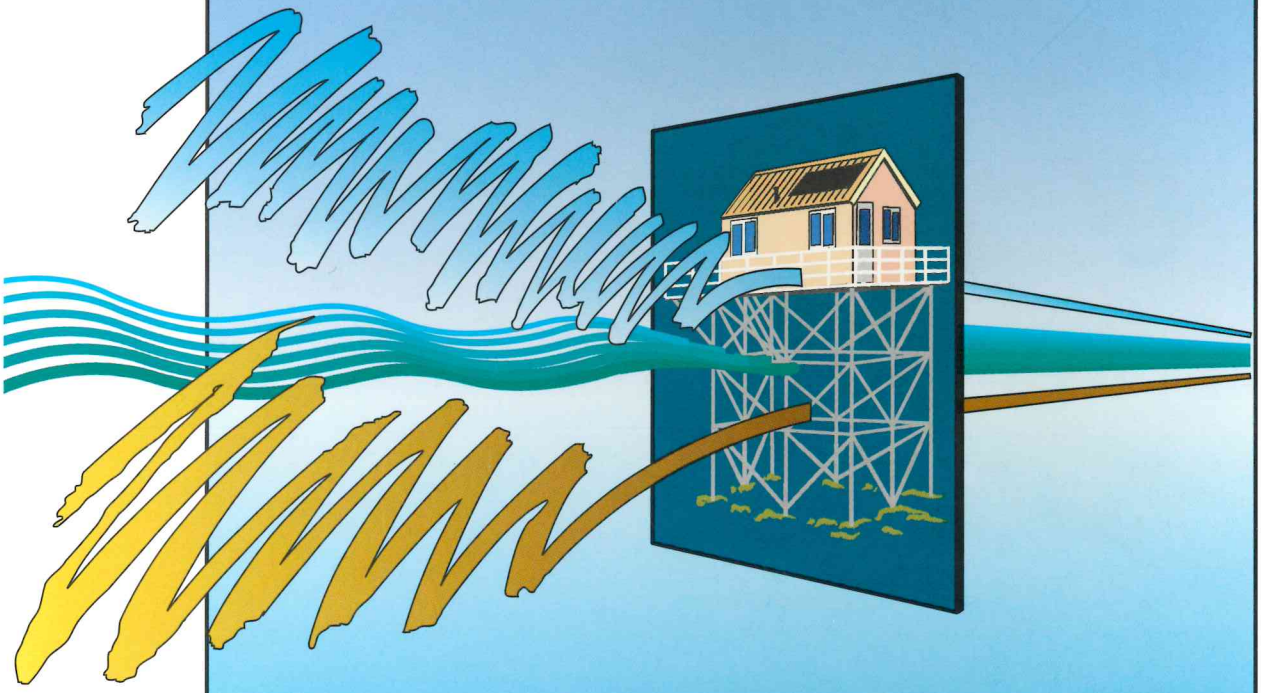
ANNUAL Report 2002



ROYAL NETHERLANDS INSTITUTE FOR SEA RESEARCH (NIOZ)

ROYAL NETHERLANDS INSTITUTE FOR SEA RESEARCH
ANNUAL REPORT 2002

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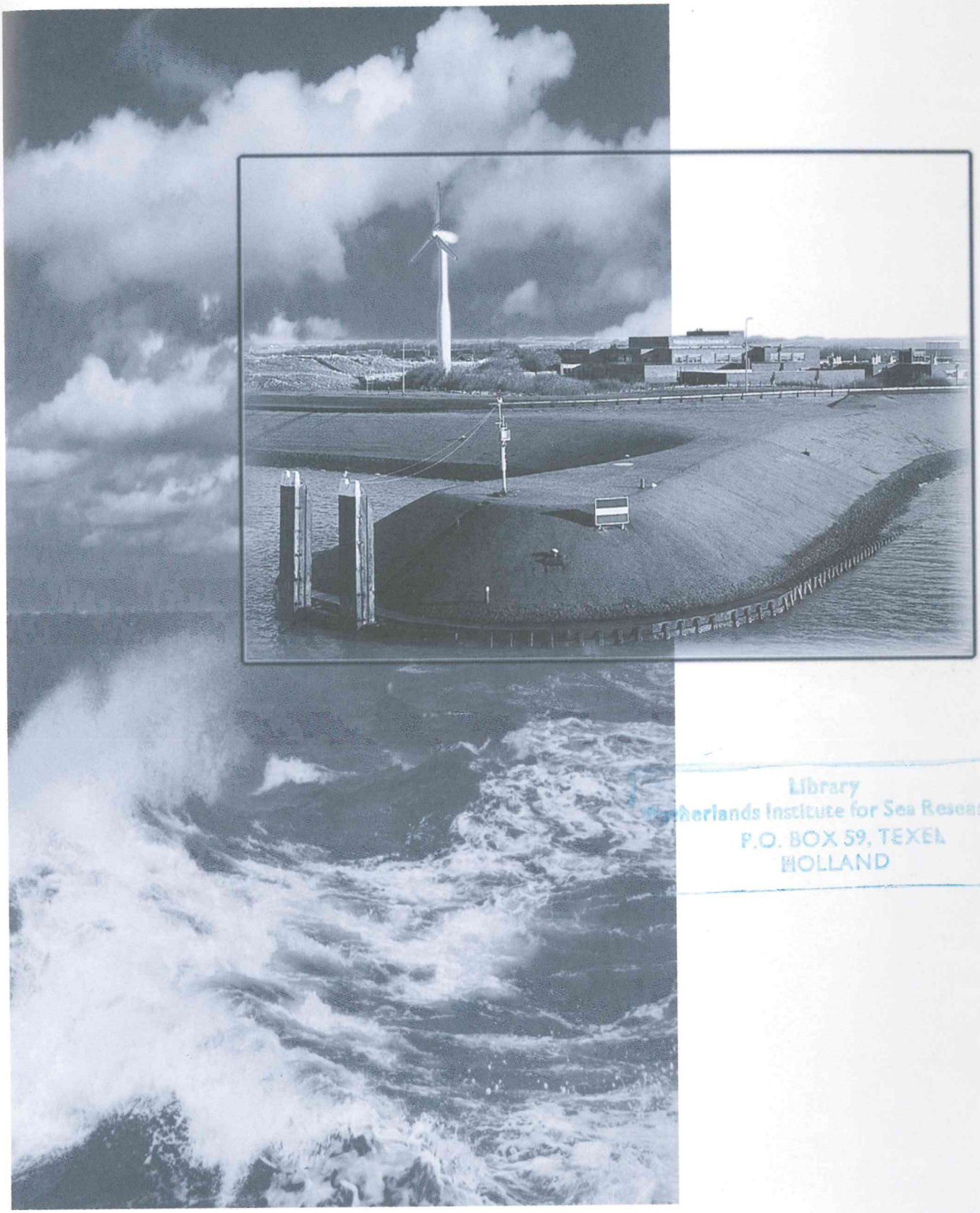

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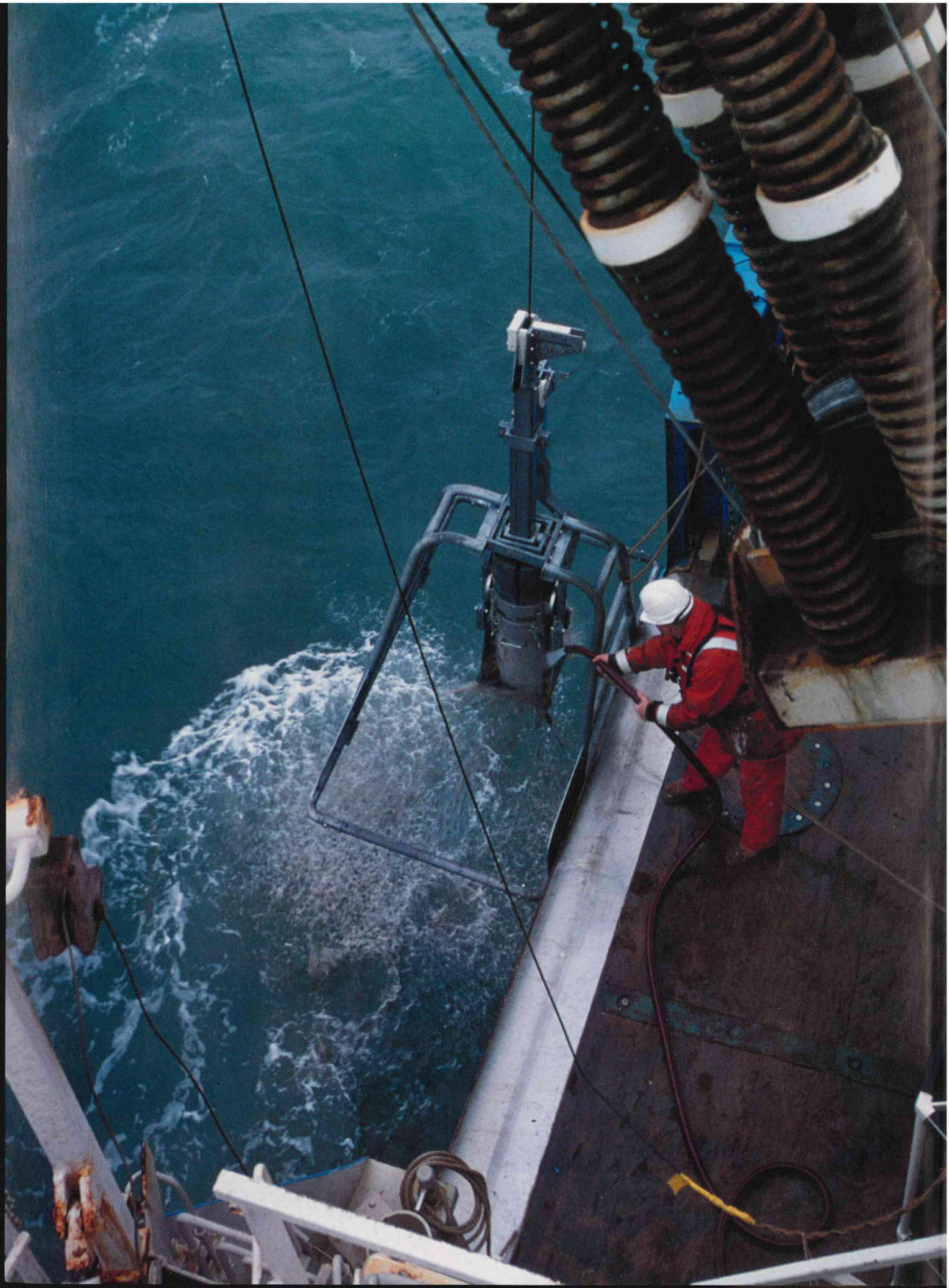

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Photo:
Jeffry Oonk & Marleen Azink.

The year 2002 has been a turbulent year in terms of science and building activities but also financially and socially.

Virtually all year long most of our personnel suffered significantly from the activities associated with the building of ca. 3000 m^2 laboratories, offices, storerooms and the canteen going on above their heads. There was a lot of noise, dust and dirt and every now and then no electricity, water or other facilities. A sigh of relief was noticed when most of the builders left the main building at the end of November. The members of several scientific and supporting departments as well as the personnel of Alterra started to move in and were installing themselves in the new offices and laboratories at the very end of the year. The major renovation of the large Experimental Facility Building went on all year and will be finished and ready for use again early next year. Furthermore, preparations have been made for a second phase of new building of offices for the technical departments, a facility to store formaline preparations and the guest centre.

The RV Pelagia as well as the other research vessels have been cruising all year long to facilitate the seagoing research of many Dutch and foreign marine research groups. The new deep-sea winch has been installed and used throughout the year and has, as expected, operated very well. Since it is foreseen that the RV Pelagia will be fully- or even overbooked in the years to come it was decided to extend the permanent crew considerably to prevent hiring external crew members on a temporary base. This year the RV Pelagia became part of a consortium of research vessels run by England, France, Germany and the Netherlands. This participation will further improve the flexibility and quality of our national seagoing research. Moreover, in July the RV Pelagia became ISM-certified, so that the quality of operation of the ship is garanteed even more than before. One of the old small ships operating on the Wadden Sea was sold and replaced by a faster and more adequate ship, the Stern. The new building of a modern fast ship, to be shared by Royal NIOZ and TNO, for transport and research in the Wadden Sea and the coastal North Sea has been prepared in detail. If sufficient funding is obtained that ship will be built next year.

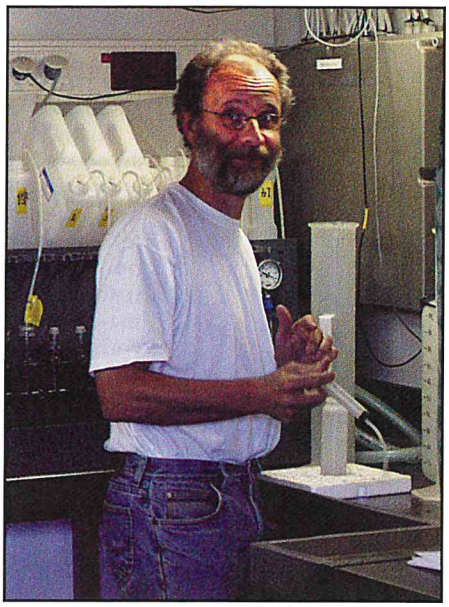
The excellent seagoing facilities will also enable the execution of a major five-year scientific program, LOCO (Long-Term Ocean Climate Observations). This program focuses on the permanent and long-term observation of the variability of the worldwide Thermo Haline Circulation (THC) at crucial locations, i.e. the Irminger Sea, the Mozambique channel and the Indonesian Through-Flow by means of mooring and modelling activities by international co-operation of the physical oceanographers of the University of Utrecht (IMAU), the KNMI and Royal NIOZ with physical oceanographic research groups of many other countries. Funding for this program was obtained through NWO (NWO-groot). At a later stage chemical and biological sensors will be installed on the mooring devices to monitor long-term changes in the chemistry and (micro)biology as well.

A major successful effort was undertaken by Helmut Thomas and many coworkers over the last two years as part of the NEBROC program. For the first time a detailed study was performed to find out whether a coastal sea like the North Sea is a source or a sink for CO_2. Four major expeditions during four subsequent seasons took place and thousands of water samples were analyzed. The intriguing results are mentioned in this annual report.

Although the tenure staff of Royal NIOZ decreased once again as a consequence of the financial status the total number of tenure and temporal scientists remained at the same level due to the successful submissions of proposals to several funding agencies. As a result the total number of articles in peer-reviewed journals, including Nature and Science increased as well as the number of theses.

To improve the financial situation of Royal NIOZ the NIOZ Board and directory have spent considerable time and energy in discussions with NWO and others. Several documents have been prepared highlighting the historical cause of the financial problems as well as the required budgets for 2003 and the years thereafter. Apart from the funding for science and seagoing facilities the high costs required for the working environment and labour conditions, for safety and security as a consequence of Dutch legislation have been emphasized. It is foreseen that the General Board of NWO will take a final decision on these matters early 2003.

Early this year a major farewell party was organized for ca. 30 coworkers who left or were about to leave Royal NIOZ as a consequence of our early-retirement arrangement set up in 2000. The atmosphere at that party was very good and all participants enjoyed several cabaret performances of NIOZ coworkers and a professional, the dinner, as well as many shared sweet memories.



November 6 and the days and weeks thereafter Royal NIOZ was in a shock; Wim van Raaphorst, the department head of the Department of Marine Chemistry and Geology, was hit by a car while biking home in terribly bad weather and died shortly afterwards in the hospital in Den Helder, leaving behind his wife and three young children. Wim was not only an excellent scientist with a very broad multidisciplinary view of marine sciences but also a dedicated Department head and a very sympathetic person with many good friends in and outside Royal NIOZ. One of his last activities was leading the preparation of a new Science Plan for the next 5 to 10 years for Royal NIOZ. His ideas and thoughts will certainly impact our science in the years to come.

I have the wish to end this introduction of our annual report 2002 by expressing my hope that Royal NIOZ as well as other scientific institutions in the Netherlands will be able to maintain the high quality of their research, despite the continuous and nation-wide loss of quality in basic and high school education, in management of enterprises and in politics and despite the ever decreasing funding for science.

Jan W. de Leeuw

1. Scientific Report

Photo: Jeffry Oonk & Marleen Azink.

THE NORTH SEA REVISITED

NIOZ has a long tradition in North Sea research, especially from sea-going expeditions. These expeditions became frequent after the R/V Aurelia was bought in 1972. A large impulse for North Sea research occurred immediately after the R/V Pelagia came into service, in 1991. This 67 m long, well-equipped ship is still NIOZ' pride. Recently, an intensification of North Sea research was noticed with five large programmes involving scientists of all NIOZ departments. On the next pages you will find summaries of these projects that are briefly introduced below. They cover many different aspects of marine research.

During *PROVESS* (for meaning of acronyms see individual paragraphs), the vertical exchange (mixing processes) in the water column was studied at sites in the northern and southern North Sea with and without stratification, respectively. The study intended to determine the impact of mixing on nutrient distribution and, thus, on (primary) production. New insights on water mass and nutrient dynamics mainly due to horizontal transport were obtained during the extensive *Plume & Bloom* campaign in the Frisian Front area. The Frisian Front is an area of enhanced phytoplankton just north of the Netherlands and subject of NIOZ-studies for over three decades. In the same area, the impact of nutrient dynamics on secondary production of benthic fauna (bivalves) was studied during *BIVALFF*. Surprisingly, for some bivalve species larger growth rates were found in sandy sediments than in the cohesive sediments at the Frisian Front. This associated well with novel insight on benthic mineralisation, as obtained during *EMIR*. This study revealed mineralisation rates in sandy sediments comparable to those in organic rich cohesive sediments. The integrated effects of the above subjects accumulated in *CANOBA*, in which the net balance of CO_2-fixation and mineralisation was studied in association with different vertical mixing regimes through the entire North Sea. It was shown that the North Sea is an overall sink for atmospheric CO_2, but that large seasonal differences occur between the shallow southern and the deep northern North Sea. These differences were attributed to the seasonal stratification, large in deeper parts and not existent in the shallow parts...

The effort of NIOZ scientists and technicians covering these programmes was large, to which many colleagues from other (domestic and foreign) institutes contributed.

Crew and participants EMIR, summer 2002 (photo: Erik Epping).

PROCESSES OF VERTICAL EXCHANGE IN SHELF SEAS (PROVESS)

Contributors: H. van Haren, J. Gemmrich

PROVESS is an EC-MAS3 programme with 18 partner institutes contributing between March 1998 and May 2001. Main results were published in 2002 in two special issues of the Journal of Sea Research (Vol. 47, 3-4 and Vol. 48, 4). The programme was centred for two contrasting sites in the North Sea on measuring and modelling vertical turbulent exchange and their effects on particles, zooplankton and nutrient cycling, particularly the relative importance of cycling in the water column, the sea bed fluff layer and the sediments. Turbulence activity was weaker at the northern site, which stratified in summer, and where measurements were taken during the start of the autumnal breakdown of stratification. The southern site was much more dynamic both in terms of turbulence and of particles. The site was close to the Dutch coast and was well-mixed throughout the year, except for the intermittent influence of the Rhine plume. The study contributes towards the long-term goal of developing robust water column plankton models applicable in the full range of turbulence environments encountered in continental shelf seas. The NIOZ contribution consisted of high-frequency current and temperature measurements and the deployment of moorings from the R/V Pelagia.

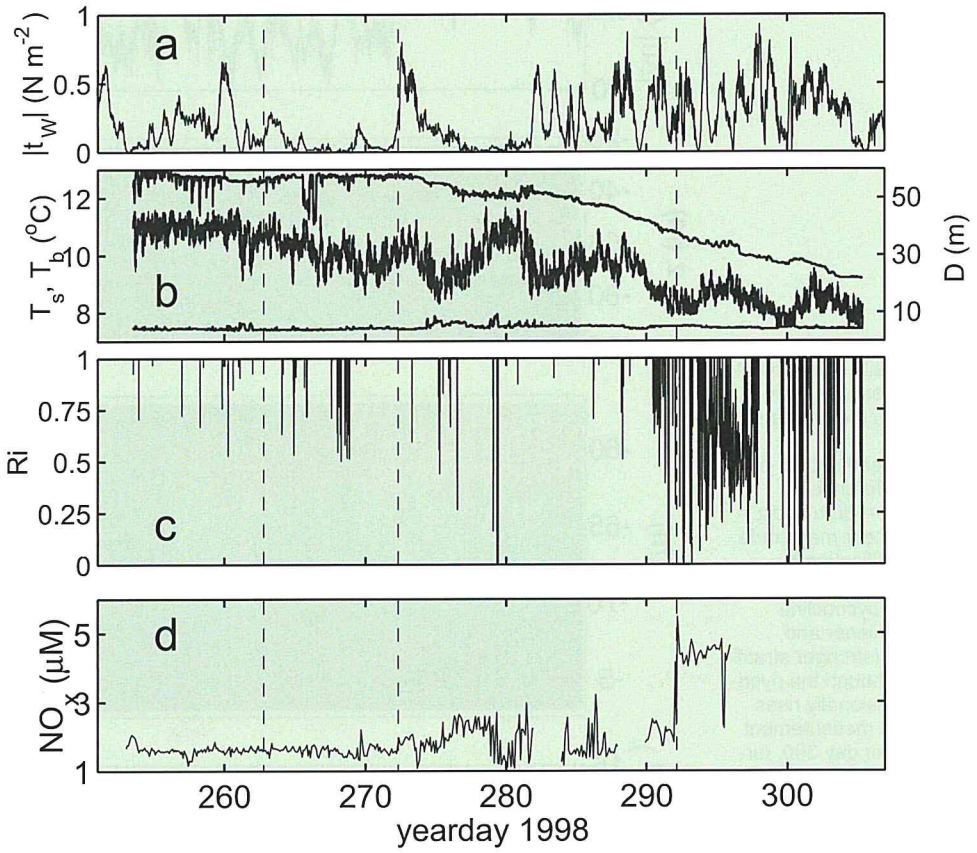


Fig. 1. Northern North Sea. a. Wind stress magnitude. b. Temperature measured at 30 and 107 m depth (thick lines) and pycnocline thickness (D from (6); central thin line, scale to the right). c. Maximum values per time interval of stratification (thick line; weak variation with time) and shear magnitude (thin line). d. Nitrate and nitrite measured at 3 m below the surface.

At the southern site, velocity and temperature measurements were used to evaluate the production of internal wave band kinetic energy (KE). Maximum production occurred in the near-bottom and the near-surface layers. A distinct mid-depth maximum in KE production occurred during a period when wind speeds exceeded 10 m s^{-1} and significant wave height ~2 m. This suggested a direct energy input from the wind via surface waves into the water column turbulence. The overall magnitude of internal wave band kinetic energy production agreed well with independent dissipation estimates obtained from microstructure profilers.

At the northern site, strong stratification was reduced primarily by atmospheric induced mixing, albeit through erosion without exchange between well-mixed surface and bottom boundary layers. However, observations from moored instruments showed that a sudden

enhanced exchange of nutrients from the light-limited, nutrient-rich deep layer into the nutrient-depleted near-surface layer occurred indirectly when inertial shear was largest, across the stratification (Fig. 1). Inertial motions (and shear) are generated after the passage of atmospheric disturbances due to the rotation of the Earth. Surprisingly, detailed observations revealed also the opposite of a sudden decrease of inertial motions following a storm. This resulted in a very thin pycnocline, which supported large internal waves that eventually caused mixing (Fig.2).

