limanda limanda*). PRIMO 10. 10th International Symposium Pollutant Responses in Marine Organisms, Williamsburg, Virginia, USA, 25-29 April.

Van Weering, T.C.E.. Pockmarks, Gashydrates and Cold water carbonate Mounds gashydrates UMBGROVE Lecture, Utrecht, 6 December.

Van Weering, T.C.E. & H. De Stigter. Near bed dynamics, sediment acumulation and carbon burial on the NW Iberian Margin, OMEX 2nd Annual Workshop, Plymouth, UK 24-27 April.

Van Weering, T.C.E. & H. De Stigter. Recent sediment accumulation at the Iberian Margin. OMEX WP III Meeting, Brussels, Belgium, 8-10 December.

Van Weering, T.C.E., M.S. Stoker, T. Svaerdborg, H. De Haas & A.McDonnel. Seismic Stratigraphy and sedimentary processes along the Rockall Trough and Porcupine margin. Meeting North East Atlantic Slope Processes, IGCP Workshop 432 Southampton, UK, 24-27 January.

Van Weering, T.C.E., M.S. Stoker, T. Svaerdborg, H. De Haas, A. McDonnel, T. Richter & A. Stadnitskaya. Seismic stratigraphy and Sedimentary processes along the SE Rockall Trough margins. Petroleum Exploration of Irelands offshore Basins Meeting, Dublin, Ireland, April 29-30.

Veldhuis, M.J.W. & G.W. Kraay. Flow cytometry in marine ecosystems: biomass-analysis and population dynamics. Mini-symposium on Flowcytometry of Aquatic Organisms. NIOO-CL, Nieuwersluis, 24 June.

Veldhuis, M.J.W. DCM2 project: general introduction and scientific background. SOMARE symposium, Amsterdam, 3 - 5 March.

Veldhuis, M.J.W., G.W. Kraay & K. Timmermans. Phytoplankton dynamics: are they all alive and how fast can they grow? SOMARE symposium, Amsterdam, 3 - 5 March.

Veldhuis, M.J.W., G.W. Kraay & K.R. Timmermans. Phytoplankton in the Ocean: are they all alive? ASLO meeting, Santa Fe, USA, 1-5 February.

Veldhuis, M.J.W. & G.W. Kraay. Application of flow cytometry in detecting marine micro-organisms. Cytometry, Dijon, France, 14 October.

Veldhuis, M.J.W. & G.W. Kraay. On the role of phototrophic bacteria in the oceans. Symposium 'Mini-bugs in the big organic ocean'. NIOZ, 23 September.

Versteegh, G.J.M., E. Ufkes, J.H.F. Jansen, R.D. Pancost, J.W. De Leeuw & R.R. Schneider. A high resolution multi-proxy study on palaeo-environmental changes off Congo. 19th International Meeting on Organic Geochemistry. Istanbul, Turkey, 6-10 September.

Versteegh, G.J.M., J.H.F. Jansen, R.D. Pancost & J.W. De Leeuw. Importance of humidity and atmospheric CO_2 variations for vegetation composition in the Congo drainage Basin during the last deglaciation. 2nd Annual CODENET network workshop, Blagnac France, 2-5 September.

Vosjan, J. Lecture series on Marine Bacteriology for the International Postgraduate Training Course on Ecological Marine Management (ECOMAMA) of the Free University, Brussels, Belgium, 29 March - 3 April.

Weber, A. Does it matter which fish you take? 27th Internat. Congress of the Association of Theoretical and Applied Limnology, Dublin, Ireland, 8-12 August.

Wernand, M.R., H. Van Aken & S. Shimwell. Spectral behaviour of the remote sensing reflectance of coastal and oceanic waters'. SOMARE International Meeting: Understanding and modelling ecosystem change. KNAW, Amsterdam, 3-5 March.

Wernand, M.R. The spectral behaviour of the remote sensing reflectance of coastal and oceanic waters in conjunction with the water quality (To sea or not to sea or to see or not to see). International Symposium on the promotion of European and interregional scientific expertise for the management of ecosystems of the littoral English Channel-North Sea. Boulogne-sur-Mer, France, 23-24 March.

West, S. & J.H.F. Jansen. Planktonic foraminifera from the Angola Basin and Walvis Basin. ODP Leg 175 2nd Post-cruise Meeting, Ventura CA, USA: 17-19 May.

Zimmerman, J.T.F. Spin-orbit coupling in geo- and astrophysical fluid dynamics. IMAU -University Utrecht 10 June

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
- co-editor Journal of Sea Research
- member Plankton Interaction Group, NWO-ALW

R.P.M. Bak
- professor Tropical Marine Biology, University of Amsterdam
- senior Editorial Advisor Marine Ecology Progress Series
- member Netherlands SCOR Committee (KNAW)
- member Board Foundation for Scientific Research Surinam and the Netherlands Antilles
- member International Council of Scientific Unions SCOR, Working Group 104 Coral Reefs and Environmental Change
- member council International Society for Reef Studies

M.J.N. Bergman
- member ICES Working Group on Ecosystem Effects of Fishing Activities
- member ICES Study Group on the Work programme to Evaluate the Environmental Impacts of Fisheries
- member Raad van Overleg voor het Fysisch-oceanografisch onderzoek Noordzee - Overleggroep Bodem
- member ICES Benthos Ecology working group

J.J. Beukema
- editor-in-chief Journal of Sea Research

J.P. Boon
- board member of the Research School Environmental Chemistry and Toxicology (M&T)
- member committee 'Environmental Contaminants and Reproduction (ecotoxicology)', Dutch Health Council (Gezondheidsraad)
- member ICES Marine Chemistry Working Group
- member ICES Working Group on Biological Effects of Contaminants
- member 'commissie voor de milieu-effect rapportage'

T.F. De Bruin
- acting secretary National Oceanographic Data Committee (NODC)
- member Joint Committee on Antarctic Data Management (JCADM)

G.J.A. Brummer
- member NWO/GOA research program committee 'Tracing a seasonal upwelling'
- member NWO/ALW 'gebruikers-adviesgroep verankerde systemen'
- alternate member of th board of NEBROC
- chairman of the steering committee Around Africa

G.C. Cadée
- editor Journal Sea Research
- associate editor ICHNOS
- member 'Commissie voor buitenlandse marien-biologische instituten', KNAW
- board member 'Nederlands Vlaamse Kring van Diatomisten'
- member 'INQUA Commissie Nederland', KNAW
- associate editor Senckenbergiana Maritima

C.J. Camphuysen
- board member Netherlands Ornithologists' Union (NOU)
- chairman Dutch Seabird Group (NZG), section of NOU
- editor SULA
- editor ARDEA
- Atlantic Seabirds
- co-ordinator Dutch beached bird survey (NZG/NSO)
- member ICES Working Group on Seabird Ecology (WGSE)
- chairman European Seabirds At Sea Database (ESAS) Co-ordinating group
- consultant, CSR Consultancy

R. Daan
- member workinggroup 'Monitoring rond Mijnbouwinstallaties'

H.J.W. De Baar
- professor General Oceanography, University of Groningen
- associate editor Marine Chemistry
- chairman committee Joint Global Ocean Flux Study (JGOFS)
- chairman SCOR Netherlands at KNAW
- member NWO/NOP Programmeringsgroep Thema 1
- coordinator MERLIM research programme EU-MAST
- coordinator CARUSO research programme EU Climate and Environment
- member board NEBROC programme
- chairman working group SOLAS of SCOR
- coordinator EU project Iron Resources and Oceanic Nutrients - Advancement of Global Environment Simulations (IRONAGES)
- member Selection Committee Joint Infrastructure Fund of UK NERC
- member board Netherlands-Bremen Oceanography (NEBROC)
- member MAB/SCOPE/IGBP Committee of Royal Netherlands Academy of Sciences (KNAW)
- convenor SCOR/IUPAC Iron Certification workshop, San Antonio, Texas, U.S.A. 28-29 January 2000
- convenor Trace Metals in the Oceans, EGS Symposium, (Nice, April 2000)

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

P.A.W.J. De Wilde
- professor Marine Zoology, University of Groningen
- member 'Programma Commissie Open Universiteit', Heerlen
- member advice board Neth. Society for Aquatic Ecology
- member MER Working Group Drilling gas in North Sea coastal zone and Wadden Sea