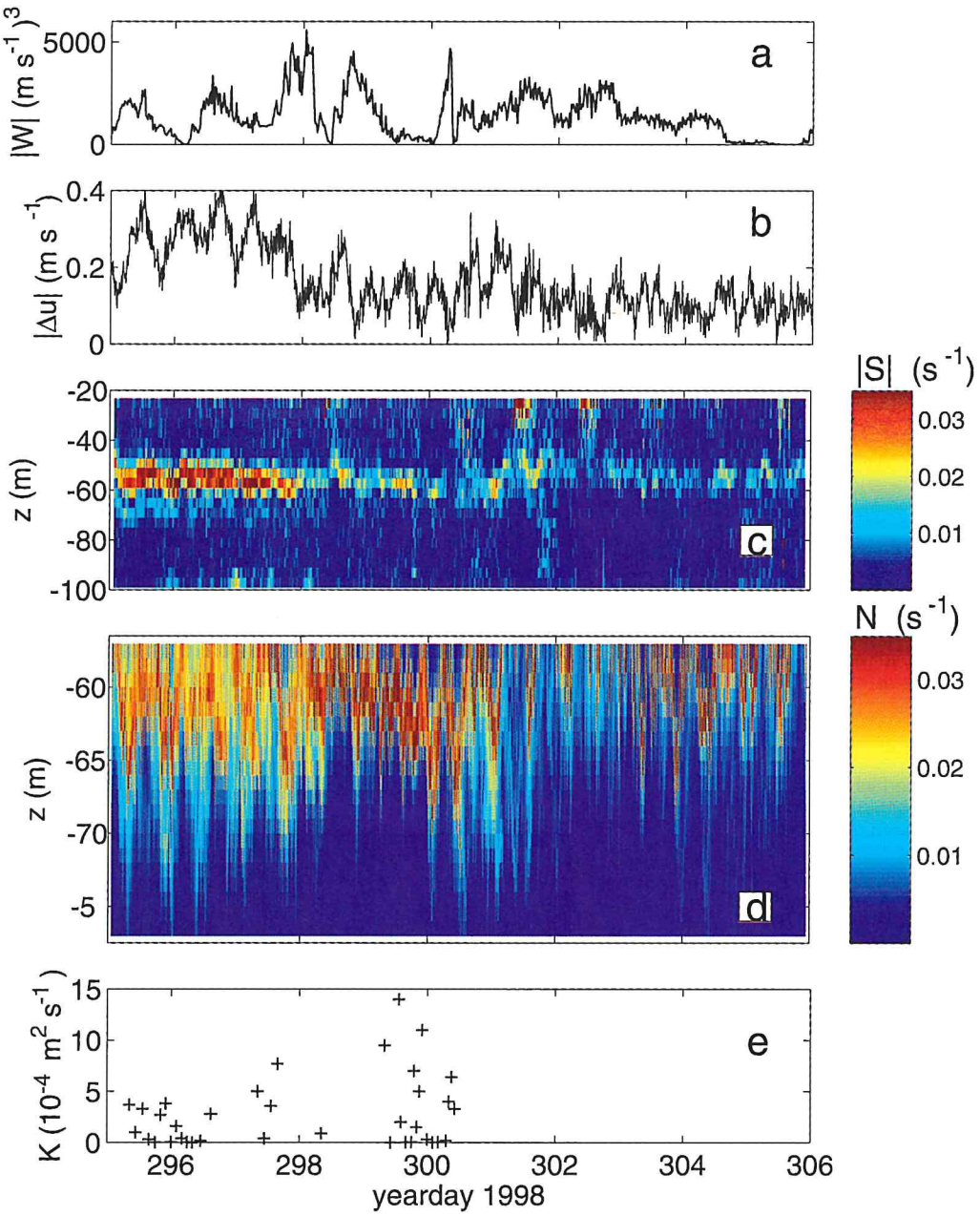


Fig. 2. Details of autumnal shear and stratification observed in the northern North Sea.
a. Wind speed cubed. b. Velocity difference between z = -85m and z = -30 m c. Shear magnitude |S|. d. Stratification N. Around day 298 the relatively thick pycnocline becomes thinner and darker red (stronger stratification). Although the pycnocline occasionally rises outside the measurement window after day 300, further stratification intensification and pycnocline thinning is seen later from the increasingly darker red colouring (with large excursions, e.g. around days 303-304). e. Eddy diffusivity estimates.

PLUME & BLOOM: WATER MASS PATTERNS AND NUTRIENT DYNAMICS IN THE CENTRAL PART OF THE SOUTHERN BIGHT

Contributors: M. Baars, S. Oosterhuis, B. Kuipers

The seasonal pattern of the dynamics of plankton, from viruses up to and including zooplankton, was mapped in the offshore area of the southern North Sea during the NWO/ALW program Plume & Bloom, with six cruises in the years 2000-2002. The study area comprised the East Anglian Silt Plume, consisting of eroded cliff material, and downstream the Frisian Front, the slope where the Plume (temporarily) sinks out. Main objectives of these cruises were studies of processes in conditions of different turbidity: varying from growth yields of viral and bacterioplankton, the grazing efficiency of protists, the effects of light- and nutrient-limitation on the phytoplankton composition and dynamics, and the role of non-phytoplankton food for zooplankton. The data collected will represent a major contribution to our knowledge of the carbon flow in the planktonic compartment of the offshore, non-stratified water column of the Southern Bight.

An unexpected discovery was that the productivity of this part of the North Sea is not only largely influenced by the turbidity associated with the East Anglian Silt Plume but also by remnants of UK rivers. The Silt Plume hides a 'river' of English Coastal Water with lower salinity (about 34), originating mainly from the Humber and the Thames. The 'river' is bordered by Central North Sea Water (salinity > 34.5) in the northwest and by Channel Water (salinity about 35) in the southeast, and extends well into the area of the Frisan Front (Fig. 3). The tongue of Channel Water forms generally a clear separation between the English Coastal Water and the Continental Coastal Water (< 34), up to 4° 30' E or beyond.

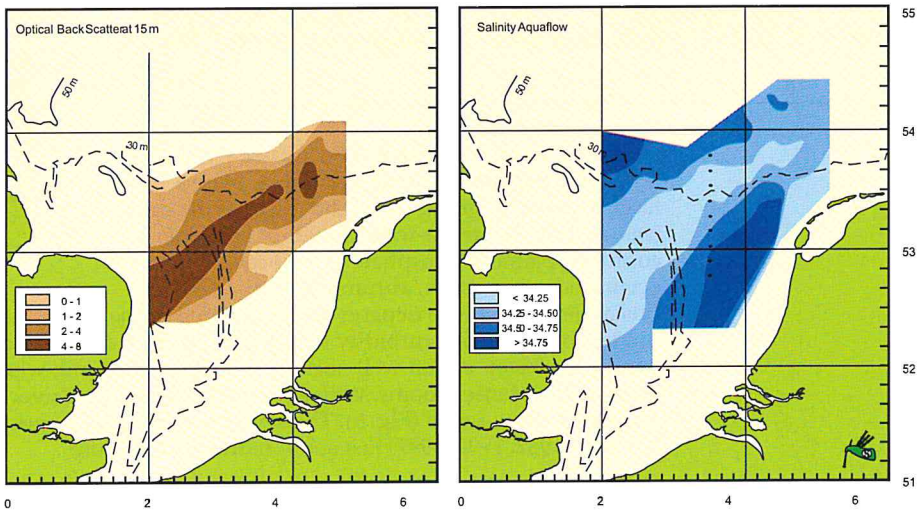


Fig. 3. Turbidity (left) and salinity (right) during Plume & Bloom 2, 11 - 21 September 2000 (R/V Pelagia). Turbidity measurements at a depth of 15 m by OBS sensor (Formazin Turbidity Units) on the CTD Rosette, at stations spaced 7.5 nm in north-south direction. Salinity continuously measured by Aquaflow pump system (4 m depth). In the salinity map the CTD stations of the standard central section along 3° 30' E are depicted.

This water mass pattern is very robust. A central north-south section along 3° 30' East was surveyed regularly by R/V Mitra (Rijkswaterstaat) and R/V Pelagia (NIOZ), in addition to the Plume & Bloom cruises, and the 'river' of English Coastal Water was recognized in all surveys, 15 in total, that were made. Storms did not mix the water masses, but merely shifted the positions. The 'river' of English Coastal Water and the tongue of Channel Water responded faster to strong winds than the suspended matter of the Silt Plume. Consequently, there was a large variation in the mutual position of 'river' and Plume (Fig. 4), but generally the 'river' was situated at the northern side of the Plume due to the predominance of southwestern winds. Along 3° 30' East, the Plume had an average width of circa 40 km in north-south direction, whereas the 'river' was usually more narrow, with a mean width of only 25 km.

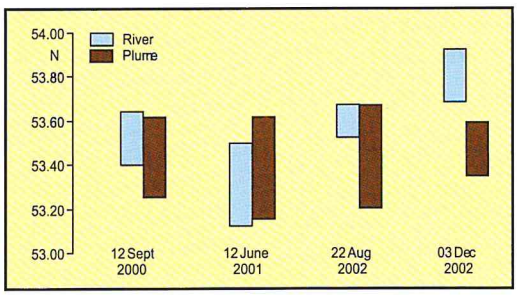


Fig. 4. North-south positions of the borders of the 'river' of English Coastal Water (blue) and of the East Anglian Silt Plume (brown), along 3° 30' E. The salinity of the 'river' was defined as < 34.25. Arbitrary borders of the Plume from OBS-CTD stations (Sept. 2000) or from continuous readings by OBS sensor in the Aquaflow system (June 2001, Aug. 2002, Dec. 2002).

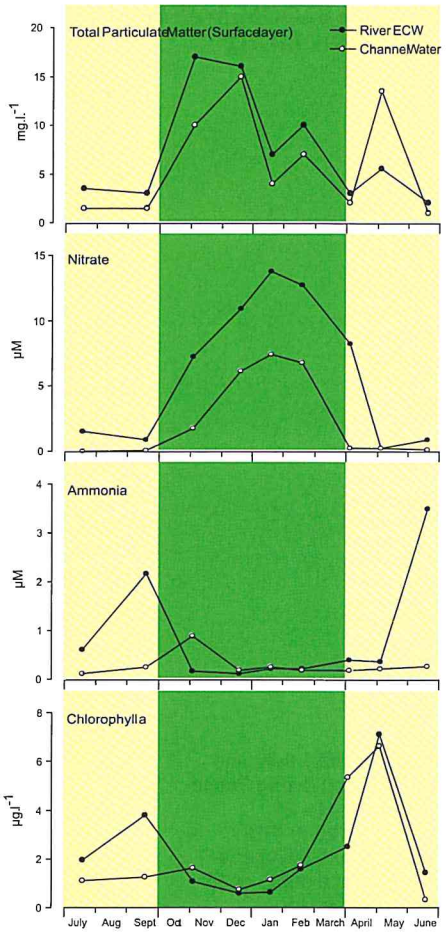


Fig. 5. Seasonal pattern July 2000 - June 2001 of turbidity (upper panel), nitrate, ammonia and chlorophyll (lower panel) along 3° 30' East for the tongue of Channel Water (open symbols) and the 'river' of English Coastal Water (closed symbols).

Winter nitrate values in the 'river' were twice as high as in the adjacent water masses. The turbidity in the Silt Plume did not prevent a spring bloom and nutrients in the 'river' were depleted in early May, one month later than in the tongue of Channel Water (Fig. 5). Thereafter, however, both nitrate and ammonia in the 'river' became relatively high again. A N/P ratio > 25 suggested that P-limitation was responsible for this 'preservation' (Table 1). The occurrence of diatoms along the northern rim of the 'river' in summer could be due to mixing with the adjacent Central North Sea Water, that was N-limited (N/P < 5).

Table 1.
N/P ratios and nutrient concentrations in the 'river' of English Coastal water during June – December. Data from Plume & Bloom cruises grouped in seasonal order.

Table 1. N / P ratios in different water masses along 3° 30 E

	Jan	Feb	Mar/Apr	May	June	July	Aug	Sept	Oct/Nov	Dec
Central NSW	13	11	nd	6	3	5	3	2	10	11
River ECW	19	19	21	10	55	27	5	13	14	17
Channel W	16	19	2	4	17	6	8	5	13	17

Similar phenomena along the 'nitrate river' may occur downstream at the Frisian Front. Here a large part of the spring (and later) blooms mineralizes, and the sediment-water fluxes of nutrients could supplement phosphate and silicate. The occurrence of summer/autumn blooms near the Frisian Front seems to depend on the position of the 'river' and the light conditions. Above the mud-rich slope zone, turbidity was generally high, due to tidal resuspension. With strong SW winds, the 'river' ended well north in the Oyster Ground, where water column depth was too large to give dense blooms. With strong NW winds, the 'river' was pushed on the upper slope and the shallow sands (Fig. 6). This could explain 'green curtains' of diatoms, as observed in the past (1982, 1990, 1997) just south of the Frisian Front .

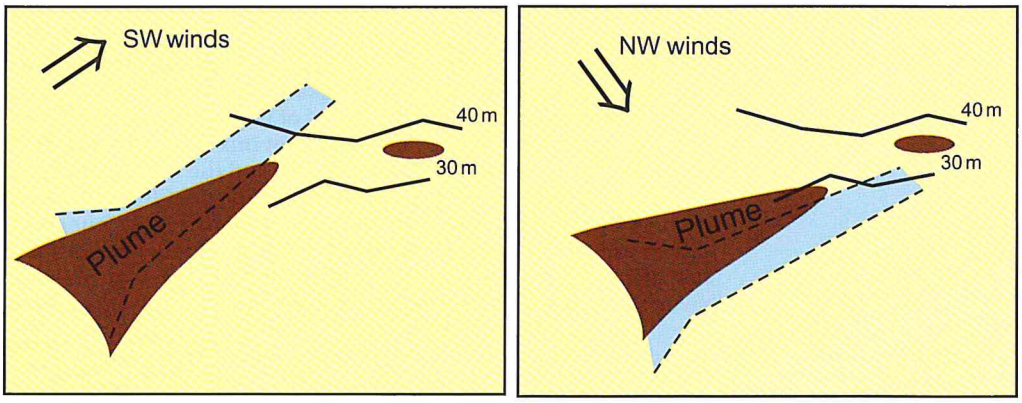


Fig. 6. Cartoon of the position of Plume (brown) and 'river' (blue) in different wind conditions. The brown ellipse denotes the bottom "Frisian Front".

Some existing nutrient data sets by earlier cruise programs in the Southern Bight are currently re-analyzed. Though station grids were coarser than during 'Plume & Bloom', some maps of 1961/1962 nutrient data remarkably show the presence of the 'river' (Fig. 7). These maps were published before eutrophication became an important topic, and it is noteworthy that it lasted nearly 40 years before this cross border phenomenon was rediscovered. Moreover, the current 2000-2002 data from a finer station grid have shown that the north-easterly orientated tongue of English Coastal Water is a persistent feature, due to the direction of the residual

current in the present average wind conditions. Remarkably, a simulation study of the spread of water from various river inflows in the Southern Bight already depicted a clear tongue of Humber and Thames water across the North Sea all the way up to offshore Jutland (De Ruijter, Postma & De Kok, 1987; 'Transport Atlas of the southern North Sea', Rijkswaterstaat, The Hague / Delft Hydraulics). A new extensive simulation model is warranted, driven by actual weather conditions, with a high resolution and with sophisticated submodels for the transport and dynamics of inorganic and organic matter. Field studies need to quantify the oxidation of organic aggregates through repeated cycles of deposition-resuspension during lateral transport. The 2000-2002 observations have shown that the transport route in this part of the North Sea is an excellent playground for understanding the processes involved.

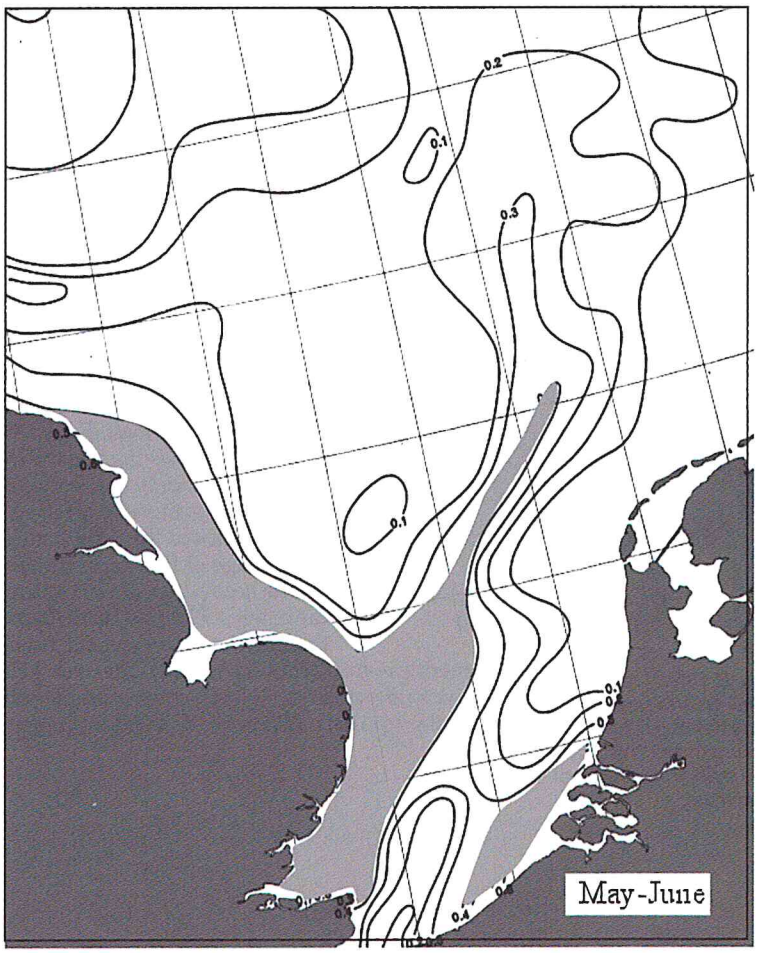


Fig. 7. Phosphate surface distribution during 'May-June', but for the Southern Bight actually based on one cruise by R/V Clione during late April (26 April - 2 May 1962). Stations were spaced 20 miles. Note the tongue of > 0.4 mg/l (> 0.4 µM; shaded area) extending to the northeast. (Adapted from Plate 2, R. Johnston & P.G.W. Jones, 1965; 'Inorganic nutrients in the North Sea', Serial Atlas of the Marine Environment, Folio 11, American Geographical Society).

POPULATION DYNAMICS OF LARGE BIVALVES IN OFFSHORE SOUTHERN NORTH SEA (BIVALFF)

Contributors: G. Duineveld, M. Bergman, R. Witbaard, T. Amaro

The frequent disturbance of the seabed in the southern North Sea by beam trawl fishery has created concern about degradation and impoverishment of the benthic habitat. From programs like the EU-funded IMPACT, which yielded actual data on benthos mortality due to fishing, it became evident that large bivalves form one of the most vulnerable taxa. Apart from their role in the benthic food chain, bivalves are archives of environmental change in the form of their growth rings. Being relatively long-lived organisms with distinct preferences for a set of environmental conditions, bivalves are frequently mentioned in the context of conservation of the southern North Sea biodiversity as Ecological Quality Objectives.

Having the disposal of the NIOZ-built Triple-D dredge we made an effort to upgrade the scanty knowledge of offshore bivalve populations. During the BIVALFF program we studied three dominant species (Chamelea gallina, Arctica islandica and Mya truncata) living in the southern North Sea and particularly in the Frisian Front area. The latter location was chosen because of the locally sharp gradient in environmental factors allowing a study of their effect on bivalve distribution and performance. Moreover, the Frisian Front benthic fauna has seemingly undergone some dramatic changes in the past 20 years, which we attempted to trace through skeletal growth records.

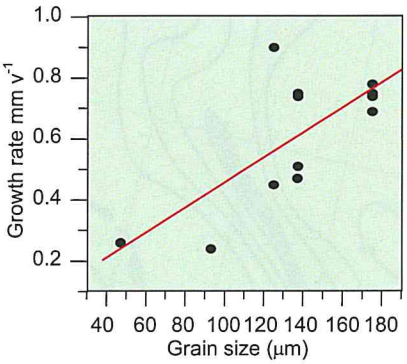


Fig. 8. Relation between shell growth rate of Chamelea gallina in the southern North Sea and the median grainsize of the sediment.

The venus shell Chamelea gallina is the smallest of the 3 species studied and the one with the lowest maximum age (~ 25y). It occurs throughout the Southern North Sea showing no particular sediment preference. In contrast, growth rates of Chamelea gallina appear to be significantly lower in fine sediments with a high silt content like those at the Frisian Front (Fig. 8). Examination of the potential food supply of interface feeders like C. gallina using a near-bed sediment trap showed that the load of organic particles at the Frisian Front is diluted by resuspended silt lowering the nutritional quality. In the Southern Bight south of the Frisian Front, only the fluffy freshly deposited organic matter is resuspended by tidal currents thereby offering periodically a high quality food source. The higher growth rates in the Southern Bight could add to a greater potential for recovery if at least age of first reproduction and reproductive output are size dependent.

The second species, Arctica islandica, is the largest and reaches highest maximum age (> 100 y). Its distribution in the southern North Sea appears confined to the northern part viz. the Frisian Front and the Oyster Ground where silty sediment prevails (Fig. 9). As with Chamela gallina, annual shell growth of A. islandica is negatively affected by high silt content of the sediment. A typical feature of the Arctica population in the southern North Sea is the dominance of adults or the near absence of juveniles < 50 mm

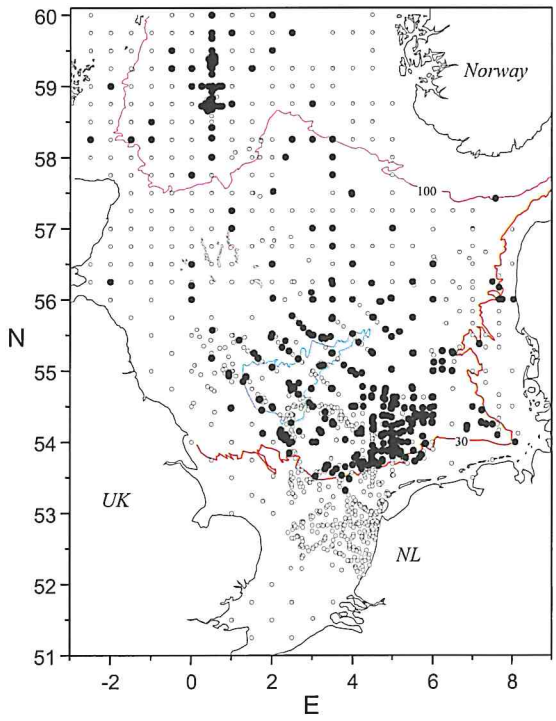


Fig. 9. Distribution of Arctica islandica in the North Sea.

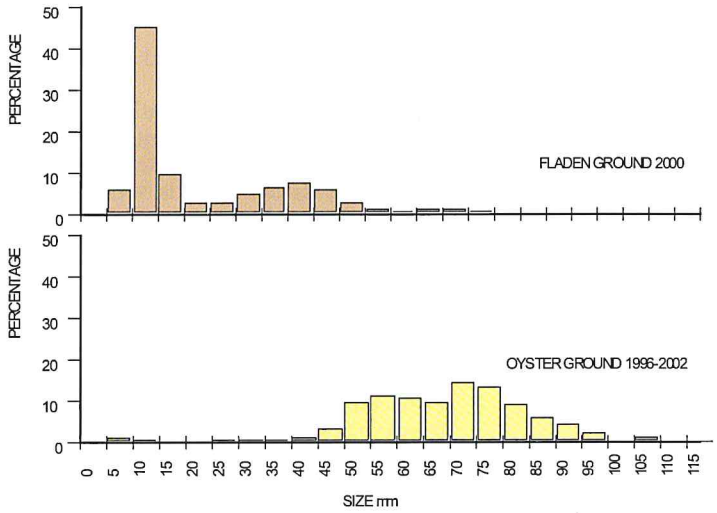


Fig. 10. Comparion between size distributions of Arctica islandica in the northern North Sea (Fladen Ground) and the southern North Sea (Oyster Ground and Frisian Front).

in size (Fig. 10). Arctica populations living elsewhere (Baltic, northern North Sea) have much higher proportions of juveniles. Causes for the failing recruitment could be more than one: a too low adult density for successful fertilization and or fishing mortality among spat and juveniles. Whatever the causes, sustainability of the A. islandica population in the southern North Sea seem questionable given the present composition of the stock.