G.C.A. Duineveld
- member ICES Benthos Ecology working group

J.M. Everaarts
- member ICES Working Group on biological effects of contaminants
- member Editorial Board of the Bulletin of Environmental Contamination and Toxicology
- member Editorial Board of Wallaceana
- member Editorial Board of the Marine Pollution Bulletin
- member Editorial Board of Ecotoxicology

M. Fonds
- member Mariculture Committee ICES

H.G. Fransz
- member JGOFS-NL working group
- member GLOBEC international working group for numerical modelling (NMWG)
- member ASMO-working group for International Model Comparison
- coordinator working group GLOBEC-NL

W. Helder
- member Dutch SCOR commission
- member Dutch JGOFS commission
- chairman ' Gebruikers Advies groep Auto-analysers' (NWO)
- co-editor Journal of Sea Research
- member Steering Committee UK-NERC programme Benthic Boundaries (BENBO)
- member Steering Committee EU-MAST- ALIPOR project.
- member of the board of NEBROC

G.J. Herndl
- member Editorial Board of Aquatic Microbial Ecology
- member Scientific Committee ASLO meeting, Copenhagen 2000
- member Scientific Committee Intern. Symposium Microbial Ecology Amsterdam 2001
- member Editorial Board of Marine Ecology
- member of the Scientific Committee of NEBROC
- organizer 7th European Marine Microbiology Symposium the year 2000
- lecturer at the NEBROC course, Univ. Bremen, 20 September to 1 October
- coordinator of the EU project COMET (Composition of dissolved organic matter and its interaction with metals and ultraviolet radiation in river-ocean systems: impact on the microbial food web)

J.H.F. Jansen
- member Scientific Committee IGBP-PAGES-IMAGES 2 (The Intern. Marine Past Global Change Study
- member Dutch Ocean Drilling Project (ODP) working group

W.C.M. Klein Breteler
- member 'Plankton Interaction Group'
- member 'Nederlandse werkgroep deeltjes-karakterisering'
- member users group Quantimet (Image Analysis)

G.W. Kraay
- member flow-cytometer working group

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 of thesis of Nicolas Perenne of LEGI (Grenoble), Universite Joseph Fourier, France.

M. Mulder
- member workinggroup 'Monitoring rond Mijnbouwinstallaties'

G. Muyzer
- member Editotial Board of Applied and Environmental Microbiology
- member editorial board of FEMS Microbiology Ecology
- member National Scientific Committee of 7th European Marine Microbiology Symposium

R.F. Nolting
- member EC commission certification of sea- and estuarine water for trace metals

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

C.J.M. Philippart
- editor Journal of Sea Research
- member NL-GLOBEC committee
- guest-editor Proceedings of the Fourth International Symposium on Flatfish Ecology (JSR)
- (co-)organiser of NECOV workshop on 'Shelfish dynamics, birds and fisheries'

T. Piersma
- vice-chairperson International Wader Study Group (WSG)
- editor ARDEA
- member editorial board Current Ornithology, Plenum Press, New York
- member BirdLife International/IWRB Grebe Specialist Group
- member of Science Advisory Board of the Western Hemisphere Shorebird Reserve Network (WHSRN)
- member of the International Ornitological Committee (IOC)
- member editorial board ZOOLOGY, Germany

H. Ridderinkhof
- member 'Overleggroep Waterstanden en Getijden Raad van overleg fysisch oceanografisch onderzoek Noordzee'
- member Committee `Milieueffectrapportage'
- member 'Beoordelingscommissie aanvragen ALW'
- member 'Beleidsadviescommissie Aardwetenschappen ALW'
- member of the EUROGOOS Science Advisory Working Group
- member EUROGOOS-NL

R. Riegman
- co-editor Journal of Sea Research

M.J. Rietveld
- member 'International research Ship Operators Meeting' (ISOM)

J.S. Sinninghe Damsté
- associate scientist University of Utrecht, faculty of Earth Sciences
- associate editor Organic Geochemistry

D.H. Spaargaren
- secretary 'Commissie voor buitenlandse marien-biologische instituten', KNAW, Amsterdam
- member Board of advisory editors Crustaceana
- secratary, treasurer organising committee 4th International Crustacea Congress
- chairman science committee subtheme Physiology & Biochemistry ICC4
- member Council of European Working Group on Chemical Evolution, Early Biolgical Evolution and Exobiology, Strassbourg (F)
- member Groupement for l'Avancement de la Biochemie Marine, Gif/Yvette (F)

M.H. Stoll
- member Joint Global Ocean Flux Study Data Management Task Team (JGOFS-DMTT)
- member Carbon dioxide in the North Atlantic Ocean (CARIAN) Steering Committee

C.C. Ten Hallers-Tjabbers
- Advisor to IUCN for the London Convention 1972
- External advisor Faculty of Zoology & Anthropology, University of Porto, Portugal
- chairman Animal Navigation Group, Royal Institute of Navigation, London, UK

H.M. Van Aken
- member ICES Working Group on Ocean Hydrography

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

C.N. Van Bergen Henegouw
- executive secretary International Research Ship Operators Meeting (ISOM)
- member for Ministry O, C & W of the 'Interdepartementaal Overleg Zeegaande Vaartuigen' (IOZV)
- secretary National Oceanographic Data Committee

A.J. Van Bennekom
- member 'Academie Raad voor de Aardwetenschappen', KNAW
- member Working Group on Oceanic Hydrography, ICES
- editor Circumpolar Journal

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

J. Van Gils
- survey coordinator international Wader Study Group (IWSG)

J. Van Der Meer
- editor ARDEA
- member ICES Working Group on Statistical Aspects of Environmental Monitoring
- member of the Science Advisory Board of SOVON (Foundation for Ornithological Field Research in The Netherlands)
- member 'Onderwijscommissie Onderzoeksschool Functionele Ecologie'

H.W. Van Der Veer
- member organizing committee 4th International Symposium on Flatfish Ecology, Moorehead City, U.S.A.
- adjunct associate professor of Zoology, North Carolina State University, Raleigh, USA
- adjunct associate professor of Marine Science, University of South Carolina, Columbia, USA
- member Working Group on Recruitment Processes (ICES)
- guest editor Proceedings 4th International Symposium on Flatfish Ecology

F.C. Van Duyl
- board member Treub-Mij
- advisor Studiekring Suriname en de Nederlandse Antillen

W. Van Raaphorst
- member 'Werkgroep habitats, graadmeters en monitoring, BEON'
- member Dutch LOICZ commission
- editor Journal of Sea Research
- member SCOR working group 114 on permeable sediments

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 Scientific Committee IMAGES
- member Proposal Review Committee for EU TOBI and GLORIA HCM and TMR programmes
- special guest editor Progress in Oceanography Volume OMEX Benthic Processes
- member organizing committee Extreme Environments, Kiel, Germany, 19-22 November

M.J.W. Veldhuis
- member working group JGOFS-NL
- member advisory board Sarsia (USA)
- member Climate Committee KNAW
- member flow cytometer working group NL
- member SOMARE-SSC

G.J.M. Versteegh
- Member GEM Working Group

C. Veth
- member Southern Ocean Planning Group for JGOFS
- member (Netherlands) Committee Antarctic Research
- membre du Comité Scientifique de JGOFS France
- member Working group Joint Ocean Global Flux Study NWO/GOA
- membr Editorial Board of Oceanologica Acta

J.H. Vosjan
- Lecturer Marine Bacteriology, Postgraduate training course on Ecological Marine Management, Free University Brussels, Belgium

A. Weber
- member Plankton Interaction Group

M.R. Wernand
- member REmote sensing of WAter quality in the NETherlands group REWANET
- member Sensor Intercomparison and Merger for Biological and interdisciplinary Oceanic Studies [NASA] team. SIMBIOS

J.T.F. Zimmerman

- Professor Fysische Oceanografie, Rijksuniversiteit Utrecht
- member editorial board Continental Shelf Research
- IAPSO representative national UGGI comite (ARA-KNAW)
- member Committee 'Milieueffectrapportage'
- member 'themacommissie kustonderzoek' (BOA-NWO)
- member New York Academy of Sciences

MEETINGS AND COURSES, HELD AT NIOZ

ISM-MARPOL course for students of the Institute of Maritime Technology Amsterdam, Organised by NIOZ and Ecomare, Texel, 26-29 January. J.P. Boon: Co-ordinator on behalf of NIOZ.

Klein Breteler, W.C.M. Course 'Zeevaartschool'. Experiments on zooplankton survival during exposure to oil. 28 January.

The 11th Verwey Symposium was held from 31 January – 1 February, as part of the national PhD programme in Marine Life Sciences organized by the RUG and the NIOZ. The symposium is integrated in the educational programme of the Graduate School of Functional Ecology.

NEBROC course. 2- 4 February.

Ten Hallers-Tjabbes, C.C. & J.P. Boon. Inception Meeting Project Action to demonstrate the harmful impact of TBT, Effective communication strategies between policy makers and scientists in support of policy development (HIC-TBT, EU-LIFE), 4-6 February.

The course Introduction to Oceanography is part of the Marine Biology curriculum at RUG and was attended by 57 students, 29 majoring marine biology and 28 majoring environmental biology. H.J.W. de Baar at RUG gave the introductory lectures from 8 to 19 February. The 29 marine biologists followed a series of practical projects at NIOZ from 22 February through 5 March, including field work at the tidal flats and aborard RV Navicula and RV Pelagia in the Wadden Sea and the North Sea. J.W. Rommets coordinated the practical part. The enthusiasm and commitment of a great number of NIOZ scientific and supporting staff once again ensured an overall very stimulating course.

CODENET (Coccolithophorid Evolutionary Biodiversity and Ecology Network) spring 1999 workshop, 19-22 March.

European workshop ''Carbon Budgets of North Sea and Baltic' (CANOBA), NIOZ, Texel, 11-12 May.

Meeting Cold water Corals and Carbonate mounds, May 19-22 (T.C.E. van Weering).

Herndl, G.J. & B.R. Kuipers. Course Marine Ecosystems for the University of Groningen at NIOZ, 7-11 June. The course was devoted to the development of planktonic communities originating from 2 different ecological provinces, the North Sea and the open Atlantic. In mesocosms, the hypothesis was tested whether the different communities develop in a similar way under identical environmental conditions, such as irradiation and temperature. The students determined the oxygen balance in the different systems as well as the standing stocks of phyto- and bacterioplankton and protists. The results indicated that the original community composition changed only marginally while the metabolism of the 2 different systems became similar over time. At the end of the course simple carbon budgets for the 2 systems were established.

The course Marine Ecosystems (19 students) which is part of the Marine Biology programme of the RUG, was held from 7-25 June. The first and second week were dedicated to practical work at NIOZ. A programme of benthos and fish sampling, guided by the department MEE, was carried out with the R/V Pelagia in the North Sea (Frisian Front, Oyster Grounds) and with the R/V Navicula in the Wadden Sea. In the department BIO a phytoplankton springbloom was studied in pelagic mesocosms. These experiments included a/o. flowcytometrical measurements of grazing on bacteria. The extensive 'Results Report' was finished at 25 June. During the third week Prof. Dr. W.J. Wolff and several NIOZ scientists gave a series of lectures in the Biological Centre at Haren.

Philippart, C.J.M. DYNAMO annual meeting & workshop, 1-2 July, NIOZ, Texel.

Micro-symposium 'Mini-bugs in the big organic ocean', NIOZ, 23 September. Thirteen lectures including keynote lecture 'Bacterioplankton dynamics, carbon utilization and iron-limitation in the Southern Ocean' by prof. H. Ducklow of the College of William and Mary, Virginia, U.S.A.

Dapper, R. & C.J.M. Philippart. Course on Applications of ArcView, 16-17 November, NIOZ, Texel (organised by GEON)

Philippart, C.J.M. DYNAMO workshop, 2-3 December, NIOZ, Texel

NWO-Prioriteit Thema 2 Kick-off meeting, 15 December. (C.J.M. Philippart)
Mini symposium on the ecology of *Macoma balthica*, 16 December (C.J.M. Philippart)

3. Guest scientists, visitors and students

The NIOZ Guest house. Photo: B. Aggenbach

GUEST SCIENTISTS

- Battley, P., Department of Ecology, Griffith University, Nathan, Brisbane, Australia (1-10 January)
- Breen K., University of British Columbia, Vancouver, Canada (1 October-15 December)
- Brugger, A., Institute of Zoology, University of Vienna, Vienna, Austria, 20- 27 May.
- Caetano, M., IPIMAR, Lisbon, Portugal
- Cini-Castagnoli, Prof. Dr. G., Dipartimento di Fisica Generale Università di Torino and Instituto di Cosmogeofisica del CNR, Torino, ITALY
- Claassen, H., University of Amsterdam, Amsterdam (1 January – 31 July).
- Ferreira, A., IPIMAR, Lisbon, Portugal
- Grossi, V., University of Marseille, France
- Kolar, I., Institute of Zoology, University of Vienna, Vienna, Austria, 20- 27 May
- Koski, M., Finnish Institute of Marine Research, Helsinki, Finland, 15 February - 5 April
- Lassen, Dr.S., Geological Survey of Greenland and Denmark
- Letcher, R.J. Research Institute of Toxicology, University of Utrecht
- Pepping, M., University of Kiel, Kiel, Germany (5 February-15 March, 15 May-10 July, 6-20 September)
- Ortner, M., Institute of Zoology, University of Vienna, Vienna, Austria, 4 October- 20 December
- Probert, I., Laboratoire de Biologie et Biotechnologies Marines, Universite Caen, France
- Ruddock, P.J. MSc., University of the West of England, UK
- Santos, M., Department of Zoology and Antropology, University of Porto, Portugal
- Schäfer, H., University of Bremen, Germany, 2 January -30 December
- Van Lenning, K., Consejo Superior de Investigaciones Cientificas Institut de Ciencias del Mar, Barcelona, Spain
- Werne, J., Northwestern University, Chicago, USA
- Min W., The East China Sea Monitoring Center of Oceanic Administration, Shanghai, PR China, 1 January - 30 June
- Lassen, Dr.S.,Geological Survey of Greenland and Denmark

VISITORS

- Adams, Prof.dr. D.D., Center for Earth and Environmental Science, State University of New York, USA
- Bickert, Dr. T., Fachbereich Geowissenschaften, Universität Bremen, Bremen, Germany
- Bouwer, L. and Scheerboom, J.E.M., Agrarisch Opleiding Centrum, Midden Nederland
- Boyd, Dr. H., Canadian Wildlife Service, Ottawa, Canada
- Bijma, J., University of Bremen, Germany
- Conan, S.M., Free University Amsterdam
- Ducklow, H., College of William and Mary, Virginia, USA
- Dullo, Dr.C., GEOMAR, Kiel
- Eggens, M.L., Institute for Coastal and Marine Management, Ministry of Transport, Public Works and the Environment
- Ellner Dr. R., Canadian Wildlife Service, Delta-British Columbia, Canada
- Ganssen, G., Free University Amsterdam
- Gomez Ariza, J.L., Department of Chemistry and Material Sciences, Huelva, Spain
- Hedges, J.I., University of Washington, School of Oceanography, Seattle, USA
- Hollander, D., Department of Geological Sciences, Northwestern University, Evanston, USA.
- Hutchins, Dr. D.A, College of Marine Studies, University of Delaware, USA
- Ivanov, Dr. M. (MSU)
- Kemp, J.F. Royal Institute of Navigation, London, UK
- Kloprogge, J.T., Queensland University of Technology, Brisbane, Australia
- Kuijpers, Dr.T. (Geological Survey of Greenland and Denmark)
- Kvist, A., Lund University, Lund, Sweden
- Lipcius, Dr. R.N., Virginia Institute of Marine Science, The College of William & Mary, Gloucester Point, Virginia, USA
- Lueck, R., Centre for Earth and Ocean Research, University of Victoria, B.C. Canada
- Marret, Dr. F., School of Ocean Sciences, University of Wales (Bangor), Menai Bridge, UK
- Moos, C.A., University of Bremen, Germany
- Morabito, R. ENEA-CASACCIA, Rome, Italy
- Nilsson, J., Meteorological Institute Stockholm University, Sweden
- Peeters, F.J.C., Free University Amsterdam
- Schneider, Dr. R.R., Fachbereich Geowissenschaften, Universität Bremen, Bremen, Germany
- Scourse, Dr. J., School of Ocean Sciences, University of Wales (Bangor), Menai Bridge, UK
- Seitz, R., Virginia Institute of Marine Science, The College of William & Mary, Gloucester Point, Virginia, USA
- Steeger, U. and Mark, F., University of Münster, Germany