The distribution of Mya truncata in the southern North Sea was found to overlap with that of Arctica islandica. Being both species with circumboreal and arctic distributions, M. truncata and A. islandica probably meet their maximum temperature limit at the southern border of the Oyster Ground. Likewise as A. islandica, the M. truncata population in the southern North Sea entirely consists of adults. Ripe gonads were found in late winter-early spring but this does not

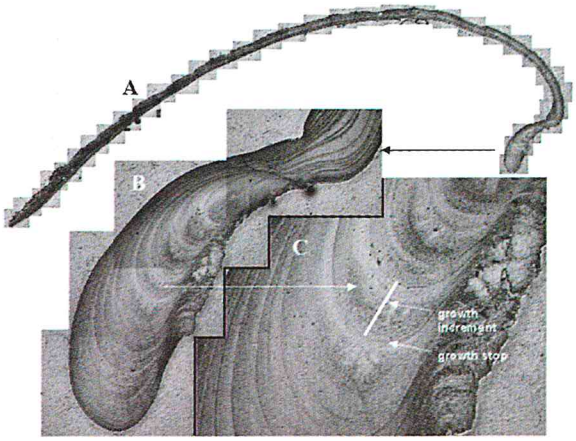


Fig.11. A. Composite image of an acetate peel of a cross section of a left valve of Mya truncata. B. Detail of chondrophore with growth band pattern. C. example of a growth band consting of increment and stop.

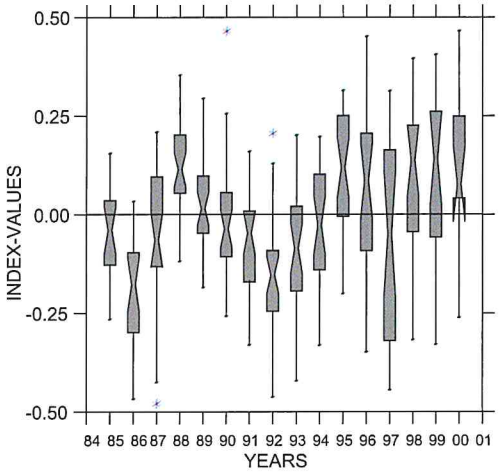


Fig. 12. Year-to-year variation in the relative growth of Mya truncata in the period 1985-2000. Boxes with non-overlapping notches are significantly different.

imply successful fertilization taken their low density. Internal growth rings in shell cross section of M. truncata (Fig. 11) revealed a maximum age of ~40 y. The lifespan of M. truncata made it a candidate species for tracing a shift in food regime being one of the explanations for the change in benthic fauna at the Frisian Front in the early 1990's. Analyses of M. truncata growth records (Fig. 12) did not yield convincing evidence for such a regime shift though large unexplained variations in growth rates were noted.

Our field studies have shown that prospects for at least 2 of 3 species look bad. Successful conservation of these long-lived fragile organisms in the North Sea e.g. in areas closed for fishery, may already be dependent on the supply of pelagic larvae from elsewhere. Stating this, we identify a missing link in our knowledge on population dynamics of North Sea benthos namely lack of data on occurrence, production, and source of pelagic larvae. Deployment next years of the new NIOZ-built ALTRAP lander that is specifically designed for long term quantitative sampling of meroplankton, will help to resolve this issue.

ENHANCED MINERALISATION RATES IN SANDY SEDIMENTS (EMIR)

Contributors: E. Epping and W. van Raaphorst

Sediments of shallow coastal seas may be subject to resuspension/deposition cycles due to wave action and tidal currents. The prevailing hydrodynamics result in a selective removal of fine sediment, leaving a sorted, relatively coarse-grained sediment. In contrast to cohesive sediments, the interstitial voids of permeable sandy sediments allow for advective transport of water and particles in response to an external pressure field, generated by e.g. surface waves and horizontal flow over topographic structures such as ripples and biogenic mounds and troughs. Permeability in turn, is a sediment property related to grainsize distribution, pore-volume and —geometry, and is a measure for the resistance of bulk sediment to interstitial flow by pressure differences.

The present view on the biogeochemistry of sandy sediments is biased by the idea that large contents of sedimentary organic carbon are required to drive large fluxes. Large fluxes, however, can also be sustained by relatively small concentration gradients in combination with high transport rates. Resuspension - deposition cycles favor solid-solute exchange, whereas pore water advection and dispersion may exceed diffusive transport provided that permeability is sufficiently large and pressure gradients are generated. Thus, in permeable sands fluxes of reactants can be large while keeping standing stocks low.

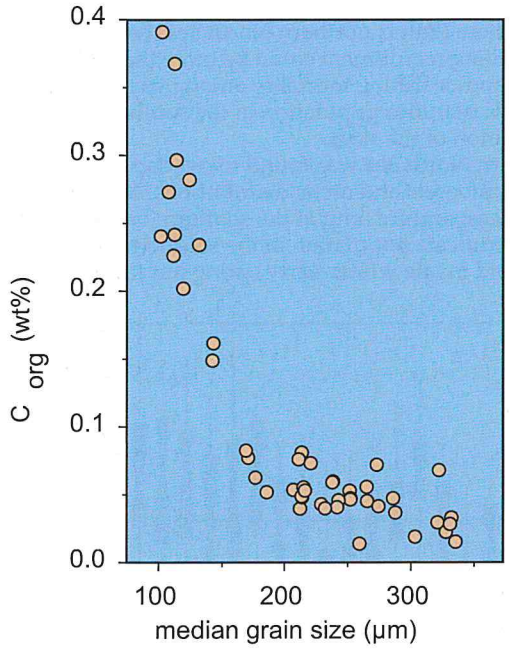


Fig.13. Organic carbon content of upper 0.5 cm of sediment plotted against the median grain size, Broad Fourteens, EMIR 2002.

Due to methodological constraints, our knowledge of the biogeochemistry and physico-chemical processes in sands is meager, particularly regarding actual field data. It was the aim of the EMIR project to contribute to the filling-in of this gap by 1) unambiguously demonstrating the importance of advective transport in sandy pore waters, and 2) providing detailed data on carbon mineralization rates in sandy sediments. It was our hypothesis that the efficient transports of substrates and reactants enhance the mineralization rates of organic carbon in permeable sandy sediments. Sands are the dominant type of sediments in the southern North Sea, a shallow and highly productive area where considerable amounts of organic carbon could reach the sediments and be mineralised there. These sediments are subject to active resuspension and even erosion that prohibit the longer-term deposition of solids, making this area excellently suited to test our hypothesis.

Data from two EMIR cruises showed a clear increase in median grainsize from 100 µm at the Frisian Front to >300 µm at 100 km to the south in the area of Broad Fourteens. To the south, sediments were increasingly sorted and showed an increase in permeability. The organic carbon content of surficial sediments revealed an exponential decrease with increasing grain size (Fig. 13) and decreased from ~0.4 wt% (Frisian Front) to <0.03 wt% (Broad Fourteens). The C/N ratio of this organic matter was ~9 at the higher end of organic carbon content (Frisian Front), but decreased to values of ~5 in carbon poor sediments (Broad Fourteens). These values are indicative for a relatively large contribution of terrestrial or aged organic matter in the depositional area of the Frisian Front and a predominance of relatively fresh, marine organic matter in the organic-poor sediments in the Broad Fourteens area. Assays on anaerobic carbon mineralisation in sediments do show enhanced rates in the coarser sediments, despite their reduced standing stock of organic carbon. This can only result from a higher quality of the organic carbon in sediments from the Broad Fourteens as compared to the Frisian

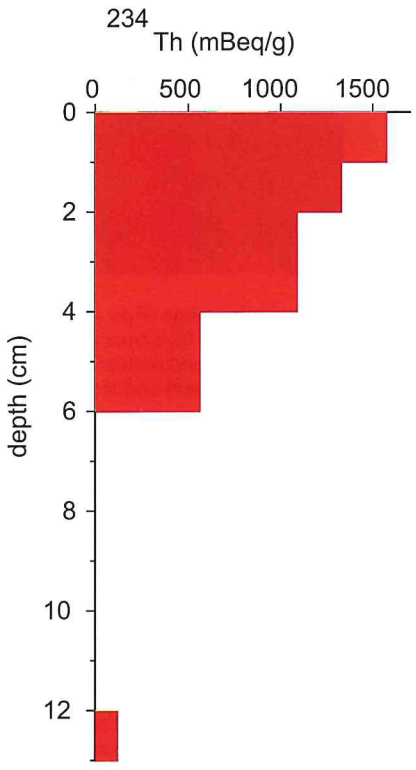


Fig. 14. ^{234}Th activity profile for sediment from Broad Fourteens, North Sea, showing the input of fine materials down to >6 cm. Median grain size at this station is 273 µm, EMIR 2002.

Front. From the inventory of organic carbon and the depth integrated carbon mineralisation rates, first order carbon decay constants have been estimated, showing values of 0.1 yr^{-1} for the Frisian Front, exponentially increasing to values of 1 yr^{-1} in the southern area. According to the age-reactivity relationship for organic carbon decay, the corresponding average age of these carbon pools are 1.5 yr and ~50 days, respectively. Evidence in support of the recent input of organic matter in sediments from the Broad Fourteens is provided by ^{234}Th isotope inventories. These profiles show that fine particles, including organic carbon, are transported downward >6 cm into the sediment (Fig. 14) on a characteristic time scale of ~100 days, presumably by moving ripples and advection. In addition, in situ oxygen microprofiles along a cross-ripple transect unequivocally demonstrated the upper sediment to be physically irrigated, in support of the idea of enhanced sediment-water exchange (Fig. 15).

The emerging view from this study is that the carbon mineralisation rates and the recycling of nutrients per unit area of permeable, sandy sediments, are at least as high as for cohesive, organic rich depositional areas. Given the fact that on a global basis about 70% of continental shelves is covered by relict sands, these sediments make a much larger contribution to (global) element cycling then supposed hitherto.

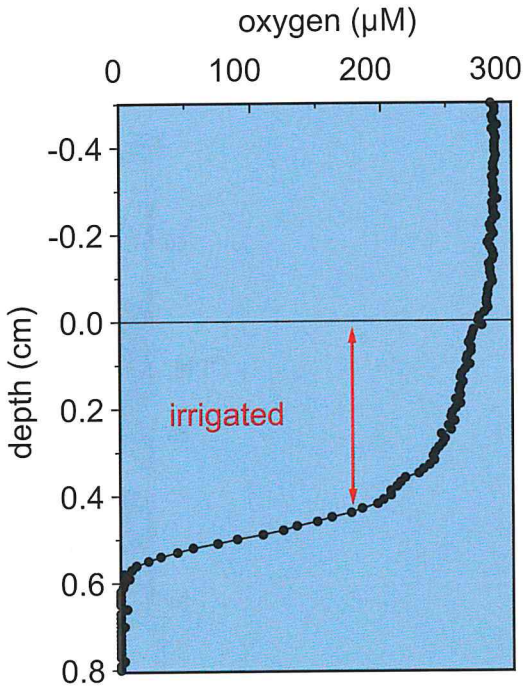


Fig. 15. Example of in situ oxygen microprofile measured with the benthic lander TROL, showing the effect of physical irrigation on the distribution of dissolved oxygen in porewaters of permeable sandy sediments from Broad Fourteens, EMIR 2002.

CANOBA (CARBON AND NUTRIENT CYCLING IN THE NORTH SEA AND THE BALTIC SEA)*

Contributors: H. Thomas, Y. Bozec, K. Elkalay and H. de Baar

During the last two years an international carbon cycle program has been established for the North Sea with participants from the Netherlands, Belgium and Germany and major funding by the Dutch Organisation for Scientific Research (NWO). The aim of the study has been to assess simultaneously all relevant parameters of the carbon and nutrient cycle during all four seasons covering a dense 97 stations grid across the entire North Sea. The cruises were carried out in August/September 2001 (summer), November 2001 (autumn), February/March 2002 (winter) and May 2002 (spring).

First results of the partial pressure difference between the atmosphere and the sea surface (ΔpCO_2) indicate the North Sea as an overall sink for atmospheric CO_2 (Fig. 16). During the summer, a clear distinction between the shallower, well-mixed southern part of the North Sea and the deeper, stratified northern part is evident from the ΔpCO_2 distribution. In the northern part the surface waters are undersaturated with respect to CO_2 as a consequence of biological CO_2 drawdown and export of organic matter to the deeper layers. In contrast, the southern part does not allow the escape of organic matter to any deeper layer. The remineralisation thus occurs in the euphotic zone and counteracts the CO_2 drawdown. As a result no net CO_2 draw-

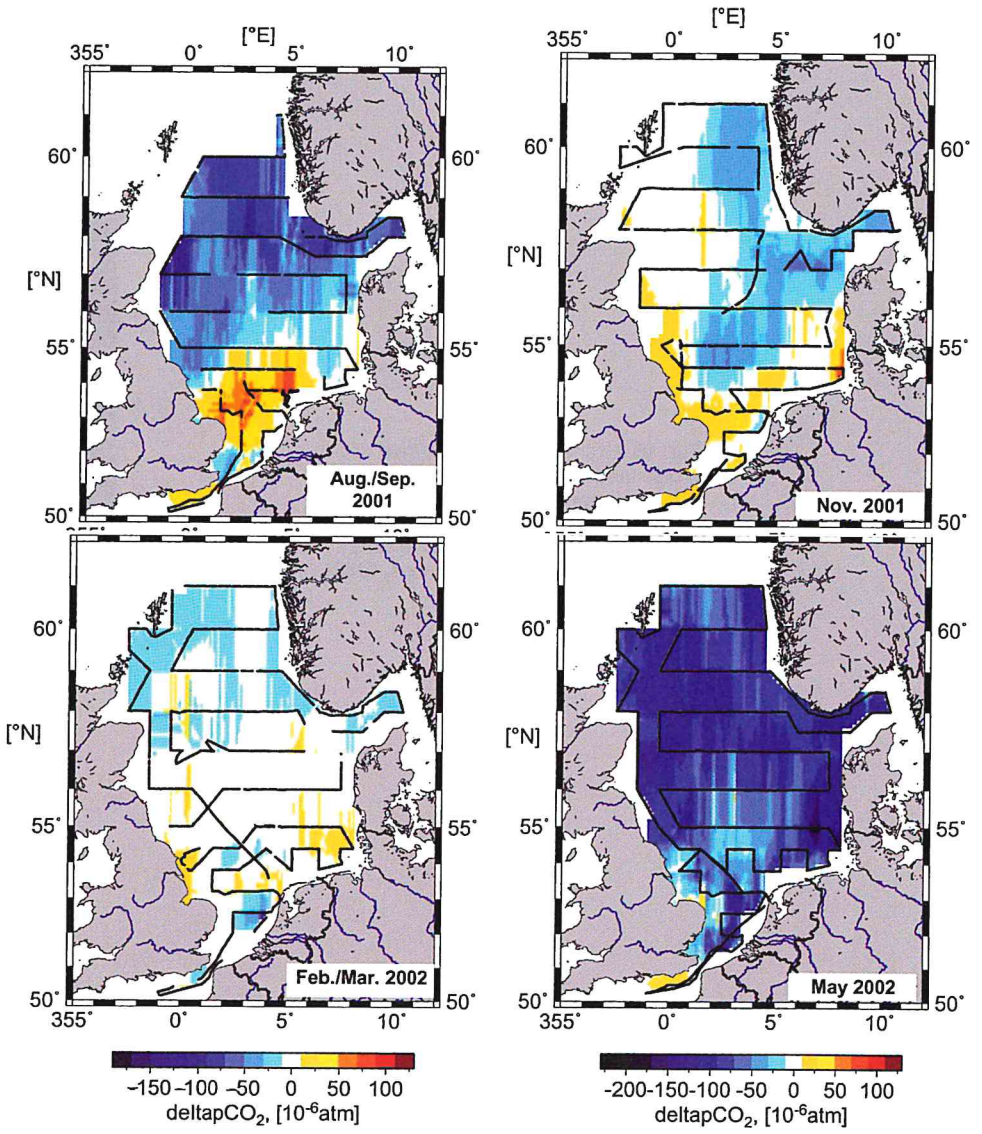


Fig. 16: ΔpCO_2 distribution observed in the North Sea during all four seasons: a) summer, b) autumn, c) winter and d) spring.

down is possible and the warming of the surface waters during summer increase the pCO_2. During autumn and winter the surface system heads toward equilibration and only slight super- or undersaturation is visible in February. During spring, which is the time of highest primary productivity the entire North Sea is strongly undersaturated because of the strong CO_2 uptake by biological activity (Fig. 16).

The $NO_{3/2}$ and DIC profiles (Fig. 17) from a central station of the North Sea clearly indicate the seasonal cycle. The wintry mixed layer shows the higher and homogeneous concentrations of DIC. The onset of the spring bloom then starts to decrease the DIC in the surface waters. The export of organic matter to the deeper layers with subsequent remineralisation increases the DIC. Lowest DIC concentrations in the surface waters and highest DIC concentrations in the subsurface waters are observed during summer, when both processes, surface layer production and subsurface remineralisation show the highest extent. During autumn the water column is homogenised by the deepening of the mixed layer until the winter situation is reached again. From the first view, the sum of nitrate and nitrite ($NO_{3/2}$) shows a similar behaviour. However, $NO_{3/2}$ is depleted in the surface layer during spring and summer and does not show any enrichment in the subsurface layer. These observations point to a strong decoupling of carbon and nitrogen cycles. The data evaluation will employ both field observations and ecosystem modelling results. The modelling is partially funded through the Dutch LOICZ.

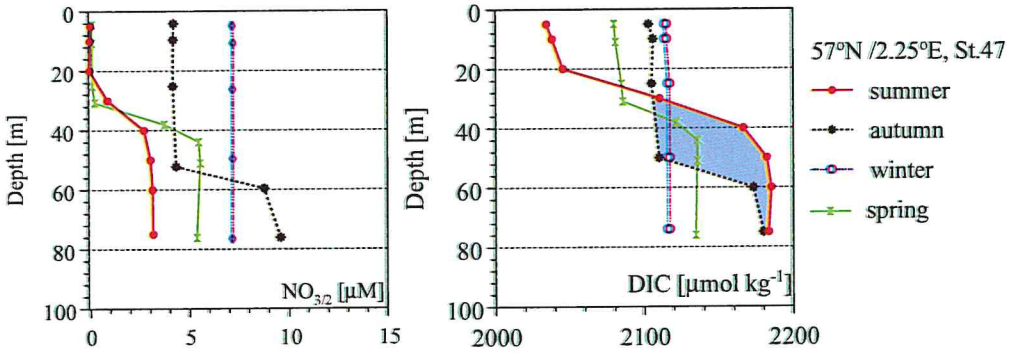


Fig. 17: Seasonal profiles of the sum of Nitrate and nitrite ($NO_{3/2}$) and DIC observed at a station in the central North Sea. The blue shaded area indicates the enrichment of DIC in the subsurface waters relative to the winter level.

*CANOBA was intended to be an European initiative investigating carbon and nutrient cycles of the North Sea and the Baltic Sea jointly. The present CANOBA currently realises this aim for the North Sea as an international effort and the corresponding counterpart for the Baltic Sea is being set-up just now.

DEPARTMENT OF PHYSICAL OCEANOGRAPHY

Scientific efforts within the department of Physical Oceanography (FYS) are organized under the following main themes:

1. Ocean circulation and hydrography
2. Processes near continental slopes, internal waves and mixing
3. Tidal and morphodynamics of coastal zones

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

In 2002 the focus was on the analysis of the data obtained during the MARE and ACSEX programmes in the Southern Atlantic and South West Indian ocean. A large proposal for investments in Long-term Ocean Climate Observations (LOCO) received funding in the middle of 2002. This funding will be used to deploy long-term (5 years) sub-surface moorings in different parts of the ocean as a follow-up on previous work in the North Atlantic (Irminger Sea) and Indian Ocean (Mozambique Channel and Indonesian throughflow). The preparation of these future activitities took much effort.

Under the second theme theoretical, laboratory and observational studies of the interaction between internal waves in a stratified ocean and topographic features are performed. Results from a PhD study combining these research methods are discussed in detail below. Both in theoretical and laboratory experiments bands of high energy in the interior of the fluid related to the presence of inertial wave attractors, were found. A similar analysis was performed using data from long term current meters in the Mozambique Channel. It appeared that the complexity of the real ocean combined with the strong temporal and spatial variability of internal wave rays makes it is difficult to detect these features from relatively few long term single point current meters. A seagoing study was performed in Rockall Channel to study mixing by internal waves and the consequences for redistribution of fine sediments near continental slopes.

The third theme consists of studies in the relatively shallow coastal zone using both field and laboratory observations and theoretical modelling. A detailed analysis of ongoing ferry observations on currents and suspended sediments in the Marsdiep inlet forms an important part of this research programme. A PhD student and a PostDoc have been appointed to study the transport of sand (PhD) and fine-grained sediments through the Marsdiep inlet (PostDoc) in great detail. First analysis focussed on secondary circulation in the Marsdiep inlet due to the curvature of the tidal channel. This secondary circulation causes a turning of the near bottom tidal current which is reflected also in the propagation direction of sand waves in the inlet (see below). A scale model of a tidal embayment was used to obtain detailed laboratory observations on non-linear aspects of tidal motions in coastal embayments.

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

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

WAVE PATTERNS DUE TO REFLECTION IN ENCLOSED ROTATING AND STRATIFIED FLUIDS

Contributors: Astrid M.M. Manders and Leo R.M. Maas

From a physical viewpoint the sea is a density stratified, rotating fluid. This allows for a wide number of phenomena, ranging from global circulation to turbulence. A class of waves which exist in stably stratified fluids are internal waves. They propagate entirely in the interior of the fluid. The maximum amplitude is in the interior and the (free) surface hardly oscillates. The most simple example is a cup filled with water and oil, where waves propagate along the interface, but the free surface remains at rest.

For a fluid that has a stable density stratification, these waves are called internal gravity waves, since buoyancy provides the restoring force. For these waves particle motion is essentially two-dimensional. Solidly rotating fluids are stratified in angular momentum, with inertia providing a restoring force.

Internal waves in a rotating fluid are therefore called inertial waves. Due to the Coriolis force, particle motion is three-dimensional. Since internal gravity waves and inertial waves have similar properties, for a fluid that is both rotating and density stratified, they combine into an inertio-gravity wave. Such waves are widely observed on scales of tens of meters to kilometers and with periods of minutes to one day.

An essential property of the internal waves is that their direction of propagation is purely determined by the wave frequency and the strength of the stratification and/or the rotation rate. For continuous stratification (no density jumps), the waves will propagate obliquely through the fluid. When such a wave reflects, the reflected wave does not obey Snell's law, but retains its angle with respect to the direction of gravity/rotation axis, even at reflection at a sloping wall. Therefore, in a two-dimensional cross section of a channel, repeated reflection in an enclosed fluid will not lead to `chaotic' but to structured patterns. Some of the structured patterns are periodic orbits, to which all wave rays converge. They act as limit cycles and all wave energy is concentrated around them. Therefore these cycles are called wave attractors. This strong concentration of energy may induce nonlinear effects like wave-breaking resulting in mixing of the fluid, in a rotating fluid eventually leading to the development of a net flow.

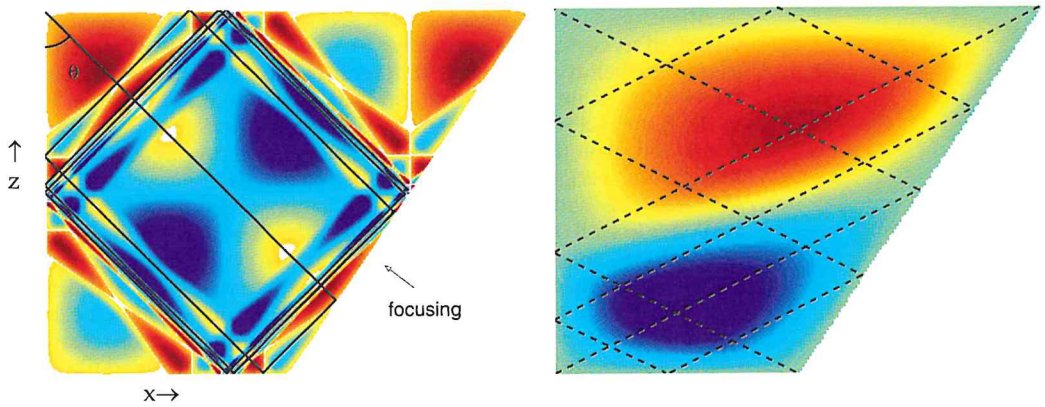
The type of equation that determines the spatial patterns of the monochromatic waves cannot be solved for arbitrary basin shapes. Numerical methods must be used, unless severe simplifications or restrictions are applied. In two dimensions one can construct solutions by describing the paths of individual wave rays. This method was used to study the existence and properties of wave attractors in a smooth basin. In three dimensions it is not possible to construct a solution this way, but alternatives are lacking. Nevertheless, description of individual rays can be used in determining the possibility of convergence towards an attractor. The formation of attractors in three dimensions has been verified in laboratory experiments. These experiments were also used to study the horizontal structure of the wave pattern.