PLAATS VOOR DE AFDELING

- Stoker, Dr.M. (British Geological Survey)
- Weinbauer, Dr. M., National Biotechnology Center, Braunschweig, Germany
- Witlatch, Dr. R., Dept. Marine Sciences, University Connecticut, Groton CT, USA
- Ydenberg, Prof. R.C., Simon Fraser University, Vancouver, Canada

UNDERGRADUATE UNIVERSITY STUDENTS

- Brans, A., HBO, Van Hall Instituut, Leeuwarden
- Broker, K., RU
- Bruin, J., HBO, Hogeschool van Amsterdam, Amsterdam
- Cabrera, Y., UvA
- Damnanovic, A., Institute of Zoology, University of Vienna, Vienna, Austria,15 October- 30 December
- De Boo, J., Scottish Agricultural College, Edinburgh, Scotland
- De Heij, M., RUG
- De Leeuw, R., TUT
- De Vries, I., RUG
- Groeneveld, B., UvA
- Holtz, F., MBO, Reynevelt College, Delft
- Hendriks, E., IMAU, UU
- Koenderink, F., UU
- Nijgh de Sampayo, E., RUG
- Ossebaar, J., NOVA College/Bakhuis Roozeboom Instituut, Beverwijk
- Özdirekcan, S., Free University, Amsterdam, NL.
- Postma, C., MBO, Reynevelt College, Delft
- Polmans, R., NOVA College/Bakhuis Roozeboom Instituut, Beverwijk
- Paeper, V., NOVA College/Bakhuis Roozeboom Instituut, Beverwijk
- Praagman, H., UvA
- Rabaste F., Ecole Nationale Supérieure de Chimie de Rennes, Bretagne, France.
- Rienstra, M., IMAU, UU
- Rouveroy, M., UvA
- Schenk, I.W., UvA
- Schuit, M., UvA
- Smelt, J., RU
- Smith, F., RUG
- Terpstra, P., RUG
- Schenk, M., MBO, Reynevelt College, Delft
- Vahl, W., RUG
- Van 't Klooster, C., VU
- Van Meerloo, M., RUG
- Van Os, D., NOVA College/Bakhuis Roozeboom Instituut, Beverwijk
- Verkade, A., VU
- Vugteveen, P., RUG
- Vugteveen, P., RUG
- Welink, D., RUG

4. Sociaal Jaarverslag

ALGEMEEN

Het jaar 1999 was een belangrijk jaar voor het NIOZ. Het was niet alleen het laatste jaar voor de afronding van het Reorganisatieplan II: NIOZ-99 met als doel de financiële gezondmaking van het NIOZ. Het was ook het jaar waarin zowel het onderzoekinstituut (NIOZ-RES) als de faciliteire poot van het NIOZ (NIOZ-MRF) werden onderworpen aan een vijfjaarlijks peer-review, elk door een speciaal daarvoor ingesteld internationaal review panel. In beide gevallen was de uitkomst positief. Desondanks zijn er geen vooruitzichten dat de basisfinanciering zal stijgen.

De consequentie is, dat niet alleen in 1999 maar, bij ongewijzigd beleid, ook in de komende vijf jaar de aanhoudend krappe financiële situatie voortduurt. Dit vergt dat een zeer stringent financieel beleid wordt gevoerd. Dit heeft in 1999 ook gevolgen gehad voor het personeelsbeleid. Vervroegde uittreding en pensionering zorgden voor daling van de gemiddelde leeftijd. Verjonging en vernieuwing van de wetenschappelijke staf kon totstandkomen dankzij de werving van externe fondsen in de competitiefinanciering en de aanstelling van jonge tijdelijke medewerkers.

Ook in 1999 is het met zeer veel inspanning gelukt om met een sluitende begroting het jaar af te sluiten. Dit kon echter alleen door de toch al zeer magere fondsen van het NIOZ maximaal in te zetten.

De uitkomst van het NIOZ-MRF review zou moeten leiden tot een herziene organisatie met als uitgangspunten zo objectief mogelijke advisering naar ALW inzake het nationale vaarprogramma, zo efficient mogelijke bedrijfsvoering binnen het NIOZ, financiering rechtstreeks via NWO/CP overeenkomstig de nieuwe organisatie van NWO, met heldere financiële lijnen en verantwoordelijkheden en een sluitende exploitatie van het onderzoekschip Pelagia, zonder dat een beroep wordt gedaan op de basisfinanciering voor het onderzoek. Het overleg hierover met NWO was aan het eind van 1999 nog steeds gaande.

Ook was 1999 een bewogen jaar. Het plotseling overlijden van Afke Brouwer in het vroege voorjaar, ons jonge en zo levenslustige hoofd Bibliotheek, heeft het hele instituut diep geschokt. Daarnaast betreuren wij het overlijden van Henk Beumkes, onze vroegere havenmeester en van Prof.dr. G.P. Baerends, die als vroeger bestuurslid veel voor het NIOZ heeft betekend.

In het kader van de arbeidsvoorwaarden is op 30 juli een nieuwe CAO tot stand gekomen met een looptijd van twee jaar ingaande 1 januari 1999. Het jaar werd afgesloten met het akkoord over een op de CAO afgestemde herziene Collectieve Arbeidsvoorwaarden Regeling NWO/FOM/SMC/NIOZ die een looptijd zal hebben van drie jaar tot 1 januari 2003.

De plannen voor nieuwbouw en renovatie zijn tot in alle details uitgewerkt. Een bescheiden start met de uitvoering is gemaakt in 1999. Echter de grootste bouw- en verbouwactiviteit zal in 2000 plaatsvinden.

Ook de overige ondersteunende en technische diensten hadden een druk jaar. Niet alleen had de Pelagia een continue vaarplanning met in totaal 241 vaardagen, maar ook het onderhoud van het schip en de voorbereiding van de grote onderzoektocht "Around Africa 2000" die op 6 januari 2000 van start ging en tot 7 juni 2000 zal duren, vergde een grote inzet. Bovendien vergde het vaarprogramma MEDINETH dat gedurende 53 dagen met R/V Professor Logachev in de oostelijke Middellandse zee werd uitgevoerd veel inzet.

BESTUUR EN WETENSCHAPCOMMISSIE

Bestuur Stichting NIOZ

Per 31 december 1999 was het bestuur als volgt samengesteld:

Prof.dr. K. Verhoeff, voorzitter	Wageningen
Prof.dr. W. Delden	Vakgroep Genetica, faculteit Biologie, RU Groningen
Prof.ir. H.P. van Heel	Veere
Prof.dr. J.E. Meulenkamp	Vakgroep Geologie, Universiteit Utrecht
Ir. D. Tromp	RIKZ, ministerie van Verkeer en Waterstaat, Den Haag

Het bestuur kwam in het verslagjaar 1999 zesmaal met de directie in vergadering bijeen, op 18 januari, 1 april, 7 juni, 19 juli en 19 november in Utrecht of Amsterdam en 22-23 september op Texel. De informele vergadering van 18 januari en de vergadering van 19 juli waren extra vergaderingen in het kader van de voorbereiding van de zelfevaluatie documenten en de uitkom-

sten zoals neergelegd in de (concept)rapportages van de beide peer review panels. Op 22 september werd een gezamenlijke vergadering gehouden met de Wetenschapcommissie over de uitkomsten van de beide peer reviews en de consequenties voor de toekomst van het NIOZ.

De reguliere 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. Van Prof.dr. J.C. Duinker is afscheid genomen als lid van de commissie na afloop van zijn met twee jaar verlengde termijn.