Do wave attractors occur for smooth basins?

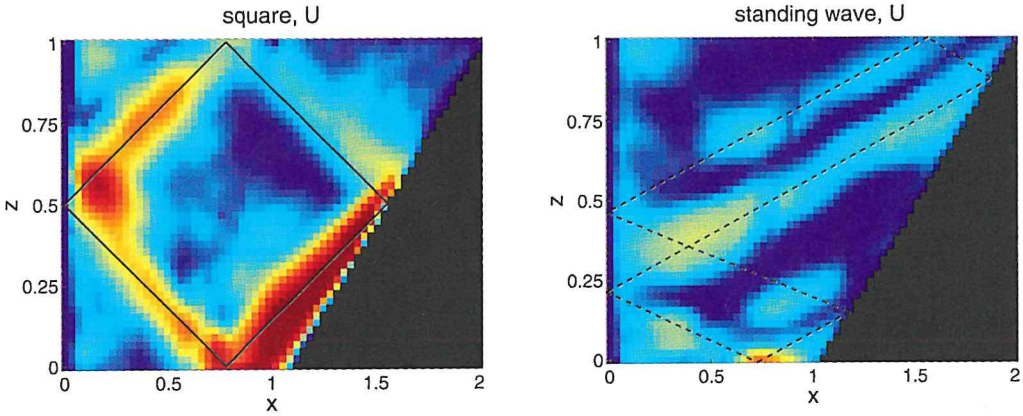
It is natural to wonder what is special about the boundaries of a fluid domain, apart from having a sloping part, to enable the formation of a two-dimensional wave attractor. Are corners necessary, or some other singularity? To answer this, a special geometry was investigated, that had completely smooth boundaries and that, depending on a parameter, varied between a circle (no attractors possible) and a symmetric triangle (where corners act as point attractors). Wave rays with different slopes were traced numerically over a large number of reflections to determine eventual convergence towards a wave attractor. For many combinations of parameter values, limit cycles were found. If the whole parameter space is plotted, bands with attractors are found that narrow when the circle is approached and which are known as `Arnol'd tongues'. When the triangle is approached the bands come closely together. In between the bands with attractors, thin regions are present where wave rays do not converge, but are shifted continuously, as well as thin regions with weak attractors of high period. Only for a single value of the direction of propagation every wave ray closes exactly onto itself and a standing wave can exist. This is because an additional symmetry exists for this direction of propagation. In the rest of the parameter space, this symmetry did play a role in the exact ordering of the tongues and their period (loosely speaking: number of reflections of the periodic orbit). The tongues were bounded by slope values for which the periodic orbit degenerated into a line, connecting critical points (points where the tangent to the bounary has the slope of the characteristic) or where two coexisting attractors merged into a single symmetric attractor.

Laboratory observations

Wave attractors and a standing wave were also investigated in the laboratory. A rectangular tank was provided with a sloping side wall over the length of the tank to make focusing



For a fixed frequency and a fixed stratification, an internal wave ray travels obliquely through the fluid with a fixed angle θ with respect to the vertical. This angle is conserved upon reflection. Reflection at a sloping wall leads to (de)focusing. In an enclosed basin, net focusing leads to the appearance of a wave attractor (left), where all wave energy accumulates. This is illustrated by the stream function. The flow is parallel to its isolines, the strength is indicated by the accumulation of isolines. When focusing is balanced by defocusing, a standing wave exists, for which all wave rays close onto themselves (right).



Experimental observations (velocity) of a wave attractor (left) and a standing wave (right). The velocities of for the standing wave are much smaller, the colour scale differs by a factor 2.
Red (blue) marks large (weak) velocities. Black solid line (left) gives location of attractor. Dashed line (right) is just one of the many periodic wave paths.

towards a wave attractor possible. This tank was filled with tap water and small neutrally buoyant particles to visualise the flow. The tank was placed on a rotating platform, of which the rotation speed was modulated slightly to generate inertial waves with the rotation frequency. By illuminating a thin sheet of fluid and recording the particle motion in time with a digital camera, two-dimensional velocity fields could be obtained (Particle Image Velocimetry). Measurements were repeated for different planes of observation, both in horizontal and in vertical planes, and for different frequencies (different structures). Two sets of experiments have been done. One in a large tank (107 cm wide, 500 cm long, 80 cm high), at the 13 m diameter rotating platform of the Coriolis Laboratory in Grenoble, France, where six different frequencies were investigated. The other in a much smaller tank (19 cm wide, 40 cm long, 19.5 cm high) on a 1 m diameter tank at the Fluid Dynamics Laboratory of the Technical University of Eindhoven. In this second set the horizontal structure could be observed better. For such a three-dimensional tank, ray tracing still predicts the appearance of wave attractors, since due to reflection and refraction at the sloping wall a wave that initially propagates in the horizontal direction can be `stuck' in the down-channel direction, when approaching a limit cycle. This is not possible for standing wave modes. However, near the vertical front and end walls of the `channel' a wave attractor cannot exist, there is a limitation to the value of ray theory and the experimental results must give insight.

Attractors were observed in both sets of experiments, as well as a standing wave. Patterns observed in vertical planes appear to agree well with the theoretical prediction. In horizontal planes the behaviour is quite different for the different frequencies. For the lowest frequency, the wave rays are the steepest and they are tangent to the slope. They are attracted immediately to the limit cycle and the attractor can be observed close to the vertical front wall. In the horizontal direction the phase of the particle motion propagates and the particle orbits are different in different sections. The horizontal wave length seems related to the horizontal aspect ratio of the tank. The `square' attractor, which is non-degenerate, is not clearly visible near the front wall, but is well observed around 1/4 and 3/4 of the length of the tank, and weakly or hardly visible in the middle. Although there is phase propagation along the attractor in the vertical planes, in the horizontal plane the attractor behaves like a standing wave with a nodal line at 1/2. The standing mode has relatively weak particle motion, i.e. about half of that of the attractors. It is hardly visible near the vertical walls, but it is more clearly visible towards the middle of the tank in the Eindhoven-experiments, where it behaved like the most simple standing wave mode in the horizontal direction, although in the vertical planes some phase propagation was observed. In the Grenoble-experiments there was clear standing wave behaviour in the vertical plane around 1/4 of the length The behaviour in the horizontal direction could not be well observed.

The real sea

Although internal tides (internal waves of tidal frequency) have been observed widely, the observations often do not tell much about their spatial distribution. Simple attractors as observed in the laboratory can hardly be expected, but it is worthwile to study their interaction with topography to find regions of stronger wave activity and mixing areas. In the ACSEX-project, an array of current meter moorings was deployed for 1.5 years in the Mozambique channel. These moorings were primarily set out to study the large scale flow, but since the Mozambique channel has steep topography and a reasonably strong tide, the measurements were also used to look for internal tides. Due to the different ray paths of the internal waves of different frequencies (M2,S2,K1), a combination of these internal tides will give amplitudes and phases that change with every location. Furthermore the ray paths change with changes in stratification, which occurs with the passage of large eddies in the channel. The current meters themselves change location during an eddy passage, since the strong flow causes considerable tilting of the moorings. Therefore changes in phase and amplitude are expected. The current meters were separated by several hundred meters in the vertical and tens of kilometers in the horizontal, much larger than the internal wave scale. Therefore, a two dimensional numerical model was used to predict the wave patterns and phases in the channel. This is currently used for comparison to the observations, but the large separation scales seem to render the different current meter results less conclusive with regards to the detection of wave focusing and attractors.

We conclude by stating that wave attractors, theoretically predicted for two dimensional containers, are observed to arise also in laboratory experiments in three dimensional containers. Field experiments in the Mozambique Channel have been spatially undersampled and therefore remain inconclusive with respect to the occurrence of large scale wave attractors in the natural environment. This invites for a finer sampling strategy. This work is funded by the NWO-NLS programme.

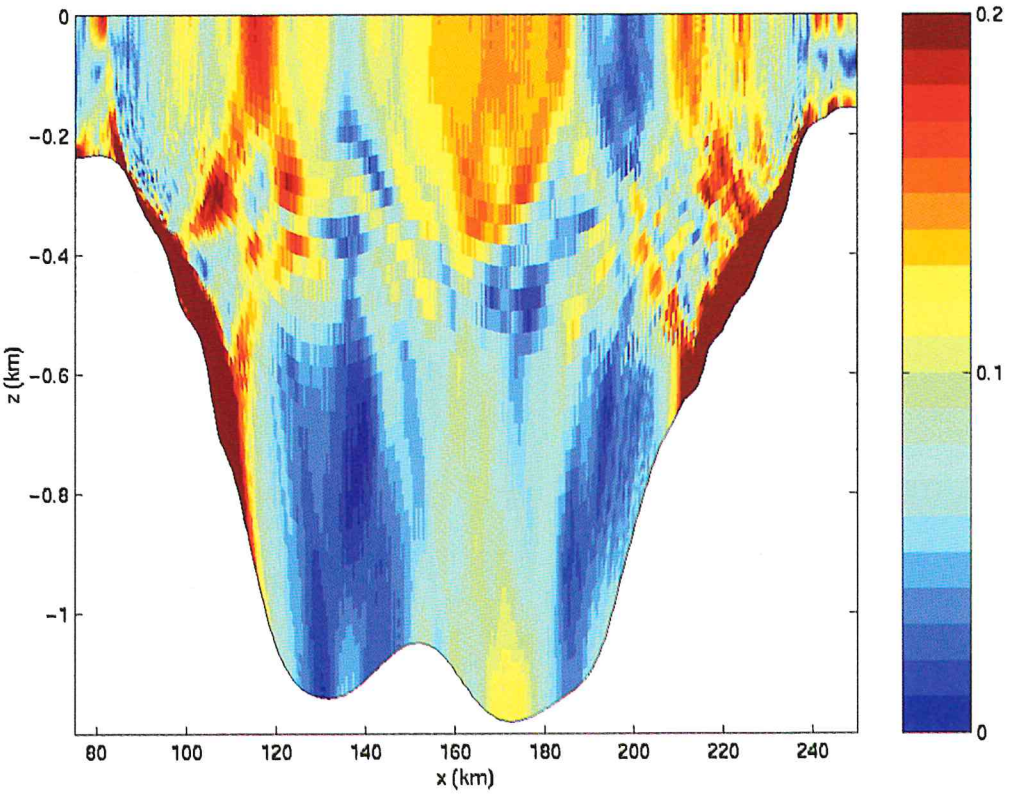
DYNAMICS OF INTERNAL TIDES – RESULTS FROM PROCS

Contributors: T. Gerkema, H. van Haren & L.R.M. Maas

Internal tides, and internal waves in general, create an `inner unrest' in the ocean. Their generation takes place mainly within the upper layer of the ocean (the surface for wind-induced near-inertial waves, and near the shelf-break for internal tides), but since the internal-wave energy propagates not only horizontally but also vertically, they provide energy to the deeper regions of the ocean as well. Here they act as agents for mixing (secret agents one would say, for the precise mechanism is still to be disclosed), which, in turn, is essential to maintaining the large-scale circulation.

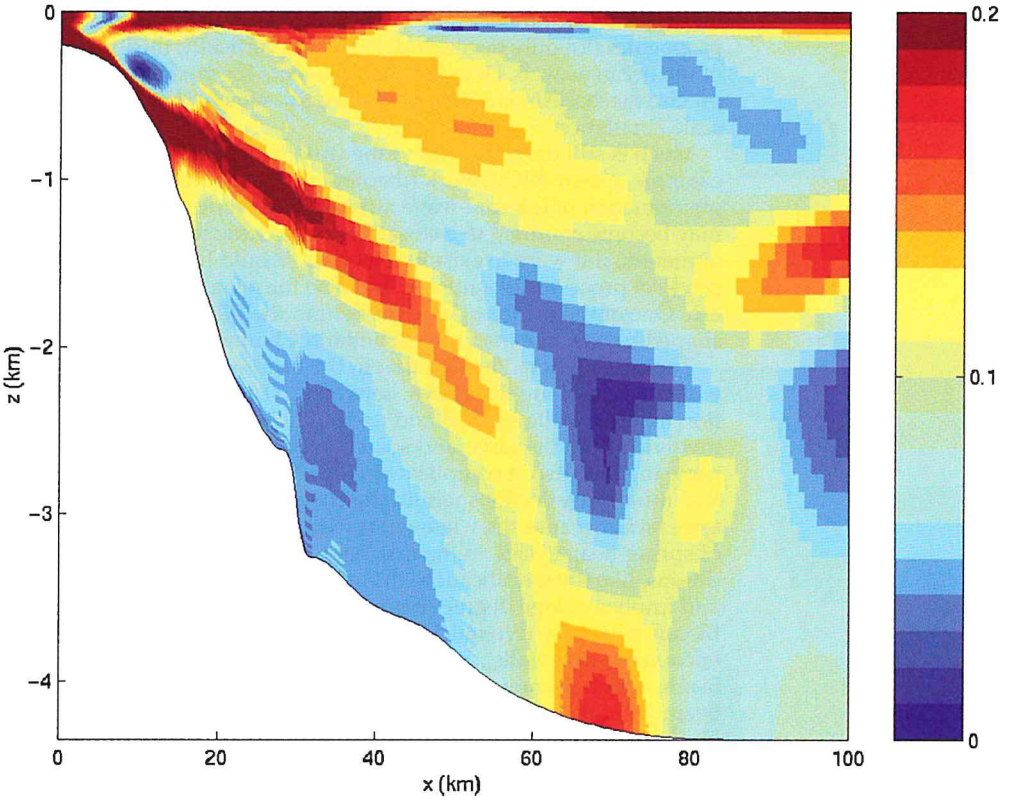
Much is still unknown about the way the internal tides propagate through the ocean. For example, recent NIOZ-work (theoretical and laboratory studies) revealed the hitherto unknown phenomenon of internal-wave attractors: in (almost) closed basins the internal-wave energy may become confined to a closed trajectory, due to repeated reflections at side-walls. This phenomenon, if it were to exist in the ocean, would have very noticeable implications, not only for physical processes like mixing, but also for related aspects like nutrient fluxes, nepheloid layers etc. One of the principal motives behind the PROCS project was to investigate this in channel-shaped basins, like the Faeroe-Shetland Channel and Rockall Trough.

The observations showed that in the Faeroe-Shetland Channel strong internal-tide currents were present along the slopes, between 300 and 600m depth. A numerical internal-tide generation model was developed and used to further interpret these measurements. The model result, involving both the lunar and solar semi-diurnal tides, indeed shows intensified currents in the same region. Also, a complicated web of internal-tide trajectories can be identified; it appears that multiple reflections within the channel do occur, but that fully developed attractors do not arise here, because the wave-energy escapes onto the shelves. It was also found that the phase of spring-neap cycles, in the internal tide, is very sensitive to variations in the background conditions, like the stratification; this provides a possible clue to the occurrence of intermittency, and implies a large degree of unpredictability. The same model was applied to the Bay of Biscay, where the dynamics is simpler in that the oceanward propagating tides do not encounter `side-walls', and hence do not return. In the model, the downward propagating beam, which is known from observations, is well reproduced. In its later evolution, when the beam, after its reflection at the bottom, propagates upward and encounters the thermocline, high-frequency large-amplitude waves can be generated, so-called internal solitary waves. The study in this project has led to an explanation of this phenomenon in terms of scattering; and it



Result from the numerical model: the amplitude of the cross-slope internal-tide current (in m/s) in a cross-section of the Faeroe-Shetland Channel; intensified currents are seen along the upper part of the slope, at the right-hand (i.e. Shetland) side between 300 and 600m depth, in accordance with the observations.

was shown that it will not take place if the thermocline is weak (Bay of Biscay, during winter), or very strong (tropical regions). The analysis of these processes has thus provided a new insight into how the internal-wave energy, which is initially concentrated around the near-inertial and tidal frequencies, can be transferred to higher frequencies, and thus help `fill' the internal-wave spectrum.



The amplitude of the cross-slope internal-tide current (in m/s) in the Bay of Biscay. The downward propagating beam, emanating from the shelf-break, is most prominent; it later reflects at the bottom (near x=70km), after which the energy propagates upward.

SECONDARY FLOW DUE TO CURVATURE IN THE MARSDIEP INLET

Contributors: Maarten Buijsman & Herman Ridderinkhof

Acoustic Doppler Current Profiler (ADCP) data collected with the TESO (Texels Eigen Stoomboot Onderneming) Ferry "Schulpengat" reveals strong secondary flow. Secondary flow is the deviation of the depth-averaged main flow, as caused by the effects of curvature and Coriolis acceleration. These effects cause the horizontal velocity vector to rotate over the vertical. This is clearly illustrated in the figure. The figure shows the current component perpendicular to the depth-averaged current at maximum flood (flowing into the plane of the figure) during one ferry crossing. The ADCP is mounted underneath the ferry at 4.3 m below the water surface. In these observations, the secondary flow is mainly caused by the cyclonic (counter clockwise) curvature of the main flow. The curvature forces the near-surface flow outward (towards Den Helder) and the near-bottom flow inward (towards Texel). Maximum secondary velocities of approximately 0.2 m/s occur between 3 and 3.5 km, coinciding with maximum flood current velocities of approximately 1.6 m/s. Secondary flow may be important for the formation and migration of large sand dunes in the Marsdiep inlet. These dunes have a wavelength of O(100 m), an amplitude of O(1 m), and a migration speed of O(25 m/yr) in northeastern direction. The observed migration directions of these dunes are similar to the directions of the primary axes of long-term time series of the flow near the bottom.

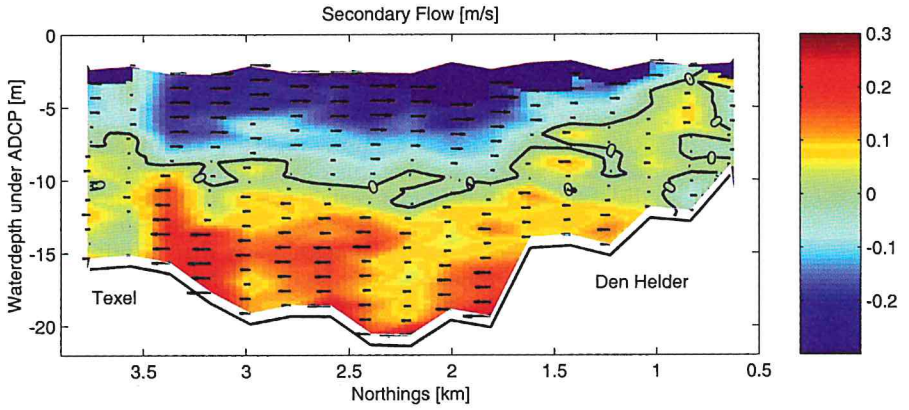


Photo: Bert Aggenbach

THE TIDAL HELMHOLTZ RESONATOR

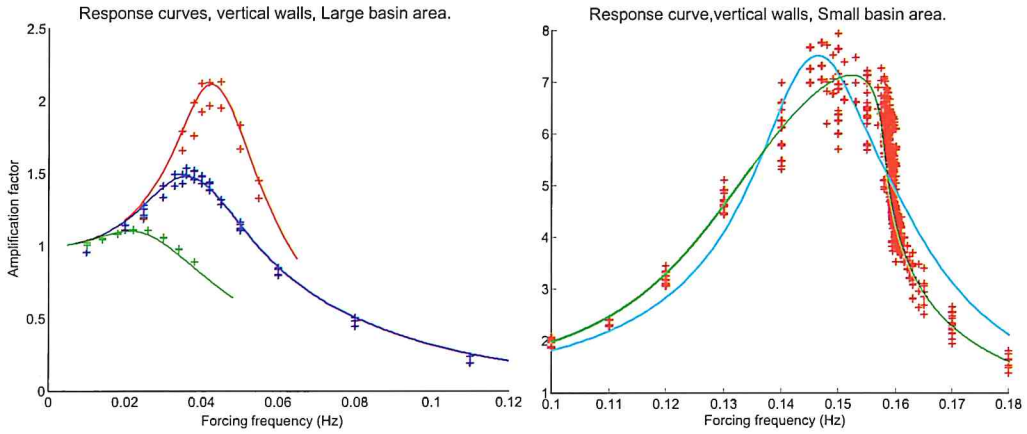
Contributors: G. Terra & L.R.M. Maas

Tides are caused by the gravitational forces exerted by the sun and the moon. However, their direct forcing is not sufficient to explain the large tidal amplitudes found in coastal areas. In fact, tidal sea-level elevations generated in the oceans are amplified due to resonance of the tidal frequencies with the natural frequencies of coastal basins. A particularly simple example is the Helmholtz resonator. This is an almost enclosed basin which is connected to the sea through a narrow channel. In such a configuration a 'pumping mode' can occur: the sea-level elevation is nearly uniform in the basin's interior with the water flowing in and out through the channel while the sea-level in the basin rises and falls during the tidal cycle. Because of the lack of sea-level differences inside the basin, such a mode has a relatively low natural frequency. Therefore even small systems with lengthscales of about 20 km can be in resonance with the tidal frequency (such as the M_2 component with its period of 12h.25min).

Linear models describing the resonance phenomenon are well understood. But questions concerning nonlinear effects remain to be answered. In the model describing the Helmholtz resonator nonlinear terms arise due to (quadratic) friction and due to a non-uniform hypsometry, i.e. when the wet area of the basin is different at high water than at low water. Nonlinear friction can be dealt with elegantly using a linearization procedure developed by H.A. Lorentz. He devised this method in 1926, when supervising the scientific committee assessing the possible effects of the enclosure of the former Zuiderzee. A linear friction law is used with friction coefficient depending on the amplitude of the oscillation such that the average energy dissipation equals that if the nonlinear friction law were used. It causes friction to be more important for increasing amplitudes.

The hypsometry causes nonlinear effects because the relation between the water flux through the channel and sea-level elevations inside the basin, which acts as the restoring force of the oscillator through the resulting pressure difference, becomes nonlinear. In a mathematical model it was shown that this can have dramatic effects on the response of the tidal basin to a tidal signal at sea. Under certain circumstances the resonance curve (the amplification of the tidal amplitude in the interior of the basin compared to to tidal amplitude at sea, as a function of frequency) can be bent in such a way that 'multiple equilibria' occur: with the same tidal signal at sea, the response in the basin can be in either a choked or an amplified regime. Sudden changes between these regimes may occur and may even happen in a chaotic manner!

In order to investigate these effects, a laboratory experiment was set up in the physics department. With the tank shown in the picture, the water level in the sea can be changed by oscillating a box filled with lead at the righthand side of the tank. The water expelled by this box flows underneath the basin area to the sea, where a tidal signal is simulated. The basin is connected to the sea through a pipe, representing a narrow channel. The waterlevel changes are measured by acoustic sensors. In this way the oscillating response of the waterlevel inside the basin to the tidal signal at sea can be measured. The results so far are in good agreement with 'linear' theory when friction is very important. If the basin area is reduced, friction becomes less important and multiple equilibria are found, though under conditions not predicted by the theory. The theory thus needs to be adapted in order to describe the behavior of our small scale water tank.

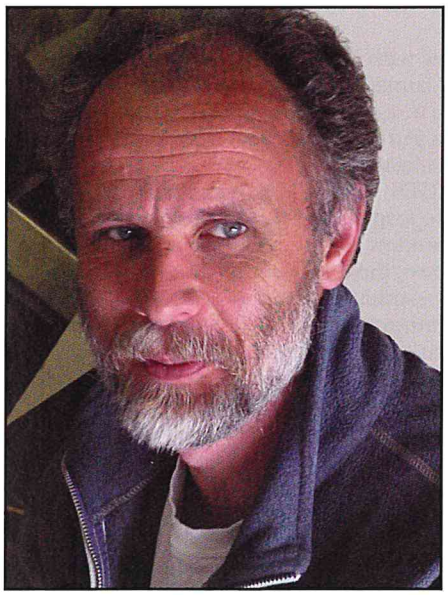


Response curves:

The amplification factor between the tidal amplitude in the basin and at 'sea', as a function of frequency. The left figure is for a large basin area, with large impact of friction, for amplitudes at 'sea' of 1 mm (red), 2 mm (blue) and 6 mm (green). Theoretical curves are according to Lorentz linearization theory. The right figure is for a small basin area, with nonlinear behavior, for amplitude at sea of 1 mm (red). The blue line shows the fit with Lorentz linearization theory, the green line is with nonlinear theory.

EXTERNAL PROJECTS OF THE DEPARTMENT OF PHYSICAL OCEANOGRAPHY

- Processes at continental slopes (NWO-ALW)
  H. van Haren, H. Ridderinkhof, L.R.M. Maas
- Internal waves in the polar ocean (EC-INTAS)
  Th. Gerkema, L.R.M. Maas
- Integrated North Sea Programme (NWO)
  H. van Haren
- Bay of Biscay Boundary Layers (NWO)
  H. van Haren
- Processes of vertical exchange in shelf seas (EC-MAST3)
  H. van Haren
- Mixing of Agulhas Rings Experiment, Component MARE-A Observations of Agulhas Ring Mixing (CLIVARNET, NWO-ALW)
  C. Veth, H.M. van Aken, T.F. de Bruin
- Ray-chaos and wave focusing of barotropic Rossby waves (EU-Marie Curie fellowship)
  U. Harlander, L.R.M. Maas
- Climatic variability of the sea surface height and circulation in the northern Atlantic Ocean observed with satellite altimetry (NWO-SRON)
  H.M. van Aken, D. Volkov
- The dynamics of internal and inertial waves in enclosed basins (NWO-NLS)
  L.R.M. Maas, A.M.M. Manders
- Secondary tides and quasi-periodically forced nonlinear oscillators (NWO-FOM)
  L.R.M. Maas and G. Terra
- Long-term Ocean Climate Observations (NWO-groot)
  H. Ridderinkhof, H. van Haren, L.R.M. Maas, H.M. van Aken, J.T.F. Zimmerman, T. Gerkema together with Utrecht University and KNMI
- Outer Delta Dynamics (NWO-ALW)
  H. Ridderinkhof, J.T.F. Zimmerman, M. Buijsman
- The transport of suspended particulate matter in the Dutch coastal zone (NWO-LOICZ)
  H. Ridderinkhof, L. Merckelbach
- Ferrybox (EC)
  H. Ridderinkhof, F. Eijgenraam, T. Hillebrand



The year 2002 was overshadowed by the tragic loss of MCG's recently appointed and inspiring chairman, Dr. Wim van Raaphorst, who died in a traffic accident on the 6th of November at the age of only 47. Wim's overall leadership and persistent, unifying approach was cut short at a time when structural changes in MCG were barely set in progress. Wim will be sorely missed for years to come. Following the loss of Wim van Raaphorst, Hein de Baar was appointed as ad interim Head of Department.

Research in MCG aims to identify and quantify the biogeochemical cycles that are involved in ocean-climate interactions, and to understand the temporal and spatial changes that are essential to reconstruct past and to predict future scenarios. Pertinent issues are grouped in three major themes, cross-linked among themselves and with other NIOZ departments:

THEME 1. Biogeochemical processes in ocean waters and air-sea exchange.
THEME 2. Particle settling and early diagenesis
THEME 3. Sedimentation and palaeoceanography

Research is focusing on present, past, and future ocean processes, thereby attempting to relate and integrate existing marine biogeochemistry with ongoing sedimentology and palaeoceanography. MCG combines the expertise from three classical backgrounds, and has developed a unique interaction between biologists, chemists, and geologists, relating surface ocean processes to vertical and lateral sediment transport, decadal trends in deep ocean waters, exchange at the sediment-water interface, and the accumulation of sedimentary archives recording past global change.

Three PhD students successfully defended their theses. Claar van der Zee studied the quantitative role of adsorbed, particulate and dissolved phases in the cycling of manganese and iron, and their interaction with phosphorus cycling in continental margin sediments. Erica Koning presented a comprehensive sediment-water silica budget for the Somalian upwelling area, applying new wet chemical techniques and mathematical formulations for quantifying biogenic silica. Mark Grutters studied the early diagenesis of amino acids in continental margin sediments, highlighting the role of de novo synthesis of cell-wall associated amino acids by autochtonous bacterial production (see contribution below).

The department organised various oceanic expeditions to the North Sea and Atlantic Ocean, focusing a.o. on the effect of dust-associated iron on primary production, on sedimentary processes in European canyons, on inorganic carbon chemistry of coastal seas, on the spatial distribution of recycling intensity resulting from local hydrodynamics and basin geomorphology, on the recycling of organic carbon in permeable sandy sediments, and on the distribution of cold water corals in relation to geological settings. A selection of activities will be reported in more detail below and in the special section dealing with North Sea research.

IRONAGES CRUISES 2002.

Contributor: Klaas Timmermans

R.V. Pelagia in Funchal.

For the IRONAGES project , 2 cruises with R.V. Pelagia were conducted in 2002. The first cruise, in March 2002, aimed at studying iron coming from sediments. Main study area of this cruise was a gradient from the continental shelf to the abyssal plain. For this purpose a transect from the English Channel to the Gulf of Biscaye was selected.

The main objective of the IRONAGES 3 cruise (October 2002) was to witness and to quantify a natural wet deposition event of iron-rich dust from the Sahara, and to follow a phytoplankton bloom development which might result from this event. In order to do so, the total deposition of iron from the atmosphere to surface seawater was estimated, and the soluble fraction of the iron entering seawater from the atmosphere were determined. Further, the chemical form of iron both in terms of its redox speciation and the extent to which it is organically complexed were identified. For this cruise, R.V. Pelagia left from Ponta Delgada, spend 3 weeks in a "box" between 32 - 25 N, and 20 — 25 W, had a brief stop in Funchal and ended its cruise in Valencia.

Results of the field sampling.

The CTD was equipped with standard NOEX bottles, and dedicated Go-Flo watersamplers. These latter were used for trace metal clean sampling. Shallow CTD casts were done in order to investigate the vertical distribution of trace metals, macro-nutrients and phytoplankton. Next to these CTD cast, special cast were done almost every other day. The special casts were done for the collection of nutrient rich, trace metal poor water for experiments with phytoplankton. The use of Go-Flo bottles on the CTD frame enabled check for trace metal cleanness of this frame and the Kevlar wire.The results were very satisfactory: It was demonstrated that the combination of the Kevlar wire, the specially coated CTD frama and the Go-Flo bottles resulted in watersamples without Fe contamination.

New coated CTD frame with NOEX and Go-Flo bottles.

Two dust samples were mounted on the bridge of Pelagia. One was dedicated to the sampling of trace metals (acid washed filters), one for the sampling of major ions. These dust samplers were continuously operated during the cruise. Only once dust was clearly visible on the filters.

Dust samplers on bridge of Pelagia. (Photo's: Klaas Timmermans)

Results from shipboard experiments.

Experiments with the natural phytoplankton population.
For these experiments, water from the Chlorophyll maximum was collected with the Go-Flo watersamplers. This ensured trace metal clean collection of the water. Subsequently, incubation and handling were done inside a clean container, at ambient temperature and light conditions. As the water had low N, P and Si concentrations, trace metal clean nutrients were added. Routinely, two treatments were incubated: Plus dust and control incubation. The indigenous phytoplankton showed little if any effect on the additions of the dust.

Experiments with single species phytoplankton cultures.
For these experiments, water from 500 m depth was collected with the Go-Flo watersamplers. This ensured trace metal clean collection of the water. Subsequently, incubation and handling were done inside a clean container, at ambient temperature and light conditions. Given the nutrient concentrations at 500 m depth no nutrients had to be added to these cultures. Routinely, two treatments were incubated: plus dust and control incubation. The phytoplankton species that were used were: Prasinococcus sp., Pelagmonas sp. and Ditylum brightwelli, brought from the home laboratory. In these experiments the phytoplankton was used as indicators of bioavailable F originating from duste. The small species (Prasinococcus sp., Pelagomonas sp.) did not respond to the addition of dust. Ditylum brightwelli growth rates, in contrast, was stimulated by addition of dust.

EARLY DIAGENESIS OF AMINO ACIDS IN SEDIMENTS ACROSS THE NE ATLANTIC SLOPE

Contributors: Mark Grutters, Wim van Raaphorst

Amino acids, constituents of proteins, are generally transported through the water column by large, rapidly sinking aggregates. During this transport, nitrogen-rich compounds like amino acids are degraded faster than nitrogen-poor compounds (e.g. lipids). Therefore, the contribution of amino acids to bulk organic matter decreases with ageing of the organic matter, and hence with increasing depth in the water column. Moreover, shifts occur in amino acid distributions due to differences in nutritional value, adsorption capacity, resistance against degradation, etc.

A study on total hydrolysable amino acids (THAA) in sediment trap samples and in sediments across the Goban Spur continental slope (NE Atlantic) demonstrated that amino acids can be used to assess the diagenetic state of organic matter in the sediments. The very low contribution of THAA to bulk organic matter as well as the rather constant amino acid distributions in bulk sediments indicated that organic matter was already substantially degraded prior to incorporation into the sediments. A diagenetic model was applied to measured THAA and total organic carbon concentration profiles in the sediments to study their input, mixing and degradation. Amino acids were degraded faster than total organic carbon at the upper slope only, confirming the relatively refractory character of the organic matter in the sediments at the lower slope. The difference in diagenetic state of the organic matter across the slope became clear by studying size fractions of the sediment top layer. Shifts in amino acid distributions indicated that the organic matter in the finest fraction (<0.5 μm) was more labile than that in coarser fractions at the upper slope and than any size fraction at the lower slope. The contribution of fine particles increased with depth across the slope suggesting they were eroded from the upper slope and accumulated at the lower slope. From this down-slope transport in combination with the continuous degradation of organic matter attached to the fine particles it was concluded that the organic matter degradability decreased from the upper slope to the deep-sea.
Across the slope of the Faeroe-Shetland Channel (FSC) in the NE Atlantic, down-slope particle transport by repetitive cycles of erosion-deposition was far more important for the delivery of organic matter to deep-sea sediments than vertical settling from the euphotic layer of the ocean. An end-member model based on total nitrogen (TN) and THAA concentrations as well as on amino acid distributions in suspended matter (SM) samples from the water column, sediment trap samples and surface sediments demonstrated that near-bottom SM comprised ~80% of fine particles that were resuspended from the sediment surface. The vertical flux from the upper water column contributed only to ~20%. The contribution of amino acid-N to TN in suspended matter increased with water depth and supported the model results that organic matter in near-bottom water was not derived from the euphotic layer. The enrichment in aspartic acid in near-bottom SM and sediments at the upper slope as well as in sediment trap samples at the lower slope suggested that carbonaceous particles were eroded from the upper slope and transported down in near-bottom SM layers. The mid-slope maximum of fine particles in the surface sediment, the elevated inventories of 234Th as well as the high contribution of amino acid-N to TN evidenced that young and amino acid-rich organic matter was transported down-slope and preferentially settled at mid-slope depth.

Part of the amino acids that are degraded by bacteria in the water column and in the sediments are used for synthesis of new biomass. Amino acid enantiomers were used to identify the contribution of bacterially derived amino acids to THAA in the sediments. Amino acids in proteins are generally composed of L-amino acids, which can a-biotically racemize to D-amino acids, the mirror image of the L-enantiomer, on time scales of a few hundred thousands to millions of years. Bacteria, however, are among the few organisms that can produce D-amino acids for peptidoglycan, the main constituents of their cell walls.

Across the Goban Spur, the contribution of D-amino acids by racemization was almost negligible which pointed at a bacterially source for D-amino acids. D-amino acids were likely not associated with whole bacterial cells, since the contribution of amino acids from whole cells would exceed measured THAA concentrations in the sediments by a factor 5. Amino acids from bacterial cell wall remnants could account for ~10% of THAA in the sediment surface and for more than one third of THAA in the deeper sediments. A diagenetic model was applied to THAA concentration profiles lowered for bacterially derived amino acids. First-order degradation rate constants of THAA were 2-10 times higher than rate constants calculated from original profiles, clearly indicating that studying THAA degradation without taking into account the synthesis of amino acids by bacteria in the sediments is unreliable.

An end-member model based on D-amino acids in suspended matter from the water column, sediment trap samples and surface sediments demonstrated that the erosion-deposition mechanism that was responsible for the down-slope transport of THAA across the FSC was

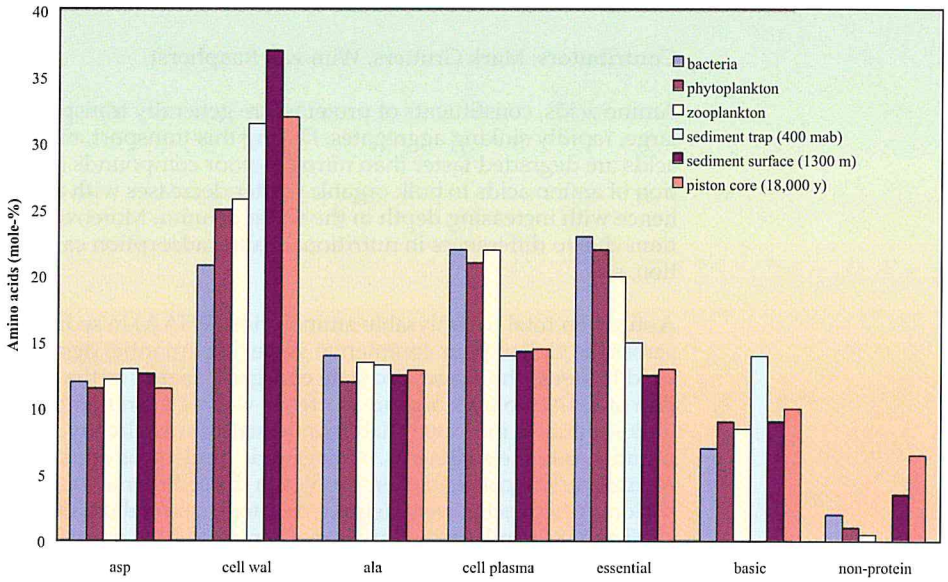


Figure X Mole-percentages of amino acid classes as measured by HPLC in samples from labile and refractory organic matter end-members. The figure demonstrates that amino acids become enriched during diagenesis in relatively refractory organic matter pools as bacterial cell walls and depleted in relatively labile organic matter pools as bacterial cell plasma. ASP denotes aspartic acid; CELL WALL denotes glycine, serine and threonine; ALA denotes alanine; CELL PLASMA denotes glutanmic acid, tyrosine and phenylalanine; ESSENTIAL denotes methionine, valine, iso-leucine and leucine; BASIC denotes lysine, arginine and histidine; NON-PROTEIN denotes b-alanine and g-aminobutyric acid.

also responsible for the distribution of amino acid enantiomers. D-amino acids in near-bottom water layers appeared not to be derived from the euphotic layer but from fine particles resuspended from the sediment surface. On average, approximately 5% of the D-amino acid concentration in the sediments could be accounted for by a-biotic racemization. Inventories of D and L-amino acids showed that there was a pronounced mid-slope accumulation of both enantiomers in the upper 5 cm of the sediments relative to the other stations. The ratio of D/L-amino acids in the upper sediments, obtained from the inventories, decreased with depth across the slope and indicated that the contribution of (newly synthesized) whole cells may increase down-slope. It was concluded that bacterial growth on fine, labile organic matter-rich particles transported down-slope in near-bottom water layers resulted in a mid-slope accumulation of D-amino acids in refractory bacterial cell wall material. With increasing depth in the sediments these amino acids are preserved as cell wall remnants and contributed at least 24% to THAA in the deeper sediments.

An important implication of the bacterial synthesis of amino acids is that degradable amino acids are transformed into labile cell plasma and relatively refractory bacterial cell walls. This conversion into cell wall material may enlarge the proportion of amino acids from primary production that survives early diagenesis, and could be the first step in the long-term burial of amino acids in marine sediments.

PALEO-ENVIRONMENTAL EFFECTS OF THE MID-PLEISTOCENE TRANSITION IN THE TROPICAL ATLANTIC AND EQUATORIAL AFRICA

Contributors: Enno Schefuß, J. H. Fred Jansen and Jaap S. Sinninghe Damsté

In this co-operative project between the departments MCG and MBT, supported by ALW, the tropical environmental changes at the start of the Late Pleistocene ice ages were investigated using lipid biomarkers and their stable carbon isotope compositions. At that time, the Mid-Pleistocene Transition (MPT) lasting from about 920 to 650 thousand years before present (kyr BP), the mean global ice mass increased and the 100-kyr cycle of the Late Pleistocene became established. The utilized lipid biomarkers are specific biochemicals derived from known organisms, such as haptophyte algae. If preserved in the sediments, they can provide insights in the past environmental conditions. The investigations were done on sediments from the Angola Basin in the tropical South Atlantic Ocean. The Angola Basin is characterised by strong seasonal changes in the atmospheric circulation. From June to August, strong southern Hemisphere trade winds blow over the Angola Basin transporting large amounts of atmospheric dust from dry areas in southern Africa. Wind-driven surface water mixing causes elevated surface water productivity by oceanic upwelling, i.e. supply of nutrients to the photic zone from below a shallow nutricline. From December to February, a strong monsoon with high precipitation in southern Africa leads to maximum Congo River discharge.

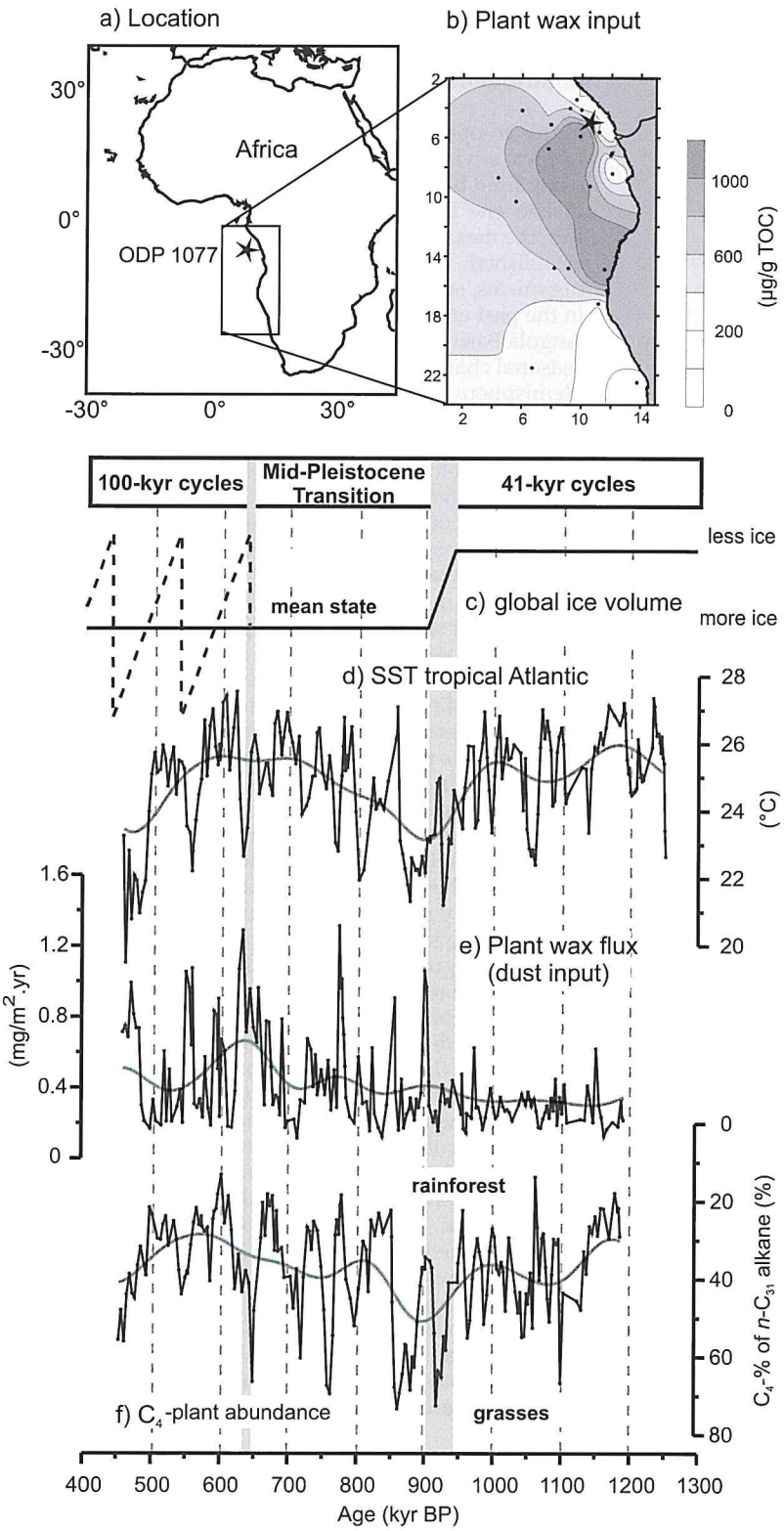
For an accurate understanding of the lipid biomarker variations and their significance, modem atmospheric-dust samples and surface-sediment samples were analysed. The lipid parameters were mapped in detail and linked to specific environmental conditions. The main lipids in the dust samples are derived from the epicuticular wax coating of terrestrial higher plants. Their stable carbon isotopic compositions appeared to primarily reflect the contemporary type of vegetation on the adjacent continent; the molecular parameters in the surface sediments reflect the main production, transport and preservation processes in the Angola Basin.

These findings were applied to the mid-Pleistocene time series derived from the Ocean Drilling Program (ODP) sediment core 1077 (lower Congo deep-sea fan). Surprisingly, the growth of the global ice mass led to a long-term warming of the tropical Atlantic Ocean during the MPT. This warming must be caused by the temporary but severe reduction of North Atlantic Deep-Water formation, the carrier of surface-water heat from the tropics to the high latitudes. The tropical sea-surface temperature (SST) variations followed the changing frequency behaviour of the high-latitude ice volume, i.e. the onset of the 100-kyr cycle. They responded, however, significantly earlier on the orbital insolation changes. This linkage indicates an early response of the tropics, which receive the largest part of the global insolation, on the changing surface thermal gradient of the South Atlantic.

After the growth of the global ice volume, the compression and energising of the atmospheric circulation cells stimulated the aeolian dust transport, significantly increasing the accumulation of plant wax lipids in the Angola Basin. The Mid-Pleistocene vegetation changes detected by the stable carbon isotopic compositions of the plant waxes, appeared strongly correlated with the tropical SST. Consequently, the low-latitude SST directly controls the African aridity via the tropical precipitation-evaporation balance and thus determines the large-scale vegetation type in southern Africa. The low SST at the beginning of the MPT thus led to an aridification of subtropical and tropical Africa, while the long-term warming caused the re-expansion of rainforest afterwards.

The environmental changes also had important effects on the marine ecosystem in the Angola Basin. The monsoonal forcing of river-induced productivity was dominant before the growth of the ice volume in the MPT, while afterwards the wind-driven upwelling of nutrient-rich deeper waters became more important for marine production. The strength of the upwelling depended mainly on the wind strength, which increased with growing global ice volume. Subsequently, the low-latitude forcing of marine productivity was suppressed.