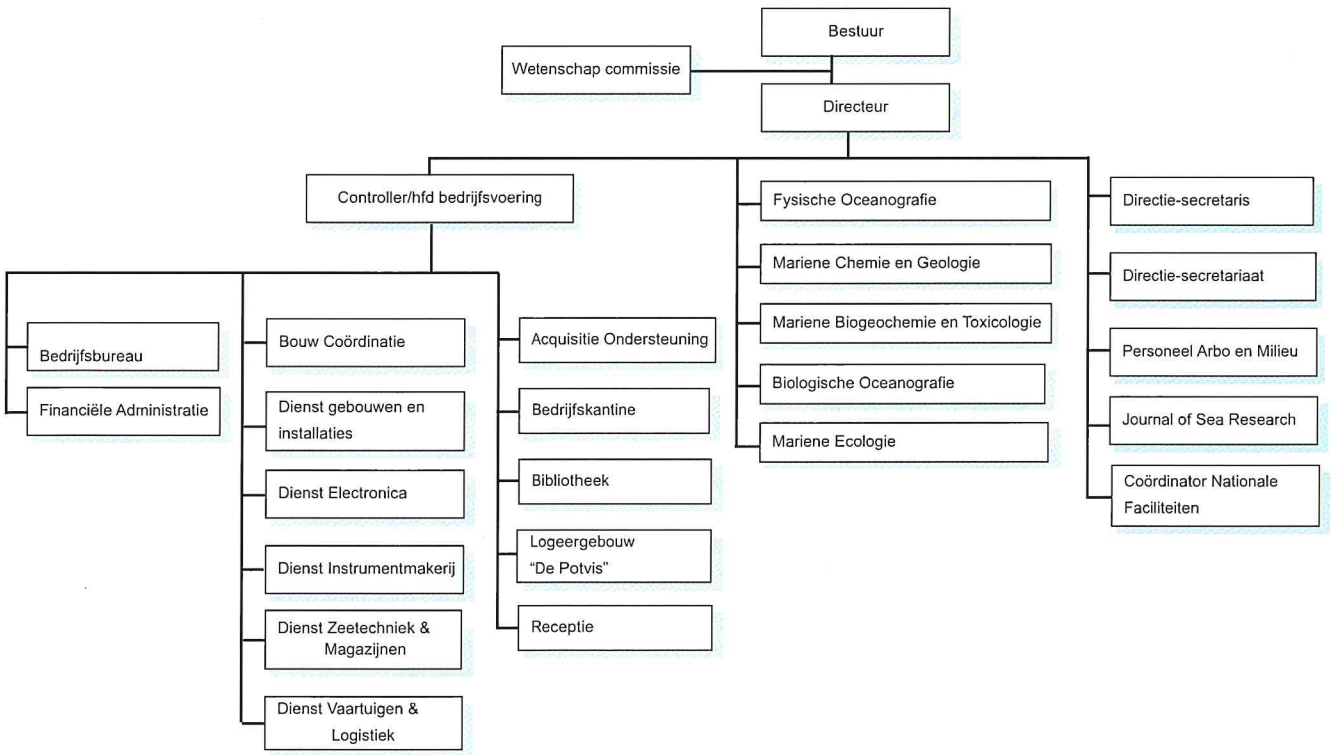
De Wetenschapcommissie was per 31 december 1999 als volgt samengesteld:

Prof.dr. W. van Delden, voorzitter	Vakgroep Genetica, faculteit Biologie Rijksuniversiteit Groningen
Prof.dr.ir. G.J.F. van Heijst	Afdeling Technische Natuurkunde, Technische Universiteit Eindhoven
Prof.dr. R.J. Law	Centre for Environment Fisheries and Aquaculture Science (CEFAS), Lowestofft, Engeland
Prof.dr. Karin Lochte	Institut für Ostseeforschung Warnemünde (IOW), Rostock-Warnemünde, Duitsland
Prof.dr. R.M. Warwick	Coastal Marine Biodiversity, Plymouth Marine Laboratory, Plymouth, Engeland
Prof.dr. G. Wefer	Geowissenschaften, Universität Bremen, Duitsland

De Wetenschapcommissie kwam in 1999 bijeen op 22-23 september te Texel. De uitkomst van het in 1999 gehouden peer review van het NIOZ was het hoofdonderwerp van de vergadering.

Op de avond van 22 september vergaderde de Wetenschapcommissie tezamen met het Bestuur. Genotuleerd werd door mevouw C.S. Blaauboer-de Jong.

ORGANOGRAM



PERSONEELSLIJST 31-12-99

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
Bol-den Heijer A.C.	29.25 uur	dir. secretaresse

STAFEENHEDEN

Personeels-, Arbo en Milieuzaken		
Vooys P.C.		hoofd
Mulder-Starreveld J.P.	28.5 uur	medewerker
Rommets J.W.		coördinator Arbo en Milieuzaken tot 1-4
Financiën en control		
Haas R.G. Drs. ir.		hoofd Bedrijfsvoering/Controller
Bijsterveld-Kessels A.C.M.		hoofd fin. administratie
Arkel M.A. van Drs.		projectcontroller
Wernand-Godee I.	32.3 uur	medew. project-administratie
Keijser A.	35.15 uur	medew. financiële administratie
Spel M.M.	13.5 uur	medew. financiële administratie
Tuinen H.A. van		medew. financiële administratie
nGraaf A.C. de		medewerker
Porto S.W. de		medewerker Inventarisbeheer
Nieuwenhuizen J.M.		medewerker Inventarisbeheer
Ran A.		hoofd Magazijn
Nationale zeegaande faciliteiten (MRF)		
Bergen Henegouw C.N.van Drs. ing		
.	32.0 uur	coördinator

CORE PROJECT OFFICE (LOICZ/IGBP)

Crossland C.J. Prof. dr		executive officer
Kremer H.H. Dr.		deputy executive officer
Pattiruhu C. Drs.		office-administrator
Jourdan M.T.	16.0 uur	administratief medewerkster

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
Gemmrich J.R.		projectonderzoeke
Gerkema T. Dr.		onderzoeker
Schrier G. van der Drs.		OIO NWO/GOA tot 16-07
Ligtenberg J. Drs.		OIO tot 17-03
Manders A.M.M. Drs.		OIO NWO
Eijgenraam F.		automatiseringsdeskundige
Nieuwenhuis J.		middelbaar electronicus
Wernand M.R.	36 uur	senior onderzoekmedewerker
Ober S. Ing.		senior onderzoekmedewerker
Hillebrand M.T.J.		senior onderzoekmedewerker
Manuels M.W.		onderzoekmedewerker
Hiehle M.A.		senior laboratoriummedewerker
Koster R.X. de		systeemanalist
Leeuw C.A. de		analist van 01-05 tot 01-09

AFDELING MARIENE CHEMIE EN GEOLOGIE

Helder W. Dr.		hoofd	
Raaphorst W. van Dr. ir.		senior onderzoeker	
Baar H.J.W. de Prof. dr. ir.	30.4 uur	senior onderzoeker	
Weering T.C.E. van Dr.		senior onderzoeker	
Jansen J.H.F. Dr.		senior onderzoeker	
Bennekom A.J. van Drs.		senior onderzoeker	tot 01-01
Brummer G.J.A. Dr.		onderzoeker	
Timmermans K.R. Dr.		onderzoeker	
Stigter H.C. de Drs.	24.0 uur	projectonderzoeker OMEX	
Stoll M.H.C. Dr.		onderzoeker	
Wilde H.P.J. de Ir.		Projectonderzoeker	tot 01-03
Haas H. de Dr.		Projectonderzoeker tot 01-07	
Gaast S.J. van der		senior onderzoekmedewerker	
Vaars A.J.		applicatietechnicus	
Nolting R.F.		senior onderzoekmedewerker	
Kloosterhuis H.T.		senior onderzoekmedewerker	
Ooijen J.C. van		senior onderzoekmedewerker	
Bakker K.M.J.		onderzoekmedewerker	
Malschaert H. Ing.		onderzoekmedewerker	
Boer W. Ing.		onderzoekmedewerker	
Iperen J. van	8.0 uur	senior laboratoriummedewerker	
Kalf J.		senior laboratoriummedewerker	
Witte A.J.M.	19.0 uur	laboratoriummedewerker	
Epping H.G. Dr.		onderzoeker	
Koning F.A. Drs.	34.2 uur	onderzoeker	
Jong J.T.M. de Ing.		projectassistent NWO/GOA	
Grutters M.C.H. Drs.		OIO	
West S. Drs.		OIO	
Loncaric N. Drs.		OIO	
Thomas H. Dr.		onderzoeker	
Richter T.O. Dr.		onderzoeker	
Schefuss E.		OIO NWO	
Visser R.J.W. Ing.		projectmedewerker NWO	tot 16-06
Croot P.L. Dr.		onderzoeker	
Laan P.		laboratoriummedewerker	
Gerringa A.L. Dr.	19.0 uur	postdoc	m.i.v. 01-07
Bonnin J. Drs.		OIO	m.i.v. 01-08