This project thus provides new insights in the climate linkages between the high-latitudes and the tropics, and the effects of the marine environmental changes on the sensitive terrestrial and marine ecosystem.



a) Location of ODP Site 1077 in the Congo deep-sea fan. b) Plant-wax input into the Angola Basin, reflected by the concentrations of the C_{25} to C_{35} odd-numbered n-alkanes in surface sediments. c) Schematic evolution of the global ice volume during the Mid-Pleistocene Transition (MPT). d) Sea-surface temperatures during the MPT at Site 1077, determined with the alkenone-unsaturation method. e) Plant-wax input during the MPT, given by accumulation rates of the C_{25} to C_{35} odd-numbered n-alkanes. f) C_3- (rain forest) to C_4-plant (grasses) vegetation changes in subtropical and tropical Africa, derived from the ?^{13}C-values of the n-C_{31} alkane. The vertical grey bars mark the beginning en end of the MPT.

EXTERNAL PROJECTS OF THE DEPARTMENT OF MARINE CHEMISTRY AND GEOLOGY

- 6C (EU). WP 2. G.J.A. Brummer, S. Schouten
- ACES (EU). T.C.E. van Weering
- ECOMOUND (EU). Coordinator WP 1. T.C.E. van Weering
- GEOMOUND (EU). Coordinator WP 5. T.C.E. van Weering
- STRATAGEM (EU). Coordinator WP 3. T.C.E. van Weering
- Canyons 2001 (EU). Coordinator NEBROC (NWO). T.C.E. van Weering
- Red River Delta project, Vietnam (WOTRO/NWO). T.C.E. van Weering
- EU Strataform (EU). Coordinator WP 2 (since September 2002). T.C.E. van Weering
  J.H.F. Jansen, G.-J.A. Brummer, F.J.C. Peeters, N. Loncaric.
- CORTEX (CORescanner TEXel) (University Bremen).
  J.H.F. Jansen, S.J. van der Gaast, B. Koster, A.J. Vaars.
- Neogene history of the Benguela Current and climate in southeastern Africa. (NWO).
  J.H.F. Jansen, J.S. Sinninghe Damsté, E. Schefuß, S. West.
- Tropical environmental change and its teleconnections during the last deglaciation: a lipid biomarker study dated with ^{14}C wiggle-matching. (NWO).
  G.J.M. Versteegh, J.H.F. Jansen.
- 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, F. Peeters
- Stratigraphical Development of the Glaciated Atlantic margin (STRATAGEM, EU-MAST)
  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, M. Grutters
- Climate history, North Atlantic (NEBROC)
  T.C.E. Van Weering, T. Richter
- Carbon Cycle, Biological Forcing I (NEBROC)
  H.J.W. De Baar, K.R. Timmermans
- Carbon Cycle, Biological Forcing II (NEBROC)
  H.J.W. De Baar, J. Kramer
- Coastal and Continental Margin Processes (NEBROC)
  W. Helder, H.J.W. De Baar, H. Thomas
- Iron resources and oceanic nutrients — advancement of global environment simulations (IRONAGES, EU-MAST)
  H.J.W. de Baar, P. Croot, K.R. Timmermans
- COMET (EU MAST)
  H.J.W.de Baar, L. Gerringa
- Positive Feedback of enhanced UV-B via the iron chemistry on the fixation of CO2 in the Southern Ocean (NWO-NAAP)
  L.J.A. Gerringa , H.J.W.de Baar, M. Rijkenberg
- The continental shelf pump: a pilot study in the North Sea (CANOBA, NWO-ALW)
  H. Thomas, H.J.W.de Baar
- Enhanced carbon mineralization rates in permeable sandy sediments (EMIR, NWO-ALW)
  W. van Raaphorst, E.H.G. Epping
- Atlantic Coral Ecosystem Study (ACES, EU-MAST)
  T.C.E. van Weering, H.C. de Stigter
- Environmental Controls on Mound formation along the European margin (ECOMOUND, EU-MAST)
  T.C.E. van Weering, H. de Haas, H.C. de Stigter
- The internal mound factory (GEOMOUND, EU-MAST)
  T.C.E. van Weering , H. de Haas, H.C. de Stigter
- Red River delta program (NWO-WOTRO)
  T.C.E. van Weering, G. van de Berg
- Climate history South East Atlantic I (NEBROC)
- J.H.F. Jansen, N. Loncaric, G.J.A. Brummer
- Key processes controlling biogenic silica preservation in marine sediments (NWO-ALW)
  W. van Raaphorst, E. Koning, E.H.G. Epping

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

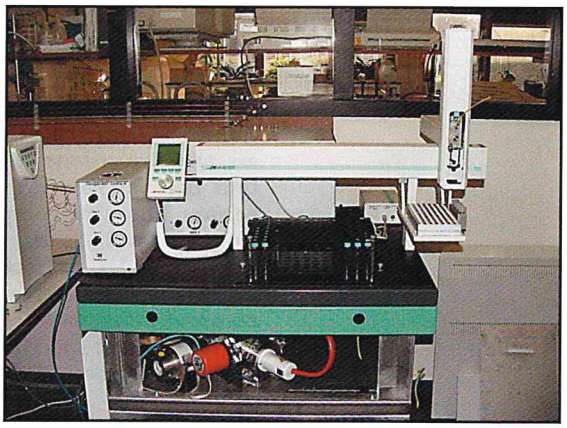
One of the most important developments in 2002 was the construction of the new lab and office facilities for the Marine Biogeochemistry group. The old temporary housing has been used for more than nine years and did not meet the criteria anymore of the 'ARBO' regulations. The new labs and offices, which the group moved into at end of November, are much safer and healthier and far more in line with these regulations. Another important development was the change of department head. After 5 years Jan Boon has stepped aside from his position as department head of MBT. His place has now been taken over by Jaap Sinninghe Damsté.

Several PhD. students successfully completed their Ph.D. projects this year and they describe the results obtained below. Enno Schefuß completed a collaborative project between MBT and MCG on the palaeo-environmental effects of the mid-Pleistocene transition on the tropical Atlantic and equatorial Africa. For his study he analysed, amongst others, an 800 Kyr-long record on the composition of biomarkers in unprecedented high resolution. Bart van Dongen studied the effect of natural sulfurization of sugars on the accumulation and composition of sedimentary organic matter. An important conclusion from his results is that if carbohydrates are sulfurized and preserved in sedimentary organic matter then large effects on total organic carbon contents and isotopic compositions of organic carbon can be expected. Finally, Rienk Smittenberg has examined the potential to accurately date marine sediments by compound-specific ^{14}C-analysis. He found that the ^{14}C-composition of specific archaeal membrane lipids provide an excellent tool for dating marine sediments in contrast to the heterogenous sedimentary organic matter.

NEW STABLE ISOTOPE MASS SPECTROMETERS INSTALLED

Through a "Middelgroot" instrument grant from NWO-ALW the department of MBT was able to purchase two new stable isotope mass spectrometers with several applications. After a long delay the instruments, a Thermofinnigan Delta^{PLUS} and a Delta^{PLUS} XL, were installed in October/November 2001 and were fully running by the beginning of 2002. Attached to the mass spectrometers are several applications. Firstly, a so-called Gas Bench and Elemental Analyzer are hooked-up to the Delta^{PLUS} to analyse carbonates/dissolved inorganic carbon and bulk organic matter, respectively. Examples of the types of analyses which can be performed using the GasBench are ^{13}C and ^{18}O analyses of carbonates, ^{13}C analysis of dissolved inorganic carbon and ^{18}O of water. The Elemental Analyzer will be mostly used for the ^{13}C and ^{15}N analysis of sedimentary organic matter. Secondly, a gas chromatograph with cumbusition/pyrolysis interface is hooked up to the Delta^{PLUS} XL. Through this application, individual organic compounds can be analysed for their ^{13}C, ^{15}N, ^{18}O and ^{2}H-contents. Finally, a thermochemical analyzer is also hooked-up to Delta^{PLUS} XL isotope mass spectrometer to enable the analysis of ^{2}H-contents of water and bulk organic matter. The installation of these machines has already provided a substantial boost to the isotope research in the department of MBT and is increasingly used by other departments within NIOZ and outside research institutes and universities.

Installed Thermofinnigan Delta^{PLUS} XL stable isotope mass spectrometer with gas chromatograph and combustion/pyrolysis interface for measuring the stable isotopes of individual organic compounds.

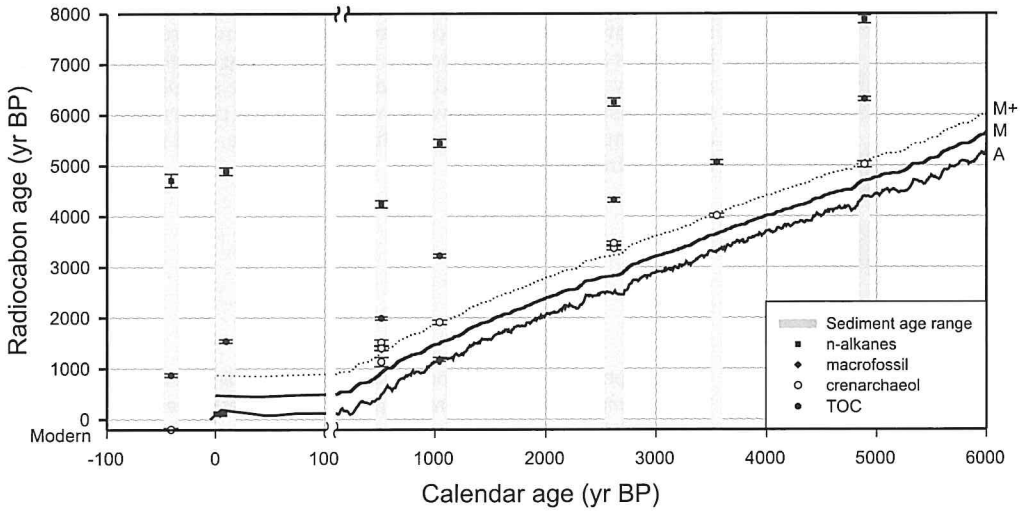


Installed Thermofinnigan Delta ^{PLUS} isotope mass spectrometer with GasBench for measuring the stable isotopes of inorganic carbon in seawater and sediments.

COMPOUND-SPECIFIC RADIOCARBON DATING AND BIOMARKER ANALYSES OF LAMINATED FJORD SEDIMENTS.

Contributors: Rienk H. Smittenberg, Ellen C. Hopmans, Stefan Schouten and Jaap S. Sinninghe Damsté

Radiocarbon dating is based on the principle that ^{14}C atoms created from ^{13}C in the atmosphere by solar radiation are taken up by organisms, which after their death exhibit an ever decreasing radiocarbon content due to radioactive decay. The introduction of accelerated mass spectrometry (AMS) in the early 1990's greatly reduced the amount of carbon required to analyze natural radiocarbon to below 100 μg, and it became possible to determine the radiocarbon age of isolated molecular remains of algae, plants and micro-organisms, so-called biomarkers. This may be of special value in cases where dating is not or hardly possible with e.g. wood or shell pieces. Our study is the first one dedicated to this possibility, as this newly developed technique has so far mainly been used for tracking carbon sources, another useful application of compound-specific radiocarbon analysis. For instance, the main source of marine derived organic carbon is dissolved bicarbonate, which is on average several centuries old, while organic carbon deposits on land may be several millennia of age. The total organic carbon fraction (TOC) of a sediment is normally a mixture of both marine and terrestrial remains, and this makes TOC useless for dating purposes.
In this study, supported by ALW, we analysed sediments from the Saanich Inlet, a Canadian fjord. The water mass inside Saanich Inlet is anoxic in the bottom part, due to an under-water sill at the entrance which prevents exchange of this bottom water with open sea. Because of this, larger animals can not live at or in the fjord sediment, and thus the record of yearly deposited light and dark layers is preserved. By counting these layers, similar to tree-rings, an accurate dating over the last 6000 yr. was obtained for this sediment. Five sediment subsamples



Radiocarbon ages of TOC, land-plant derived n-alkanes, two macrofossils (a seed and a leaf), and crenarchaeol, derived from marine microorganisms, plotted against sediment calendar ages, together with the calibration curves derived from the literature. A: Atmospheric calibration curve. M: Marine calibration curve. M+: Marine calibration curve corrected for a local 'reservoir effect'. Note the change of scale at 100 yr calBP. Because of clarity, not all measured biomarkers are plotted.

were selected, from which several biomarkers (organic compounds with known origin) were isolated. The isolation was for a large part performed using a specially developed preparative HPLC (liquid chromatography) method, so that larger and more polar compounds could be isolated then is traditionally done using gas chromatography. The isolated biomarkers on which radiocarbon dating was performed were derived from photoautotrophic plankton, from marine Crenarchaeota (a microorganism that ubiquitously occurs in the ocean), and from land plants. For comparison, the TOC fraction was also dated. The main result was that the biomarkers derived from the marine Crenarchaeota could be easily isolated in relatively large quantities and that their calibrated radiocarbon ages agreed well with the independently determined sediment ages. In the future, this method can thus be used as an alternative or extension for radiocarbon dating of marine sediments. Radiocarbon dating using phototrophic plankton gave

variable results. This is most likely due to the fact that phototrophic plankton grow in the surface waters, which are highly influenced by seasonal changes in air-ocean CO_2 exchange and by fresh water inputs that may also have varying radiocarbon contents. The radiocarbon ages of the biomarkers derived from land plants were several thousands of years older than the sediment, and this clearly influenced the age of the TOC. Moreover, the age difference between this terrestrial biomarker and the sediment increased towards more recent times. This can be related to an ever increasing age of the soils at the environs of the fjord, which started to develop after the termination of the last ice age.

Laminated and anoxic fjord sediments are in general very suitable for biogeochemical research, because they often contain well-preserved high resolution palaeoclimatic and palaeo-environmental records. To investigate this, two Norwegian fjords were sampled, i.e. the small Kyllaren fjord, located north of the city Bergen, and the larger Drammensfjord, a side fjord of the Oslofjord, which was visited during a cruise of the RV Pelagia during 1998.
Concentration profiles spanning approximately 400 years were obtained for a large suite of biomarkers extracted from Kyllaren fjord. Together with the stable carbon isotopic compositions of some of these biomarkers, it could be shown that this fjord is susceptible to natural eutrophication. Because the water exchange is reduced to a large extent by the sill between the fjord and the open sea, incoming nutrients are trapped and are intensively recycled, including CO_2. The building of a bridge annex dam in 1950 enhanced this effect. Due to the increase of trapped nutrients, more planktonic growth occurred, which also resulted in a rise of the level below which water column anoxia prevails, resulting in an almost completely anoxic basin.
In the Drammensfjord, eutrophication was also clearly recognisable from the biomarker profiles. At the onset of the industrial revolution around 1850 the logging industry expanded, resulting in a higher load of wood chips and pulp in Norwegian waters. The amount of plankton-biomarkers increased gradually, related to the increased supply of nutrients coming out of the wood pulp. However, almost immediately specific biomarkers derived from the plankton species Botryococcus braunii disappeared from the sedimentary record. This indicates that this plankton species is sensitive to eutrophication, probably because they are outcompeted by faster growing algae that can profit better from increased nutrient levels. Because Botryococcus braunii is a fresh water species, the occurrence or lack of its remains in a marine sediment was until now generally linked to variations in the supply of fresh water to a marine system. The results just described show, however, that the occurrence or lack of Botryococcus braunii may also be caused by a change in the trophic state, and not necessarily by a change in the actual input of fresh water.

Photograph of a 15 cm section of the laminated sediment from Saanich Inlet. The white layers are deposited during summer, due to calcareous plankton. The dark layers are deposited during winter, and consist mainly of silt and clays.

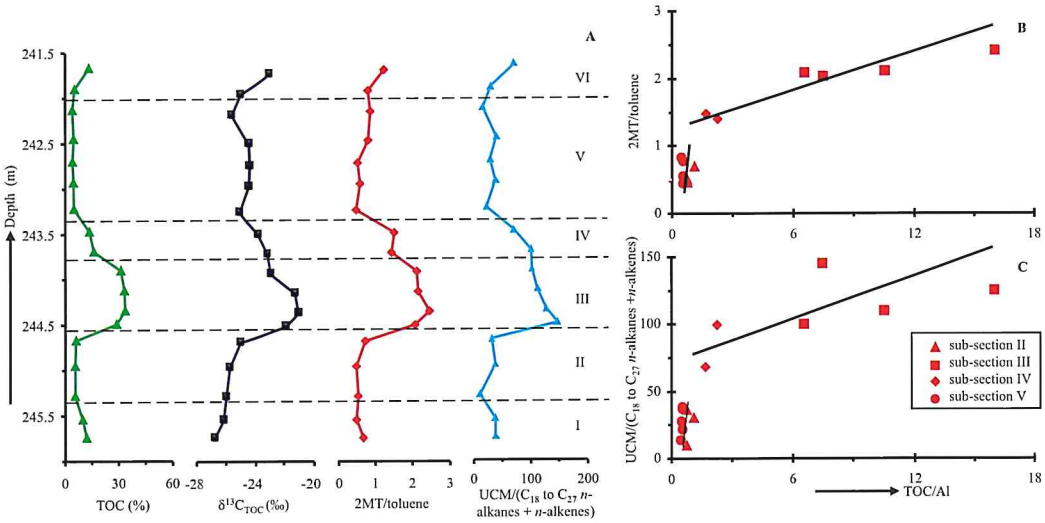
NATURAL SULFURIZATION OF CARBOHYDRATES IN MARINE SEDIMENTS: CONSEQUENCES FOR THE CHEMICAL AND CARBON ISOTOPIC COMPOSITION OF SEDIMENTARY ORGANIC MATTER.

Contributor: Bart E. van Dongen, S. Schouten and Jaap S. Sinninghe Damsté

Carbohydrates make up the largest part of the organic matter in the biosphere and serve living organisms as carbon and energy source as well as metabolic intermediates. Carbohydrates are generally thought to be remineralized during early diagenesis in the water column and sediment and are thus not preserved in substantial amounts. However, some studies have suggested that preservation of carbohydrates through sulfurization could be an important pathway for the preservation of sedimentary organic matter. However, it is still unclear to what extent carbohydrates can be preserved through this pathway in sedimentary organic material and what the consequence of a substantial preservation of carbohydrates is for the chemical and isotopic composition of the total organic carbon (TOC). The primary goal of this study, supported by NEBROC, is to test the hypothesis that preservation of carbohydrates through sulfurization may be an important pathway for the preservation of organic matter and, if so, to determine what the consequences for TOC and ^{13}C contents of TOC ($\delta^{13}C_{TOC}$) records are.

First the sulfurization of carbohydrates was mimicked in laboratory experiments which showed that at relatively low temperatures (50ϒC) monosaccharides are completely converted into organic sulfur compounds (OSC). Monosaccharides with the carbonyl function replaced by sulfur formed a substantial part of the low molecular weight OSC. However, most of the sulfurization products were of high molecular weight and linked through monosulfide linkages. These results provide experimental evidence that sulfurization of monosaccharides at relatively low temperature can result in the formation of OSC, most likely starting with sulfurization of the carbonyl functionality.

Organic geochemical analyses of a TOC cycle in the Jurrassic Kimmerdige Clay Formation (KCF) comprising the extreme TOC-rich (34%; Fig. 1) Blackstone Band sediment showed that the enhanced TOC values are most likely caused by an increase in the accumulation rates of organic matter and not by a decrease in the accumulation rate of inorganic matter. A linear correlation is observed between the $\delta^{13}C_{TOC}$, and the amounts of short-chain alkylated thiophenes and the S-rich unresolved complex mixture (UCM) found in the kerogen pyrolysates and the TOC/Al ratios for TOC/Al ratios >2 (Fig 1B and C). Detailed analyses of an S-rich UCM revealed that it probably consists of a large number of S-bound and O-bound, short chain, carbon skeletons. These most likely originate from carbohydrates incorporated into macromolecular organic matter through sulfurization during early diagenesis. Together with the alkylated thiophenes, also likely originating from sulfurized carbohydrate carbon, this indicates that the primary cause of the TOC maximum is the enhanced contribution of carbohydrate carbon to the organic matter. Estimations of primary production rates and preservation factors based on the barium and aluminium contents show that the primary production increased only by a fac-



(A) Depth profiles of TOC, δ^{13}CTOC, the ratio of 2-methylthiophene over toluene and UCM/(C_{18} to C_{27} n-alkanes + n-alkenes). (B) Cross-plot of the TOC/Al ratio and 2-methylthiophene over toluene and (C) UCM/(C_{18} to C_{27} n-alkanes + n-alkenes) in kerogen pyrolsates. The different sub-sections are indicated with roman capital letters. MT= methylthiophene.

tor 2 in the Blackstone Band, while the preservation factor of the carbohydrates increased by a factor 18. These results strongly suggest that preservation of carbohydrates through sulfurization may thus be an important pathway of preservation of organic matter, especially in shallow euxinic shelf seas.

Stable carbon isotope composition analyses of individual monosaccharides and lipids, as well as the bulk stable carbon isotope composition of total cell material from different aquatic and terrestrial plants showed that, in general, monosaccharides are 0 to 9‰ enriched in ^{13}C compared to total cell material and substantially enriched, 1 to 16‰, in ^{13}C compared to lipids within single organisms. The magnitude of the differences between the ^{13}C values of carbohydrates and total cell material or lipids is far greater than previously reported. This suggests that an enhanced contribution of carbohydrates to sedimentary organic carbon can significantly affect $\delta^{13}C_{TOC}$ values, explaining the linear correlation of $\delta^{13}C_{TOC}$ with TOC in the KCF.
In general this study strongly suggest that preservation of carbohydrates through sulfurization may thus be an important pathway of preservation of organic matter. This enhanced contribution of normally labile organic carbon to sedimentary organic carbon can have substantial impacts on TOC records and $\delta^{13}C_{TOC}$ records.

EXTERNAL PROJECTS OF THE DEPARTMENT OF MARINE BIOGEOCHEMISTRY AND TOXICOLOGY

- Chemical fossils of diatoms for age determination of petroleum: Improved tools for solving exploration and production problems (STW).
  B. Abbas, S. Rampen, G. Muyzer, S. Schouten, J.S. Sinninghe Damsté.
- Marine Environmental Awareness Courses for the Dutch Maritime Universities of Higher Professional Education (3 courses in 2002, funded by ProSea). In co-operation with EcoMare.
  J.P. Boon (co-ordinator and lecturer), K. Booij, C.C. Ten Hallers-Tjabbes (lecturers).
- TBT in Marine Mammals (RWS-RIKZ).
  J.P. Boon, C.C. Ten Hallers-Tjabbes.
- Evaluation of proposed methods to measure the occurrence of potential bioinvading species in ballast water of ships. (Royal Haskoning).
  J.P. Boon, C.C. Ten Hallers-Tjabbes, M.J. Veldhuis, W. Van Raaphorst.
- Bioaccumulation of persistent organic pollutants in small cetaceans in European waters: Transport pathways and impact on reproduction (BIOCET). (EU-DG XII).
  J.P. Boon, B.N. Zegers.
- Tetrabromobisphenol-A (TBBA) in animals of different trophic levels from the North Sea. (Bromine Science and Environmental Forum (BSEF)).
  J.P. Boon, B.N. Zegers.
- Risk assessment of brominated flame retardants as suspected endocrine disrupters for human and wildlife health (FIRE). (EU-DG XII).
  J.P. Boon, B.N. Zegers (guest scientist).
- Analyses of organotin compounds in harbour porpoises from the North Sea and their food. (RIKZ, Ministry of Transport, Public Works and Water Management). In co-operation with the Institute for Environmental Studies, VU Amsterdam.
  J.P. Boon, B.N. Zegers
- Passive sampling of organic contaminants in the waterphase (RIKZ).
  K. Booij, C.V. Fischer
- A historical molecular record of Holocene environmental changes from Antarctic sediments of stratified fjords and lakes (NWO-ALW).
  M. Coolen, G. Muyzer, S. Schouten, J.S. Sinninghe Damsté.
- Rapid global change during the Cenomanian/Turonian oceanic anoxic event: Examination of a natural climatic experiment in Earth history (CT-Net).
  A. Forster, S. Schouten, J.S. Sinninghe Damsté.
- Archaeal carbon fixation and burial and terrestrial organic matter input in the coastal system as revealed by tetraether membrane lipids (NWO-ALW and LOICZ)
  L. Herfort, E.C. Hopmans, S. Schouten, J.S. Sinninghe Damsté
- Early diagenetic transformations of carotenoids: A key to understanding past environmental changes (NWO-ALW).
  E.C. Hopmans, J.S. Sinninghe Damsté.
- 6C: Climate change, carbon cycle and carbonate chemistry (EU)
  J. Ossebaar, G.J. Brummer, S. Schouten.
- Neogene history of the Benguela Current and climate in southeastern Africa: a high resolution study of biomarkers and planktonic Foraminifera (NWO-ALW).
  E. Schefuss, J.H.F. Jansen, J.S. Sinninghe Damsté.
- Decadal climatic changes in the Holocene as revealed by biomarker records in finely laminated marine sediments (NWO-ALW).
  R.H. Smittenberg, J.S. Sinninghe Damsté.
- Impact of TBT in Neptunea antiqua from the North Sea (DGG).
  C.C. Ten Hallers-Tjabbes.
- Recycling of respired CO_2 in stratified marine systems: Consequences for the interpretation of the stable carbon isotope record (NWO-ALW).
  Y. Van Breugel, J.S. Sinninghe Damsté.
- Sulfurised carbohydrates: An important sedimentary sink for organic carbon? (NEBROC)
  B.E. 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.
- Carbon Isotopic Biogeochemistry of Eastern Mediterranean Mud Volcanoes. (NWO-ALW)
  J. Werne, J.S. Sinninghe Damsté.
- Development, evaluation and application of organic geochemical tracers for terrestrial carbon input into the marine environment (NWO-ALW)
  J. Weijers, E.C. Hopmans, S. Schouten, J.S. Sinninghe Damsté, T. Wagner
- Tetraether membrane lipids in the water column and sediments: Insights into the evolution and ecology of marine pelagic archaea.
  C. Wuchter, S. Schouten, J.S. Sinninghe Damsté
- Molecular and isotopic compositions oh hydrocarbon gas and organic matter from cold-seep deposits.
  A. Stadnitskaia , Tj. Van Weering, J.S. Sinninghe Damsté

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. Specific emphasis is put on the complex interaction between bottom-up and top-down control mechanisms in the lower planktonic food web.