AFDELING MARIENE BIOGEOCHEMIE EN TOXICOLOGIE

Boon J.P. Dr.		hoofd	
Everaarts J.M. Dr.		senior onderzoeker	
Sinninghe Damsté J.S. Dr. ir.	34.2 uur	senior onderzoeker	
Booy K. Dr.	32.0 uur	onderzoeker	
Versteegh G.J.M. Dr.		onderzoeker	
Schanke A. van Ir.	32.0 uur	OIO	
Blokker P. Drs.		OIO NWO	
Meer van der M.T.J. Drs.		OIO NASA	
Dongen B.E. van Drs.		OIO	
Smittenberg R.H. Ir.		OIO NWO	
Pool W.G. Dr.		senior onderzoekmedewerker	
Baas M.		onderzoekmedewerker	
Rijpstra W.I.C.	19.0 uur	onderzoekmedewerker	
Dekker M.H.A. Ing.	32.0 uur	onderzoekmedewerker	
Lewis W.E.	23.0 uur	senior laboratoriummedewerker	
Weerlee E.M. van		laboratoriummedewerker	
Fischer C.V. Drs.	28.0 uur	laboratoriummedewerker	
Slootweg P.M.		projectmedewerker	tot 01-10
Kinkel H.		projectonderzoeker	
Pancost R.D.		beursaal	
Schouten S. Dr. ir.		projectonderzoeker	m.i.v. 01-03
Zegers B.N. Dr.		postdoc	m.i.v. 15-08
Hopmans E.C. Dr.		postdoc	m.i.v. 01-05
Kienhuis M.V.M.		analist	m.i.v. 01-09

AFDELING BIOLOGISCHE OCEANOGRAFIE

Herndl G.J. Dr.		hoofd	
Ruardij P. Drs.		onderzoeker	
Fransz H.G. Dr. ir.		senior onderzoeker	
Baars M.A. Dr.		senior onderzoeker	
Klein Breteler W.C.M. Dr.		senior onderzoeker	
Vosjan J.H. Dr.		senior onderzoeker	tot 01-09
Veldhuis M.J.W. Dr.		senior onderzoeker	
Duyl F.C. van Dr.		senior onderzoeker	
Riegman R. Dr.		senior onderzoeker	
Kuipers B.R. Dr.		onderzoeker	
Embsen E.G.M. Ing.		automatiseringsdeskundige	
Kraay G.W.		senior onderzoekmedewerker	
Kop A.J. Ing.		onderzoekmedewerker	
Oosterhuis S.S.		onderzoekmedewerker	
Noordeloos A.A.M. Ing.		senior laboratoriummedewerker	
Noort G.J. van		senior laboratoriummedewerker	
Gonzalez S.R.		senior laboratoriummedewerker	
Witte H.J.		senior laboratoriummedewerker	
Schogt N.		laboratoriummedewerker	
Snoek J. Ing.	30.4 uur	projectmedewerker NWO	tot 15-11
Muyzer G. Dr.		hoofd moleculair lab.	
Stoderegger K.E.		projectonderzoeker	
Pausz C.		projectonderzoeker	
Bleijswijk J.D.L. van Dr.	22.8 uur	onderzoeker	m.i.v. 01-05
Moeseneder M.M.		OIO	tot 01-06
Kramer G.D.		OIO	m.i.v. 01-01
Dutz J. Dr.		postdoc	m.i.v. 01-08

AFDELING MARIENE ECOLOGIE

Lindeboom H.J. Dr.		hoofd	
Meer J. van der Dr.		senior onderzoeker	
Beukema J.J. Dr.	24 uur	senior onderzoeker/hoofdredacteur JSR	
Bak R.P.M. Prof. dr.		senior onderzoeker	
Spaargaren D.H. Dr.		senior onderzoeker	
Fonds M. Dr.		senior onderzoeker	tot 01-05
Cadée G.C. Dr.		senior onderzoeker	
Veer H.W. van der Dr. ir.		senior onderzoeker	
Piersma T. Dr.		senior onderzoeker	
Wolf P. de Dr.		gastonderzoeker	
Bergman M.J.N. Ir.		onderzoeker	
Duineveld G.C. Drs.		onderzoeker	
Daan R. Dr.		onderzoeker	
Dekker R. Drs.		onderzoeker	
Philippart C.J.M. Dr.		projectonderzoeker	
Lavaleye M.S.S. Drs.		Projectonderzoeker	m.i.v. 27-09
Witbaard R. Dr.		projectonderzoeker NWO	
Drent J. Drs.		OIO NWO	
Epstein N.	24 uur	OIO	tot 01-12
Gils J. van Drs.		OIO RUG	
Edelaar W.M.C. Drs.		OIO RUG	
Luttikhuizen P. Ir.		OIO RUG	
Dapper R.		automatiseringsdeskundige	
Berghuis E.M.		senior onderzoekmedewerker	
Nieuwland G.		senior onderzoekmedewerker	
Spaans B. Drs.		senior onderzoekmedewerker	
Hegeman J.		onderzoekmedewerker	
Kok A.		onderzoekmedewerker	
Mulder M.		onderzoekmedewerker	
Witte J.IJ.		onderzoekmedewerker	
Puyl P. van der		laboratoriummedewerker	
Bruin W. de		laboratoriummedewerker	
Zuidewind J.		laboratoriummedewerker	

Weele J.A. van der	project-assistent	m.i.v. 01-06
Winter C.J.N.	project-assistent	tot 01-04
Dekinga A. Drs. Ing.	project-medewerker NWO	
Koutrik A. van	15.2 uur laboratoriummedewerker	
Lindstrom A.V.	19.0 uur onderzoeker	
Damme C.J.G. van	analist	van 16-8
		tot 16-12
Bos O.G. Drs.	OIO NWO	m.i.v. 01-04
Weber A. Dr.	postdoc	m.i.v. 12-04
Raaymakers C.E.	analist	m.i.v. 01-06
Maier C.	OIO	m.i.v. 01-09

ONDERSTEUNENDE DIENSTEN

Dienst gebouwen en installaties

Alkema P.R.	35.15 uur	hoofd DGI
Groot S.P.	22.8 uur	med. werktuigbouw
Kuip T.		med. werktuigbouw
Lakeman R.	20.0 uur	med. werktuigbouw
Daalder R.M.		med. houtbewerking
Witte R.J.C.		med. houtbewerking
Brondsema A.		med. energietechniek
Schilling F.J.		bouwcoördinator

Receptie

Kikkert A.	20.0 uur	telefoniste/receptioniste
Jourdan M.T.	20.0 uur	telefoniste/receptioniste
Starink J.M.	13.0 uur	telefoniste/receptioniste

AON

Aggenbach R.P.D.		eerste medewerker
Hart W.	24.0 uur	medewerker
Manshanden G.M.	32 uur	automatiseringsdeskundige
Barten-Krijgsman N.	15.2 uur	dir. secretaresse

Bibliotheek

Brouwer A.		Hoofd
Bruining-De Porto M.E.	31.5 uur	medewerker

Redactie

Beukema J.J. Dr.	24.0 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
Derksen J.D.J.		electronicus Pelagia
Asjes A.J.		medewerker m.i.v. 01-05

Zeetechniek

Porto H.H. de	hoofd
Schilling J.	plv. hoofd
Polman W.	medewerker
Bakker M.C.	medewerker
Blom J.J.	medewerker
Wuis L.M.	medewerker
Boom L.	medewerker
Gieles S.J.M.	medewerker Magazijn
Wit J.T. de	medewerker m.i.v. 13-07
Stins R.	medewerker m.i.v. 01-08

Bonne E.	medewerker (detachering)

Vaartuigen en logistiek

Buisman T.C.J.	hoofd
Eelman A.	chauffeur (detachering
Souwer A.J.	medewerker
Groot J.C.	gezagvoerder Pelagia
Ellen J.C.	1e stuurman Pelagia
Duyn M.D. van	2e stuurman Pelagia
Pieterse J.M.	hoofdwerktuigkundige Pelagia
Seepma J.	1e werktuigkundige Pelagia
Kalf J.J.	2e werktuigkundige Pelagia
Grisnich P.W.	scheepstechnicus Pelagia
Saalmink P.W.	scheepstechnicus Pelagia
Stevens C.T.	scheepstechnicus Pelagia
Mik G.	scheepskok m.i.v. 15-09
Betsema G.L.J.	matroos m.i.v. 24-11
Adriaans E.J.	schipper Griend
Star C.J. van der	schipper Navicula
Tuntelder J.C.	scheepstechnicus/kok Navicula
Vis van der P.C.A	machinist/motordrijver Navicula
Jongejan W.P.	komvisser

ARBEIDSVOORWAARDEN

In 1999 is de eerste specifiek op onderzoekinstellingen gerichte CAO van kracht geworden. Dit is een mijlpaal in het proces van decentralisering van het arbeidsvoorwaardenoverleg. Voor het eerst zijn alle primaire, secundaire en tertiaire arbeidsvoorwaarden die voor werknemers van het NIOZ gelden overeengekomen in onderhandelingen waarbij het NIOZ, als werkgever binnen de onderzoekorganisatie NWO, zelf invloed kon uitoefenen. Het tot standkomen van de CAO maakte wijzigingen noodzakelijk in de documenten waar tot dan toe arbeidsvoorwaarden van NIOZ-werknemers in werden vastgelegd. Over een nieuwe Collectieve Arbeidsvoorwaardenregeling (CAR) werd al een akkoord bereikt. Over de aan te passen NIOZ-arbeidsvoorwaardenregeling (AVR) en de daarin opgenomen Uitvoeringsregelingen wordt met de Ondernemingsraad overleg gevoerd.
Dit hoofdstuk bevat details over de nieuwe:

- CAO-Onderzoekinstellingen,
- CAR-NWO/FOM/SMC/NIOZ
- NIOZ-Uitvoeringsregelingen

CAO-onderzoekinstellingen (CAO-OI)

De CAO werd overeengekomen tussen de Werkgeversvereniging Onderzoekinstellingen[1] (WVOI) en de vakcentrales.
Door de komst van de CAO staan de (primaire) arbeidvoorwaarden en regelgeving nu overzichtelijk geregeld in één basisdocument. Voorheen stonden deze onderwerpen verspreid geregeld in documenten die op zeer verschillende niveaus tot stand komen (het Burgerlijk Wetboek, het BBOO, het RWOO, de CAR en de NIOZ-AVR).

Belangrijke punten uit de CAO-OI:

- looptijd: 1 januari 1999 tot 1 maart 2000.
- salarisverhogingen: per 1 maart 1999: 3%
  per 1 februari 2000: 0,5%.
  per 1 januari 2000 de eerste drie treden in de oio-schaal (resp. 5, 3, en 1 %).
- oio's ook recht op minimum vakantieuitkering
- systeem van gronden en voorwaarden voor tijdelijke dienstverbanden
- mogelijkheid tot deeltijdarbeid
- aantal verlof dagen terug naar 23, maar uitbreidingen aantal leeftijdsdagen
- terugbetalingsverplichting ouderschapsverlof verkort tot 6 maanden
- mogelijkheid tot 1 maand betaald zorgverlof bij zeer ernstige ziekte van bloedverwant of aanverwant
- verruiming aanleidingen voor calamiteitenverlof

[1] *De Werkgeversvereniging Onderzoeksinstellingen bestaat uit de Nederlandse Organisatie voor Wetenschappelijk Onderzoek, NWO, de Koninklijke Nederlandse Akademie voor Wetenschappen, KNAW, de Koninklijke Bibliotheek en het Nederlands Interdisciplinair Demografisch Instituut NIDI.*

In deze eerste CAO moest een start worden gemaakt met het harmoniseren van de verschillen tussen de - secundaire - arbeidsvoorwaarden en regelingen van de werkgevers vallend onder de koepel NWO en de andere werkgevers in de WVOI. Voor NIOZ betekende dit bijvoorbeeld dat de vermindering van leeftijdsdagen uit de CAR-1993 weer werd teruggedraaid. Door de wettelijke verschillen tussen werknemers met en zonder ambtenarenstautus (beiden komen voor binnen de WVOI) is harmonisering niet op alle punten mogelijk. Zo blijven er tijdens de looptijd van de CAO verschillende ontslag-regimes gelden.

Collectieve Arbeidsvoorwaardenregeling (CAR)-NWO/FOM/SMC/NIOZ

De CAR dateert uit een eerdere fase in het proces van decentralisering van het arbeidsvoorwaardenoverleg. Toen de onderhandelingen over de primaire arbeidsvoorwaarden nog centraal plaatsvonden op het niveau van de minister van OC&W maakten de werkgevers NWO, FOM, SMC en NIOZ afspraken met vakcentrales over secundaire ('tijd en geld") arbeidsvoorwaarden in de CAR.

Vooralsnog is de CAR aan de nieuwe situatie aangepast met als uitgangspunt budget- en kostenneutraliteit.

Belangrijke aanpassingen in de CAR:

• looptijd:	1 januari 2000 tot 1 januari 2003 .	
• pensionkostenvergoeding:	in geval van aantoonbaar dubbele (woonruimte)kosten. de duurbeperking van 1 jaar is, voor bijzondere gevallen verhoogd naar 2 jaar.	
• verhuiskosten		
tegemoetkoming inrichtingskosten:	bij tijdelijk dienstverband	verhoogd naar *f*4000.-.
	bij vast dienstverband	verlaagd naar *f*5000.-.
terugbetalingsverplichting:	de omvang van de verplichting neemt af (maandelijks met 1/24 ste deel).	
• nevenwerkzaamheden:	afdracht van de vergoeding vervallen. (bij nevenwerkzaamheden buiten werktijd)	
• reiskosten woon-/werkverkeer:	vaststelling afstand met de ANWB-routeplanner.	

NIOZ-Uitvoeringsregelingen

Toen er in 1989 voor het eerst tussen NIOZ en de OR een arbeidsvoorwaardenregeling werd afgespoken was er nog geen sprake van een eigen collectieve arbeidsovereenkomst of collectieve arbeidsvoorwaarden regeling. Ook in de toekomst zal echter naast een CAO (en eventueel een CAR) de behoefte bestaan om over NIOZ-specifieke onderwerpen afspraken te maken met een werknemersvertegenwoordiging: uitvoeringsregelingen. De eerste NIOZ-uitvoeringsregelingen in het CAO-tijdperk wordt vastgesteld na overleg en in overeenstemming met de Ondernemingsraad van het NIOZ.

Arbo- en milieujaarverslag NIOZ 1999

Inleiding

In dit verslag wordt gerapporteerd over de belangrijkste activiteiten op het terrein van arbo en milieu die in 1999 hebben plaatsgevonden. Omwille van de leesbaarheid is de rapportage zo beknopt mogelijk gehouden.

1. Beleid
Het NIOZ is bezig met het opzetten van een integraal management systeem. In verband met internationale afspraken in eerste instantie voor de dienst vaartuigen. Het systeem zal stapsgewijs worden uitgebreid.

2. Personeel
Arbo- en milieuzaken werden besproken in de overlegvergaderingen van directie met de OR en van directie met de kleine staf.

3. Ongevallen
Een medewerker wilde een kitpatroon openmaken met behulp van een beitel. De beitel schoot uit en verwondde zijn hand. Na eerste hulp van de EHBO doorverwezen naar arts.
Een medewerker verwondde zijn duim en vinger aan scherp laboratorium glaswerk. Door de EHBO doorgestuurd naar arts. Deze heeft de wond gehecht. Glaswerk is vervangen.

Door een stoeipartij gleed een matroos uit op het natte dek van de Pelagia en brak naar later bleek een rib.
Aan boord van de Pelagia werd een matroos geraakt aan haar knie en onderbeen door stenen toen ze het net leegmaakte na een vistrek. Ze kon het werk niet hervatten.
Een lid van de bedrijfsbrandweer ontdekte een brandende asbak in de gang in blok A10. Hij heeft dit brandje gedoofd en de asbak geleegd. Oorzaak van de brand: iemand had papier in de asbak gedeponeerd op een nog smeulende peuk.

4. Veiligheids- en milieuzaken
De tussen 1995 en 1998 uitgevoerde risico inventarisaties en evaluaties zijn door AVIOS arbo in december 1998 getoetst. Rapportage over deze toetsing kwam beschikbaar in mei 1999. Goedkeuring van de RIE werd verleend onder enkele voorwaarden. Om aan de voorwaarden te voldoen wordt een Plan van Aanpak opgesteld. Prioriteiten zijn in dit plan aangegeven.

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

Via de gehuurde container is door de firma Watco EcoService (voorheen Ecotechniek) 2487 kg klein gevaarlijk afval afgevoerd; dit was in 1993 805 kg, in 1994 2155 kg, in 1995 1395 kg, in 1996 2295 kg, in 1997 1345 kg en in 1998 3147 kg. De belangrijkste componenten waren oplosmiddelen, giftige chemicaliën, laboratoriumafval, ontwikkelaar, batterijen en TL buizen.

Overzicht papierverbruik in vellen A4.