In the year 2002, three cruises were executed. The final Plume & Bloom cruise in the North Sea was carried out during summer with input from MCG to obtain additional data on the role of clay and nutrient transport for the dynamics in productivity of the southern North Sea. During the MOMAP-1 cruise, also in the North Sea, growth and mortality of *Phaeocystis* was studied. An important component of this cruise was the assessment of the phyto- and bacterioplankton viral-induced mortality. In the TRANSAT-1 cruise performed in collaboration with FYS, the diagenesis of dissolved organic matter and the accompanying changes in prokaryotic community composition was followed in the North Atlantic Deep Water (NADW). This was done along a transect from the Greenland-Island-Norwegian Sea to the Azores, covering roughly the first 50 years of NADW in the oceanic conveyor belt.

A major field campaign in the frame of the AIRWIN project, funded by the EU, was performed in the Mediterranean Sea. In this project, the biology and chemistry of the air-sea microlayer, i.e. the first ca. 200 µm of the water column, is studied. As part of the (EU)-BIOHAB program scientists participated in the microcosm experiments in Barcelona. These experiments were designed to examine the release of toxic substances of *Alexandrium catanella* and their effect on the different trophic levels of a natural plankton community (viruses, bacteria, other phytoplankton, micro-and mesozooplankton). The EU-funded BASICS project started in fall. The main goal of this project is to perform single-cell analysis using a combination of phylogenetic and functional probes and laser confocal laser scanning microscopy to decipher the phylogenetic and functional dynamics of prokaryotic plankton communities at specific sites in European coastal waters.

MAJOR SHIFT IN BACTERIOPLANKTON UTILIZATION OF ENANTIOMERIC AMINO ACIDS BETWEEN SURFACE WATERS AND THE OCEAN'S INTERIOR

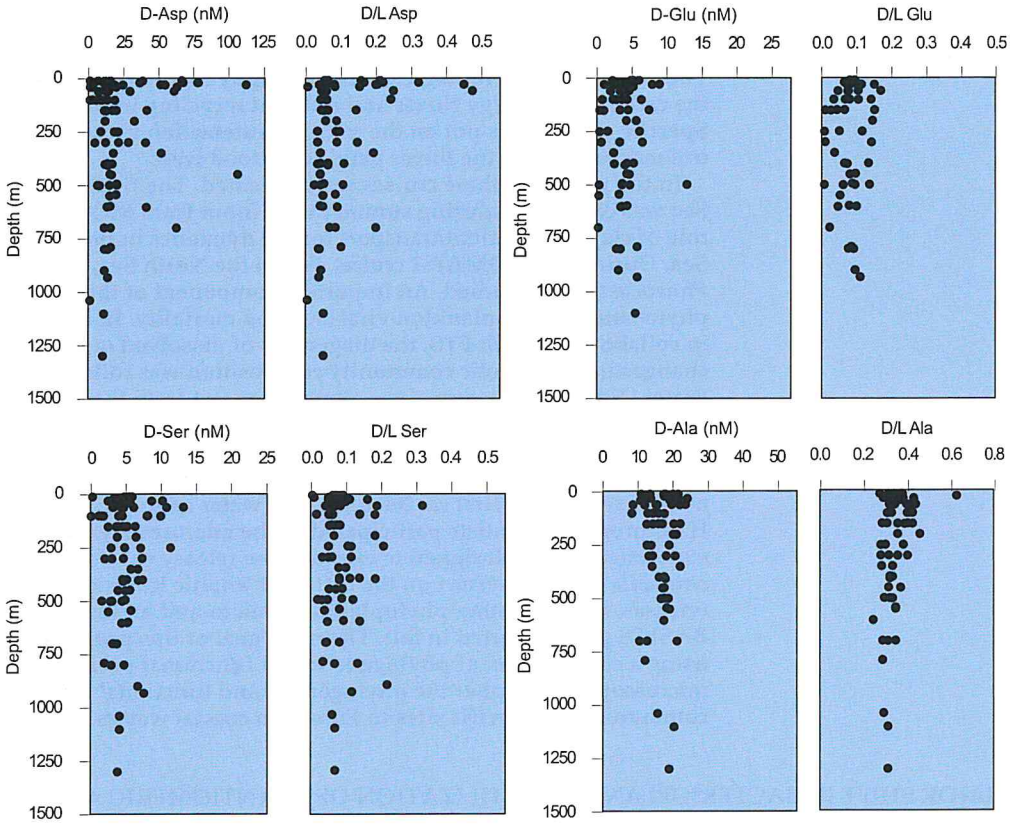
Contributors: Maria T. Pérez, Clemens Pausz, Gerhard J. Herndl

The oceanic dissolved organic carbon (DOC) pool is considered to be mainly of phytoplankton origin. This view has been challenged by the notion that the largest oceanic biomass, the bacterioplankton, also considerably fuel this DOC pool. It has been demonstrated that bacterioplankton transform labile DOC into recalcitrant DOC. One of the most refractory compounds of the bacterial cell is its cell wall. Specific compounds of this cell wall, the peptidoglycan layer, have been shown to constitute a significant fraction of the oceanic DOC pool as indicated by the characteristic enantiomeric ratio (D-/L-ratio) of its dissolved total amino acids. L-amino acids are those where the amino group is on the L-eft side in its Fisher projection of the compound, D-amino acids where the amino group is on the right side.

The main biotic source of D-amino acids in the sea is the peptidoglycan layer of the bacterial cell wall where 4 specific enantiomeric amino acids (alanine [Ala], glutamic acid [Glu], aspartic acid [Asp], and serine [Ser]) are present. Abiotically, D-amino acids are formed by racemization, which converts the L-enantiomeric form of amino acids into the corresponding D-amino acids. This racemization is a significant source of D-amino acids only over geological time scales. While the production of D-amino acids in the sea is largely restricted to bacteria, L-amino acids are produced and released into the oceanic DOC pool by a large variety of organisms but the most important source is phytoplankton. These phytoplankton-derived L-amino acids serve as an important substrate for bacterioplankton and are consequently turned over rapidly.

In contrast to that, D-amino acids are generally considered to be refractory as indicated by the increase in the ratio of D-/L-amino acids in DOC degradation experiments with surface water DOC. Therefore, it has been recently suggested that the ratio of D-/L-amino acids can be used as a diagenetic indicator of the bioreactivity of the oceanic DOC pool. Since the DOC pool becomes increasingly refractory from the surface layers to the deep waters, one would expect that the D-/L-amino acid ratio of the DOC pool increases with depth as well. However, such an increase in the D-/L-amino acid ratio with depth has not been found in the DOC fraction larger than 1,000 molecular weight which represents about 20-30% of the bulk oceanic DOC.

In this study we measured the concentrations of the 4 bacterial cell wall-derived enantiomeric amino acid species present in the DOC pool throughout the North Atlantic water column. Concurrently, we determined the uptake of D- vs. L-Asp by bacterioplankton in the different water layers. Since major shifts in the D-/L-Asp uptake ratio of bacterioplankton from the surface to the deep mesopelagic layers were found, additional laboratory experiments were



Concentrations of dissolved total D-aspartic acid (Asp), D-glutamic acid (Glu), D-serine (Ser) and D-alanine (Ala) and the corresponding D/L ratios in the water column of the North Atlantic.

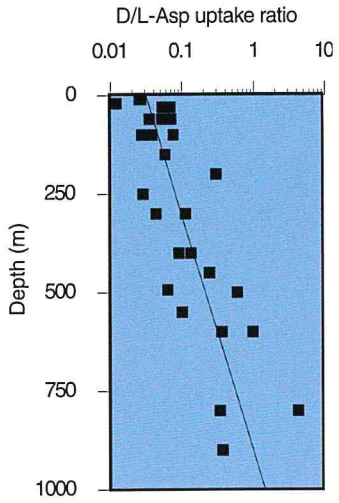
performed. In these experiments, the hypothesis was tested that bacterioplankton, in the absence of other utilizable organic matter, shift from a preferential L-amino acid uptake to a more efficient utilization of D-amino acids, i.e. bacterial-derived DOC. Furthermore, the potential role of flagellates in the production of bacterial cell wall-derived dissolved amino acids was examined.

The field work for this study was done in the Faroe Shetland Channel of the North Atlantic (1°W 62°N — 5°W 60ϒN) during the BIOPROCS cruise with the R/V Pelagia in the summer of 1999.

The concentrations of the 4 dissolved total enantiomeric amino acid (DTEAA) species indicative for cell wall-derived DOC (Asp, Glu, Ser, Ala) exhibited no particular trend with depth in the water column of the Faroe Shetland Channel. Also, no trend with depth was discernable for the ratio of the D-/L-amino acid species. The lack of any trend with depth in the D/L ratios of these 4 DTEAA species in the water column of the Faroe Shetland Channel is in agreement with the few data available for other oceanic regions obtained with different methods.

Based on the mean D-Ala concentration of 27.9±6.3 nmol L^{-1} (54 samples), averaged over all the stations and depths and assuming that all the dissolved total D-Ala originates from the peptidoglycan layer of bacterioplankton we can estimate the contribution of bacterioplankton-derived peptidoglycan to the bulk DON pool. It has been shown that the D-Ala concentration in peptidoglycan is relatively constant, at least for culturable non-marine bacteria (D-Ala-N x 5.7). Based on these directly measurable hydrolyzable D-Ala and the DON concentrations (data not shown), bacterioplankton-derived peptidoglycan contributes about 2 — 2.5 % to the DON pool of the study site. There is evidence from recent NMR studies that most of the oceanic DON not recoverable on a molecular level consists probably of non-hydrolyzable amino acids. Thus, since only about 10 % of the DON pool are hydrolyzable amino acids it follows that dissolved peptidoglycan contributes about 20 — 25 % to the pool of hydrolyzable dissolved amino acids in the study area. These figures should be considered as a rough estimate only since the above calculation is based on the D-Ala concentration in peptidoglycan obtained from cultured non-marine, mostly biomedically important bacteria. The contribution of D-Ala on the peptidoglycan of marine bacteria might be more variable considering their phylogenetic and functional diversity.

In order to estimate the potential of bacterioplankton to utilize bacterial cell wall-derived dissolved D-amino acids, we compared D- and L-Asp uptake of natural bacterial communities collected from different depth layers. The ratio of bacterial D-/L-Asp uptake increased exponentially from 0.03 in the surface layers to about 1 at 900 m depth. If the other 3 amino acid species are taken up at similar D-/L- uptake ratios as Asp, then the high uptake ratio of D-/L-Asp in



Depth dependence of the uptake ratio of D-/L-aspartic acid (Asp) by bacterioplankton in the water column of the Faroe Shetland Channel of the North Atlantic. The D-/L-Asp uptake ratio increased exponentially with depth.

the mesopelagic zone indicates an adaptation of the mesopelagic bacterioplankton community to utilize D-amino acids relatively more efficiently than bacteria in the euphotic zone. In the euphotic zone, phytoplankton activity supplies mainly L-amino acids, which are taken up by bacteria efficiently and, according to our data, preferentially over D-amino acids. Thus, in the euphotic zone the supply ratio of D-/L-amino acids might be similarly low as the D-/L-Asp uptake ratio we measured. In the mesopelagic zone, however, due to the absence of phytoplankton production and the preferential use of L-amino acids in the surface layers, the bioavailable DOC, including the freshly-produced DOC supports a supply ratio of D-/L-amino acids which is considerably higher than that in the euphotic layer. In short, we speculate that the observed shift in bacterial uptake ratios of D-/L-amino acids with depth reflects the shift in the production of bioavailable D-/L-amino acids from the surface layers to the mesopelagic zone. Such a close coupling between the supply ratio and the uptake ratio would explain the rather constant D-enantiomer concentrations and D/L ratios of the 4 DTEAA species throughout the water column.

Since bacterioplankton are thought to be the main source of the 4 D-amino acids one might tentatively assume a close relation between bacterial production and D-amino acid concentration. The remarkably constant dissolved total D-Ala and D-Asp concentrations over a wide depth range are in sharp contrast, however, to the decline in bacterial production from the near-surface (0.17 ± 0.15 µmol C L^{-1} d^{-1}) to the deep mesopelagic layer by 3 orders of magnitude. Bacterial production was positively correlated with D- and L-Asp uptake and negatively correlated with the D-/L-Asp uptake ratio. The steeper slope for L-Asp than for D-Asp uptake causes the increasing D-/L-Asp uptake ratios with decreasing bacterial production. The question remains to be solved whether these relatively higher uptake rates of D-Asp as compared to L-Asp in the deeper layers of the water column are due to specific species of prokaryotes inhabiting the mesopelagic zone.

Major shifts in the bacterial community composition between surface and mesopelagic waters have been reported for the Mediterranean Sea. About 50 % of all the phylotypes of Bacteria present in the mesopelagic zone are specific for this layer as determined by terminal-restriction fragment length polymorphism. Thus, there is accumulating evidence that the prokaryotic community changes significantly with water column depth and it is likely that these shifts in the prokaryotic community composition are responsible for the shifts in the uptake ratio of D-/L-Asp from the euphotic layer towards the deep mesopelagic zone.

Our findings have several important implications. For using D-/L-amino acid ratios as an indicator of the diagenetic state of DOC, caution is required since D-amino acids are more bioavailable than hitherto assumed, especially in the mesopelagic zone. For the microbial ecology of the mesopelagic realm, our results indicate that specific prokaryotic communities are present there utilizing D-amino acids as efficiently as L-amino acids. The phylogeny of these prokaryotes responsible for this efficient D-amino acid utilization in the mesopelagic environment is unknown but even surface water bacterioplankton have the physiologic capacity to utilize these D-amino acids efficiently if other organic nutrient sources are not sufficiently available. Whether this efficient utilization of D-amino acids represents a common strategy of bacterioplankton to utilize them as a supplementary carbon, nitrogen and energy source when other suitable organic substrates are scarce in the mesopelagic and deep waters remains to be investigated.

FLUORESCENT DETERMINATION OF CHANGES IN BACTERIAL CELL SURFACE CHARGE BY CONFOCAL LASER SCANNING MICROSCOPY

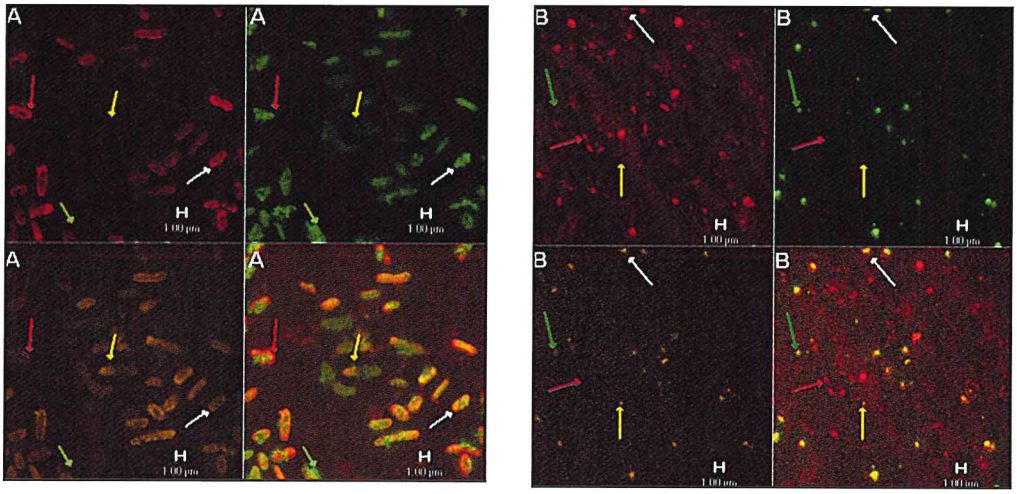
Contributors: Karen E. Stoderegger, Gerhard J. Herndl

Surface properties of bacterioplankton may play a crucial role in the uptake of inorganic and organic nutrients by bacteria and in regulating the grazing pressure of potential predators such as flagellates. Common techniques to measure the hydrophobic and the hydrophilic properties such as bacterial adhesion experiments, contact angle measurements or spectroscopy methods require extensive manipulation of the cells including filtration, dehydration or centrifugation prior to analysis. These cell manipulations might, however, modify the physicochemical properties of the specific organisms.

Therefore we developed a non-destructive, minimally manipulative cell surface analysis technique to assess and quantify the hydrophobic and hydrophilic moieties of the bacterial cell in different life stages. The hydrophobic and hydrophilic parts of the bacterial cell surface were detected by applying a combination of three fluorescent dyes to the filtered, living sample and subsequently, confocal laser scanning microscopy (LSM, Zeiss 510) (Fig. 1). Using this method, we related the surface properties to other characteristics of the bacterial cell.

On a single cell basis, bacterial strains were significantly different from each other in at least one of the measured properties, indicating large interspecific variations. No proportional changes of the hydrophobic or hydrophilic properties with cell size were detectable, indicating that bacteria are able to express weak and intensive hydrophobic and hydrophilic properties independent of their specific size.

We could also show that hydrophobic and hydrophilic properties were highly dynamic over time. Bacterial cells assembling in aggregates showed a distinct but small, elevated hydrophobicity as compared to free-living cells. While hydrophobic properties remained fairly constant

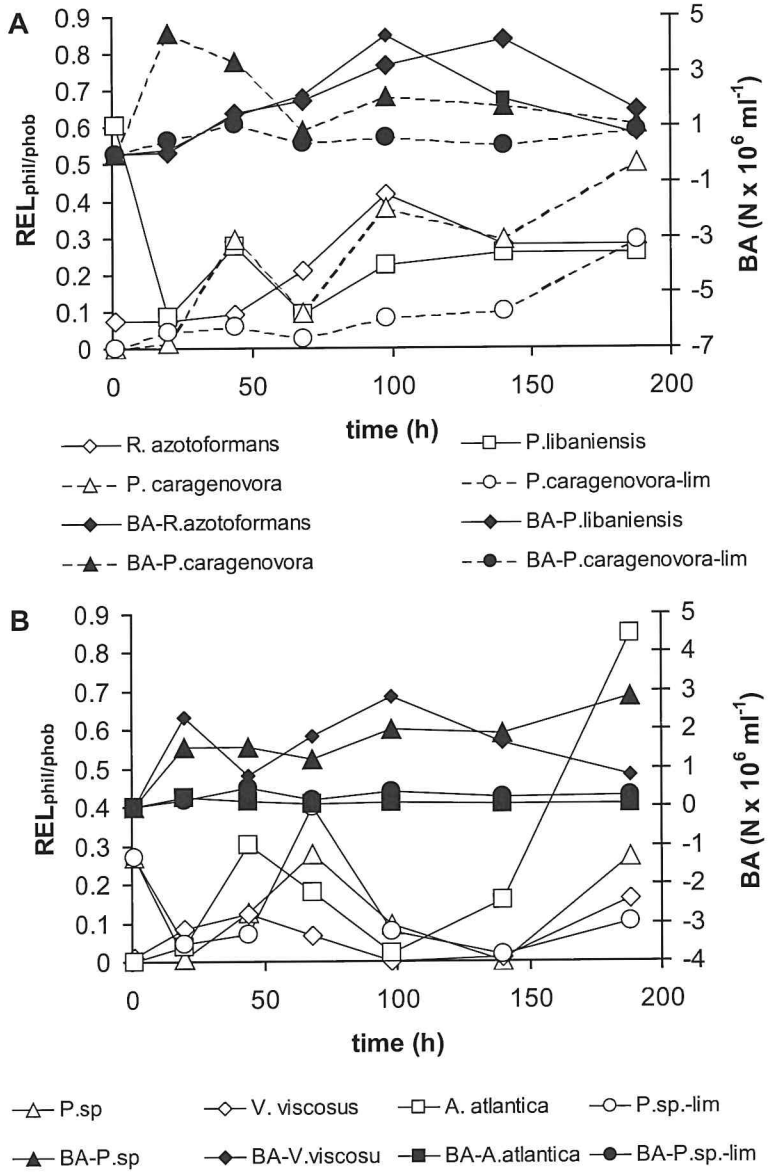


Visualization of the bacterial cell stained with the different tracers. Each image is divided into 4 parts reflecting the 3 channels and the combined image. False colour-image upper-left: hydrophobic properties are displayed red, lower left: hydrophilic properties are displayed in yellow and upper right: genome properties are displayed green, lower right: shows a combination of the 3 images. Red arrows indicate mainly hydrophobic, yellow arrows hydrophilic and green arrows genome-stained parts. White arrows show cells stained with all three tracers. Typical examples are shown in (A) for a bacterial strain (Pseudoalteromonas sp. ANG.ro2), and in (B) for a natural bacterial community.

and still exhibited species-specificity, the polarity of the surface was more depending on the life stage of the culture.

Based on their hydrophobicity, 2 distinctly different groups of bacteria were distinguished. In environments with dynamic nutrient concentrations increased hydrophobicity seems to be advantageous for the cell, in order to enhance particle attachment, therefore avoiding grazing by increasing size and by high growth rates, while increased polar moieties of the cell facilitate nutrient assimilation. In contrast, in more oligotrophic environments where nutrients are usually scarce, hydrophobicity is low to avoid grazing, while the observed dynamic variation in hydrophilic nutrients reflects the cell's ability to compete for these different nutrients.

Following a K-strategy implies low growth rates, high substrate-affinity, but low substrate demand, in connection with specialization is commonly described as a typical strategy for stable environments, while r-strategy can be mainly found in less stable environments. The less hydrophobic and less abundant species encountered were isolates from the Atlantic Ocean (Fig. 2B). Strains exhibiting higher hydrophobicity were isolated from more mesotrophic environments (North Sea, Adriatic Sea) except P. libaniensis (South Atlantic). Thus, we hypothesize that the less abundant species, isolated from the more stable environments exhibiting lower growth rates, are K-strategists, while r-strategists are increasing their hydrophobic and hydrophilic properties, essentially maximizing their efforts to acquire nutrients or to attach to particles. Therefore, measuring cell surface properties of bacterioplankton reveals different life strategies. Combining these measurements with phylogenetic analysis allows us to obtain information on the specific niches bacterial species are occupying in their environment.