Jaar	Totaal	Kopieermachines	Overige
1990	746.567	736.567	10.000
1991	1.034.654	886.654	148.000
1992	1.279.539	993.539	286.000
1993	1.391.614	967.614	424.000
1994	1.686.015	1.124.015	562.000
1995	1.696.993	996.993	700.000
1996	1.172.000	774.175	397.825
1997	1.261.000	814.741	446.259
1998	1.170.500	727.256	443.244
1999	1.205.000	709.698	495.302

Overzicht energieverbruik en energiekosten

Jaar	kWh	m3 gas	m3 water	Energiekosten
1991	1.406.820	300.707	15.500	404.437
1992	1.729.800	278.716		454.748
1993	1.991.180	307.489		481.909
1994	2.082.247	479.480	16.716	443.122
1995	1.285.740	422.477	15.923	417.168
1996	1.147.907	562.329	13.599	462.221
1997	1.212.420	491.194	12.380	452.186
1998	1.143.423	506.155	11.952	473.694
1999	1.304.540	471.621	11.252	482.627

Door de warmte-kracht installatie (WKK) is behalve warmte ook 980.000 kWh electriciteit geleverd.
Door de windmolen is nog extra 115.736 kWh voor NIOZ gebruik opgewekt.

5. Bedrijfsgezondheidszorg
De radiologische werkers werden door de arbodienst gekeurd.

Ziekteverzuim
In 1999 bleef het ziekteverzuim (5.45%) nagenoeg gelijk aan dat in 1998 (4.98%). Hieronder een onderverdeling in ziekteverzuim bij wetenschappelijk (WP) en niet-wetenschappelijk personeel (NWP)

	WP	Man	Vrouw	NWP	Man	Vrouw	
1993	2.0	-	-	5.1	-	-	
1994	2.4	1.5	5.5	5.4	5.6	4.7	
1995	1.5	1.3	2.2	5.2	5.0	5.8	
1996	2.1	1.8	4.3	9.5	8.1	14.1	
1997	4.3	4.3	4.3	6.8	6.1	9.8	
1998	4.5	4.0	12.8	5.3	3.5	13.4	
1999	5.5	5.4	5.8	5.5	5.5	5.1	(%)

Volledigheidshalve wordt opgemerkt dat de verzuimpercentages uitsluitend betrekking hebben op het kalenderjaar 1999.

6. Bedrijfshulpverlening
Om de EHBO ploeg weer op sterkte te brengen gingen vijf personen de basiscursus EHBO volgen te Den Helder.
Ten behoeve van de EHBO voorziening zijn vijftien personen op herhaling-cursus geweest voor het eenheidsdiploma EHBO van het Oranje Kruis. De cursus werd gegeven door Arbodienst Den Helder.

De leden van de bedrijfsbrandweer oefenden maandelijks 2 uur.
De jaarlijkse controle van de brandmeldinstallatie en alle brandmelders is verricht evenals de controle van de kleine blusmiddelen en de zeven adembeschermingsapparaten van de brandweerploeg. Er werden vier nieuwe kunststof cilinders aangeschaft. De draagbare motorspuit van 1985 werd vervangen door een nieuwe Rosenbauer Fox motorspuit.

7. Investeringen
Door de afdelingen en diensten was in totaal f 102.900 begroot voor de verbetering van de werkplek.

8. Vergunningen
Er is een vergunning ANW 99/8209 verleend op grond van de Wet verontreiniging oppervlaktewateren door het Ministerie van Verkeer en Waterstaat, Directie Noord-Holland voor het lozen van afvalwater van laboratoria en aquaria op de Waddenzee voor vijf jaar
Voor het verspreiden/storten van baggerspecie afkomstig uit de NIOZ-haven in de Waddenzee heeft Rijkswaterstaat Directie Noord-Holland op 12 februari 1999 een vergunning afgegeven op grond van de Wet verontreiniging oppervlaktewateren. De vergunning ANW 99/870 is geldig tot 1 januari 2002. Op grond van de wet Milieubeheer heeft Gedeputeerde Staten van de Provincie Noord Holland een gedoogbeschikking verleend. Directie Noord van het Ministerie van Landbouw, Natuurbeheer en Visserij verleende toestemming door een besluit volgens de Natuurbeschermingswet en de Gemeente Texel gaf een aanlegvergunning af voor nautisch baggerwerk.

Omschrijving	Methode	Maximum grens	1e kwartaal 1999	2e kwartaal 1999	3e kwartaal 1999	4e kwartaal 1999
Ontsluiting	NEN 6465					
Cadmium	NEN 6458	10 µg/l	<4,0	0,4	0,6	<2
Kwik	NEN 6449	0,1 µg/l	0,3	<0,1	0,1	<0,1
Arseen	NEN 6457	1,0 µg/l	1,5	<1	2	<1
Zink	NEN 6426	1000 µg/l	<40	50	23	44
Chroom	NEN 6426	1000 µg/l	<20	<2	<2	<7
Nikkel	NEN 6426	1000 µg/l	36	2	2,5	7
Koper	NEN 6426	1000 µg/l	<40	17	5	42
Lood	NEN 6426	1000 µg/l	<100	<10	<10	<10
Molybdeen	NEN 6426	1000 µg/l	<60	13	19	14
Zilver	NEN 6426	1000 µg/l	<40	<4	<4	<4
PAK EPA (16)	o-NEN 5771	4 µg/l	-	-	-	-
EOX	NEN 6676	100 µg/l	<1	<1	<1	<1
Som van MAK	o-NEN 6407	100 µg/l	<1,8	<1,8	<1,8	<1,8
Totaal cyanide	o-NEN 6655	1 µg/l	<2	<2	<2	<2
pH	NEN 6411		7,6	7,7	7,8	7,8
Chloride	NEN 6476	mg/l	10700	12900	14500	15000
OCB-PCB	NEN 5718	0,01 mg/l	-	-	-	-
Geloosde hoeveelheid		m^3	14.920	15.520	16.760	20.760

In verband met de vergunning voor het lozen van afvalwater op de Waddenzee heeft het laboratorium van Tauw Milieu te Deventer ieder kwartaal het geloosde afvalwater geanalyseerd op de onderstaande parameters volgens de vermelde methode:

Het NIOZ heeft opgave gedaan van de geloosde hoeveelheid zeewater en laboratoriumafvalwater in m^3/kwartaal. Voor een beter inzicht in de aard van het water is een chloride bepaling gedaan als aanvulling op de vereiste metingen.

Deze gegevens zijn uiterlijk één maand na het beëindigen van ieder kwartaal toegezonden aan Rijkswaterstaat Directie Noord Holland met afschrift aan het RIZA.

VERSLAG VAN DE PERSONEELSVERENIGING

In het jaar waar het millenniumprobleem de boventoon voert en een groot deel van het huidige bestuur te kennen gaf er aan het einde van dat jaar (vorige eeuw) mee te willen ophouden was het toch weer gelukt er een leuk jaartje van te maken.

In april '99 stond ons traditionele kinderpannenkoekenfeest op het program. Met ballonnen, een kleurwedstrijd, videofilms, kindertoneel en natuurlijk pannenkoeken waren dit de ingrediënten voor een geslaagd kinderfeest.

Na vorig jaar van een busreisje te hebben genoten was het in oktober '99 weer eens tijd voor een beetje beweging: 'Klootschieten', een voor velen van ons onbekende tak van sport. Menigeen werd daardoor 'zwaar' op de proef gesteld. Gestart en gefinisht werd er bij de Catharinahoeve, na het doorkruisen van een lastig (en soms nat) parcours, kon men hier genieten van een borrel bij het haardvuur en van de sterke verhalen van de andere groepen, om zich vervolgens culinair te laten verwennen.

Op naar de eeuwwisseling. Dit gebeuren wilden wij zeker niet onopgemerkt aan ons voorbij laten gaan. In samenwerking met de Directie, afd. MCG en Dienst Zeetechniek was er van alles uit de kast getrokken om hieraan voorafgaand een knalfeest te organiseren. In een schitterende en sfeervolle entourage met hapjes, drankjes en live muziek was dit weer zeker genieten.

Ook was er nog een officieel tintje aan deze namiddag, met een dankwoord aan de scheidende bestuursleden M.Wernand, M.Mulder, A.Keyzer en H.Witte, die ons in alle voorgaande jaren prima hebben vermaakt. Met het huidige (vernieuwde) bestuur willen wij de bij deze PV behorende activiteiten zeker voortzetten.