Development of bacterial abundance (BA) and the ratio ($REL_{phil/phob}$) between hydrophilic and hydrophobic properties for (A) more hydrophobic and (B) less hydrophobic bacterial strains over time. Slopes of regression are significantly different between (A) and (B) for $REL_{phil/phob}$ but not for bacterial abundance. R. azotoformans - Rhodobacter azotoformans, P. libaniensis - Pseudomonas libaniensis, P. caragenovora - Pseudoalteromonas caragenovora, P. sp. - Pseudoalteromonas sp., V. viscosus - Vibrio viscosus, A. atlantica - Alteromonas atlantica, lim-phosphorous limited.

2

DNA FINGERPRINT OF CYANOBACTERIA AND ALGAE IN MICROBIAL MATS EXPOSED TO DIFFERENT LEVELS OF OIL POLLUTION

Contributors: J.D.L. van Bleijswijk, G. Muyzer

A role of microbial mats in the biodegradation of oil in the Arabian Sea was suggested when about one year after the massive oil spills in the Gulf war of 1991, cyanobacterial mats developed on top of the oil. Yet, oxygen producing phototrophs (cyanobacteria and algae) are generally believed to play a major role in the breakdown of oil. Probably they do not themselves breakdown the oil components on a large scale but they create favourable conditions for oil degradation by bacteria, because they influence oxygen and nutrient concentrations, pH and the physical characteristics of the mats.

Detailed studies on the biodiversity of microorganisms in marine mats were still lacking. Even less was known about the oil tolerance of individual species. NIOZ provided data on species richness and species composition of cyanobacteria and algae that were present in selected microbial mats exposed to different levels of oil pollution. The research is part of the European project on the Role of Microbial Mats in Bioremediation of Hydrocarbon Polluted Coastal Zones (MATBIOPOL). In this integrated program, studies on microbial diversity and activities in response to oil pollution are combined with studies on behavior and degradation of hydrocarbon molecules in microbial mat systems. Knowledge of the biodiversity of microorganisms in mats and identification of oil sensitive, oil tolerant and oil loving species and communities may help to select effective strategies for the bioremediation of oil pollution in coastal zones.

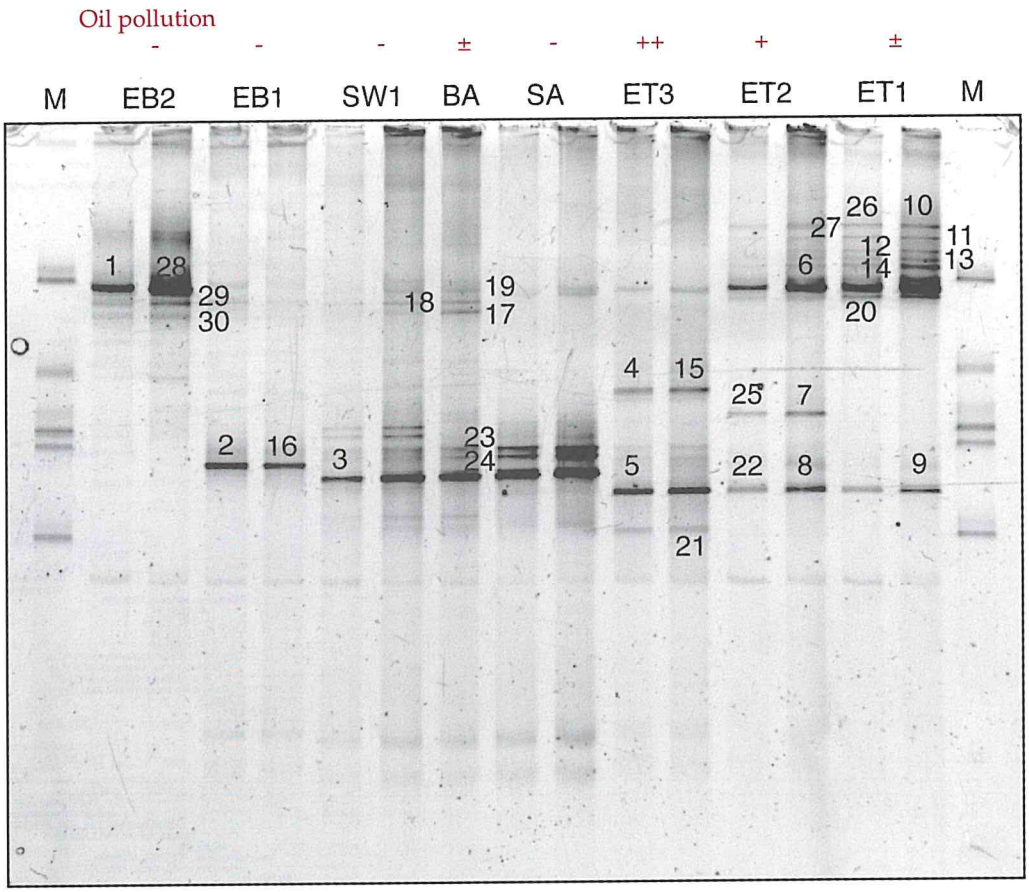
A DNA fingerprint was determined of nine selected microbial mat communities that were exposed to different levels of oil pollution. PCR-DGGE-Sequencing analysis of 16S rRNA gene fragments revealed information on the species richness of the community and on the identity of the organisms that were present in the samples (see figures).

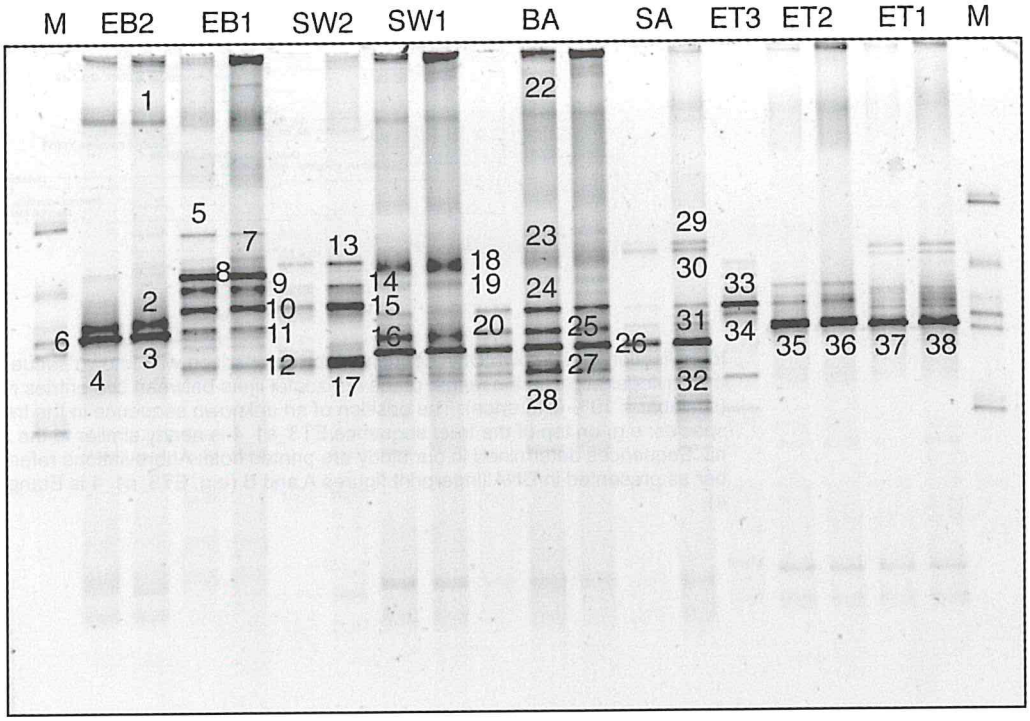
The DGGE banding patterns were unique for every site we sampled, reflecting differences in environmental parameters on a large scale (different locations) and on a smaller scale (different sites on the same location). By focussing on the mats in Etang de Berre (ET1, ET2, ET3), which were subjected to the same climatic conditions (temperature, light intensity) and only differed in the degree of oil pollution, we can observe trends that are related to oil pollution.

Diatom algea (e.g. Skeletonema sp.) were abundant in the slightly polluted mat, present but not abundant in the medium polluted mat and absent in the heavily polluted mat. The cyanobacteria Phormidium sp. and Planktotrix sp. were present in slightly and medium polluted mats but could not persist in the highly polluted mat. The only oxygenic phototrophs that were able to cope with the heavy oil pollution were affiliated to the cyanobacterium Oscillatoria sp., and to the Prymnesiophyte algea Isochrysis sp. From culture work it is known that Isochrysis galbana is able to take up naphthalene. There were no field data of Prymnesiophyte algeae as indigenous parts of microbial mat communities. According to the common idea, these pelagic algea bloom in the overlaying waters and reach the microbial mat surface due to sinking. However, a study of lipid biomarkers in microbial mats by MATBIOPOL colleagues did indicate the presence of indigenic alkenone containing algea, such as Prymnesiophycea, but efforts to isolate these organisms from mats have not been successful.

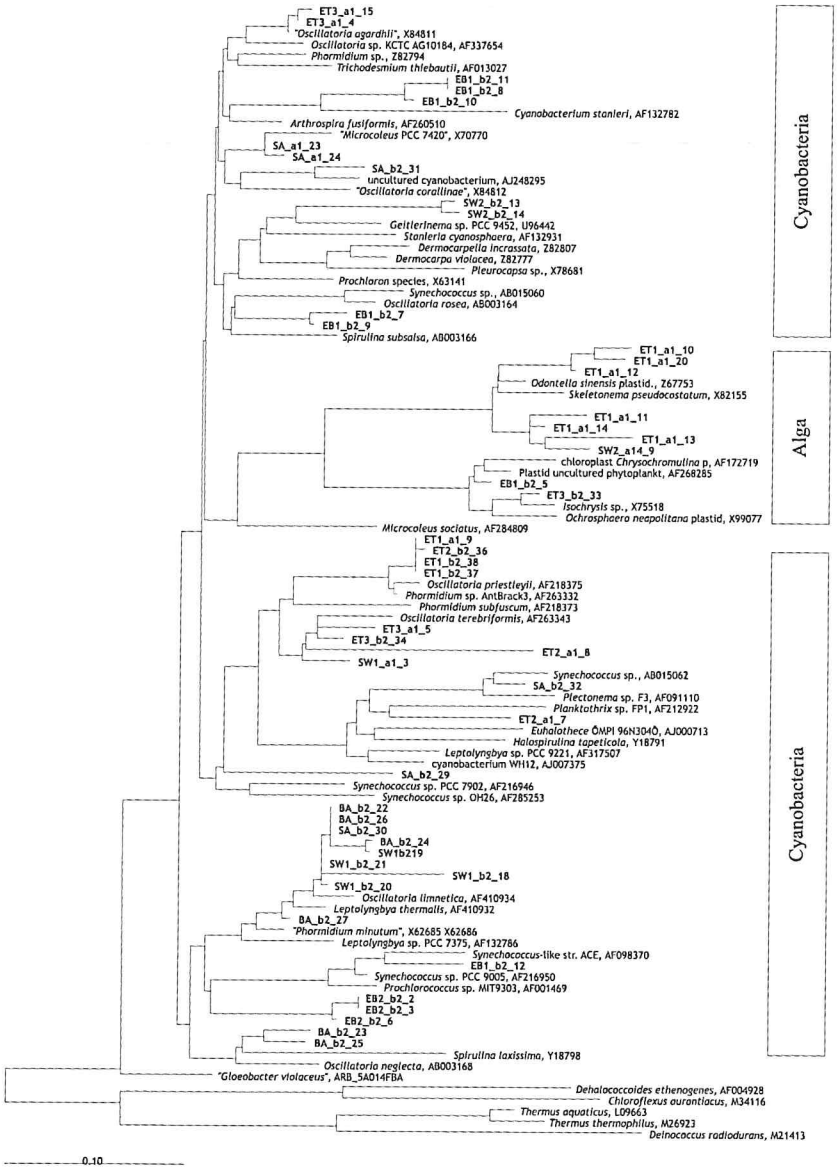
Conclusions

Oil pollution affected the species composition of cyanobacteria and algea in microbial mats: Diatom algea (e.g. Skeletonema sp.) were abundant in the slightly polluted mat, present but not abundant in the medium polluted mat and absent in the heavily polluted mat. The cyanobacteria Phormidium sp. and Planktotrix sp. were present in slightly and medium polluted mats but could not persist in the highly polluted mat. The organisms that were able to cope with the heavy oil pollution were affiliated to the cyanobacterium Oscillatoria sp., and to the Prymnesiophyte algea Isochrysis sp.





DNA fingerprint of cyanobacteria and algea in samples of microbial mats exposed to different levels of oil pollution (see top of figure: – not polluted; ± slightly polluted; + medium polluted; ++ heavily polluted). Samples: M=Marker; EB=EbroDelta, Spain; SW=SwanbisterBay, Orkneys; BA=Bay of Slick, Orkneys; SA=Saline de Giraud, Camarque; ET=Etang de Berre, Camarque. Two types of DNA fragments were analysed: A and B, as shown in the corresponding figures. Of every mat, two samples of double stranded DNA fragments were loaded on top of a gel and were forced by an electrical field to migrate downwards in an increasing gradient of urea/formamide. Bands indicate specific DNA fragments: different species in the sample show up as different bands in the figure. The blackness of the bands roughly corresponds to the quantity of the species present. The numbers in the figure refer to bands that were cut out the gel, sequenced and analysed. These numbers return in the figure of the phylogenetic tree.



Identification of unknown DNA sequences by comparison with known sequences from a global database. In the phylogenetic tree the length of the horizontal lines between two entries relates to sequence differences (scalebar = 10% difference): The position of an unknown sequence in the tree indicates the most similar species: e.g. on top of the tree: sequence ET3_a1_4 is nearly similar to the sequence of Oscillatoria agardhii. Sequences determined in our study are printed bold. Abbreviations refer to sample site and band number as presented in DNA fingerprint figures A and B (e.g. ET3_a1_4 is Etang de Berre site 3, figure A, band 4).

EXTERNAL PROJECTS OF THE DEPARTMENT OF MARINE ECOLOGY

- Role of non-phytoplankton food for zooplankton in the North Sea (ALW-NWO).
  M.A. Baars
- Mortality of marine phytoplankton in ecosystems with contrasting trophic status (oligotrophic vs eutrophic) (ALW-NWO).
  C.P.D. Brussaard
- The chemical composition and reactivity of bacterially derived dissolved organic carbon (DOC) and its contribution to the bulk oceanic DOC pool (ALW-NWO).
  G.J. Herndl
- Ecological role and diversity of planktonic bacteriophages in the North Sea and the Wadden Sea. (ALW-NWO).
  G.J. Herndl
- Transformation of dissolved organic matter (DOM) in the North Atlantic Deep Water and intermediate waters: assessing the functional and phylogenetic variability of marine bacterioplankton communities in relation to the quality of DOM (TRANSAT) (ALW- NWO).
  G.J. Herndl
- Bacterioplankton cell death: competition between flagellate grazing and viral lysis and the role of bacterioplankton cell wall-derived dissolved organic matter in the ocean (BADE) (ALW- NWO). G.J. Herndl
- Composition of dissolved organic matter and its interaction with metals and ultraviolet radiation in river-ocean systems: impact on the microbial food web (COMET, 5th FWP of the EU). Coordinator: G.J. Herndl
- Structure and role of biological communities involved in the transport and transformation of persistent pollutants at the marine AIR-Water Interface (AIRWIN, 5th FWP of the EU). G.J. Herndl
- Bacterial single-cell approaches to the relationship between diversity and function in the sea (BASICS, 5th FWP of the EU) G.J. Herndl
- Application of capillary electrophoresis for isolating bacteria and assessing ectoenzyme diversity and kinetics (ACE, Marie Curie Training Site Fellowship) G.J. Herndl
- Role of Microbial Mats in bioremediation of hydrocarbon polluted coastal zones (MATBIOPOL, 5th FWP of the EU). J. van Bleijswijk & G. Muyzer
- Preparation and Integration of Analysis Tools towards Operational Forecast of Nutrients in Estuaries of European Rivers (PIONEER, EU-MAST III). P. Ruardij
- The ecological role of the bacterial capsule. (Austrian Science Foundation). K. Stoderegger
- The linkage between nano/picoplankton production and reef cryptic fauna: a key process in degrading reefs? (WOTRO-NWO). F.C. van Duyl, R.P.M. Bak
- Biological control of harmful algal blooms in European coastal waters: role of eutrophication (BIOHAB, 5th FWP of the EU). M. Veldhuis
- Iron Resources and Oceanic Nutrients — Advancement of Global Environment Simulations (IRON-AGES, 5th FWP of the EU). M. Veldhuis

THE DEPARTMENT OF MARINE ECOLOGY AND EVOLUTION

The department of MEE aims to assess the relative role of bottom-up (food input) and top-down (predation) processes in structuring benthic communities, ranging from the shelf margin to the intertidal. The general approach that is followed and which is also one of the great challenges in modern ecology, is to try to understand the structure and dynamical behaviour of populations and communities on the basis of characteristics of individual organisms. Research methods include field observations, including long-term (and wide range) surveys; manipulative field experiments, e.g. using new lander technology; laboratory experiments, e.g. using the experimental large-scale tidal facilities; and modelling.

Basically, within the department three different systems are studied: the benthic communities of the tidal flats in the western Wadden Sea; the benthic community of the North Sea and continental shelf margin; and the tropical reef communities in the Caribbean and Indonesia.

The first system has the advantage that these communities are relatively species-poor and, in terms of biomass, dominated by only a few species. This means that the problem of complexity, which is a major obstacle in linking community behaviour to individual characteristics, may be less severe. At Balgzand, only four species (three bivalves and one polychaete worm) account for 80% of the total biomass of the infauna. Detailed individual-based studies focus on these four most abundant species: the soft-shelled clam *Mya arenaria*, the cockle *Cerastoderma edule* (filter-feeders), the balthic tellin *Macoma balthica* (a filter/deposit feeder), and the lugworm *Arenicola marina* (a deposit-feeder). Furthermore, four of the most dominant predators are studied in detail: the crustacean predators brown shrimp *Crangon crangon* and shore crab *Carcinus maenas*, the plaice *Pleuronectes platessa*, a flatfish, and the red knot *Calidris canutus*, an avian predator.

In addition to the detailed individual-based studies, long-term studies are being performed in all three study systems. In the Wadden Sea these series already started in the late 1960s. These long-term studies focus on the population dynamics of the benthic fauna and their predators, the food conditions for the benthic fauna, and on environmental conditions, such as water temperature and salinity. They provide an important mean for generating and validating hypotheses on the structuring processes in marine ecosystems.

Recent developments in the employment of landers that can be installed at the seafloor for longer periods, enables advanced manipulative experiments at the seafloor that were hitherto beyond reach. For example, in situ mesocosms can be installed, in which the amount of food input can be manipulated. This implies that the experimental approach, so far only possible on the tidal flats, can now also be followed in our second area of interest, the shallow parts of the North Sea.

RESEARCH THEMES

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

(A) The structuring role of top-predators in marine ecosystems
(B) Recruitment and dispersal in relation to spatial and genetic structure of benthic invertebrate populations
(C) Dynamic energy budgets, life-history strategies and implications for competitive relationships

(A) The structuring role of top-predators in marine ecosystems

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

(B) Recruitment and dispersal in relation to spatial and genetic structure of benthic invertebrate populations

Competition for food and other resources, both intra- and interspecific, may also play a major role in determining community processes. Special attention with respect to competitive processes is paid to adult-juvenile interactions in benthic organisms. Particularly the period around the settlement of the recruits may be of utmost importance in population reg-

ulation. Henceforth the department increasingly focuses on recruitment processes (e.g. settlement inhibition by adults). Recruitment studies are performed in both intertidal systems, shallow coastal seas and in coral reef communities.

Thus far it has been impossible to perform manipulative experiments on the shelf sea floor, but recently developed autonomous "permanent" bottom landers form a promise, since they provide data series over periods of months. Past experiences gained by the department with construction and implementation of deep sea landers have paved the way for a new type of autonomous lander which is capable of sampling planktonic stages of benthos and simultaneously exposing (genuine or manipulated) substrates, while measuring a suit of environmental variables. The new landers allow study of topics, such as the effect of planktonic larval abundance on settlement success, hitherto unable to tackle in deeper water.

Another important development in marine benthic ecology is the incorporation of molecular genetics in ecological work. The easy accessibility of molecular techniques over the last decade has already allowed ecologists to describe patterns of genetic variation within and among populations. In itself such descriptions may not be very interesting, but when placed in a general ecological setting, these techniques are already very promising. One example concerns the apparently open character of most marine benthic populations. Most marine benthic animals have dispersive propagules and when studying a local population it usually remains unclear how much real immigration occurs when settlement takes place. Both molecular techniques and marking methods may help to unravel these problems of open systems. The techniques are already available at the NIOZ and intensively used by (population) scientist from all groups (benthic invertebrates, corals) within the MEE department.

(C) Dynamic energy budgets, life-history strategies and implications for competitive relationships

At the level of the individual, interest is directed towards the performance of individual benthic organisms (e.g. their growth and fecundity, or more generally their energy budgets) in response to external factors, e.g. food availability and physical factors, and the consequences of choosing a specific (energetic) strategy for competitive interactions. Filter-feeding bivalves are one of the main study objects. Research basically follows an experimental approach, which is greatly facilitated by the possibilities within the newly renovated aquarium building.

BENTHOS AND BIRDS ON TROPICAL INTERTIDAL MUDFLATS: THE JUNE 2002 MAPPING EFFORT IN ROEBUCK BAY, NORTHWEST AUSTRALIA

Contributors: Theunis Piersma, Marc Lavaleye, Petra de Goeij, Pieter Honkoop & Tanya Compton

There are few places on earth where soft bottom intertidal mudflats support large numbers of migratory shorebirds. Roebuck Bay is probably one of less than only twenty scattered around the globe. The features that characterise this Bay and make it so outstanding are varied and complex. They have also been the subject of considerable scientific and community investigation in recent years. This unusual collaboration between science and community has been the catalyst for some exceptional efforts to map the nature and distribution of the sediments of Roebuck bay.

Roebuck Bay is indeed one of the wetland wonders of the northern part of Western Australia. The intertidal foreshore of the Bay stands out for its importance as a key nonbreeding area used by arctic-breeding shorebirds. About 150,000 roosting shorebirds have been counted in recent years. Although it is widely agreed that most species use the intertidal foreshore as their feeding area, only recently have studies been conducted on the feeding distribution and the behaviour of shorebirds, or the nature of their food resources at Roebuck Bay and Eighty Mile Beach.

This information is essential if we are to conserve the immense and internationally shared natural values of these important shorebird sites, and to find informed compromises between the increasing use of the foreshore by the ever increasing human population in the Broome area and their use by the beasts and the birds. A large proportion of the world's Great Knots (Calidris tenuirostris) depends on (very specific portions of) Eighty Mile Beach and Roebuck Bay for moult, survival and fuelling for migration. This is also true for perhaps all the Red Knots (Calidris canutus piersmai) and Bar-tailed Godwits (Limosa lapponica menzbieri) of specific, reproductively isolated and morphologically and behaviourally distinct subspecies. The intertidal macrobenthic community of Roebuck Bay is likely to contain unique species and species assemblages. Some of these species will be new to science. It is clear, however, that much more work on the extensive collections of specimens made during this and previous expeditions is required to establish this for a fact.

The present project builds on the logistical methods and the techniques developed and used so successfully during the co-operative intertidal benthic invertebrate mapping project in Roebuck Bay in June 1997 (ROEBIM-97), the benthic invertebrate mapping effort along the Eighty-mile Beach foreshore in October 1999 (ANNABIM-99), and the low tide shorebird counting methods developed by Danny Rogers (a PhD student of shorebird foraging at Charles Sturt University) in Roebuck Bay from October 1997 onward. In the period 7-26 June we mapped both the invertebrate macrobenthic animals (those retained by a 1 mm sieve) over the whole intertidal area of Roebuck Bay (Fig. 1) and the shorebirds that depend on this food resource. Our prime focus were the eastern and southern mudflats had not been visited and mapped before; it is this southern region of the Bay that gave the project the name SROEBIM-02, the Southern Roebuck Bay Invertebrate and bird Mapping project 2002. In addition to the mapping efforts, as a reach-out to the Broome community the project incorporated the 'Celebrate the Bay Forum' on 8 June in the Town Hall of Broome. This one-day event was visited by about 150 people and was widely considered successful.

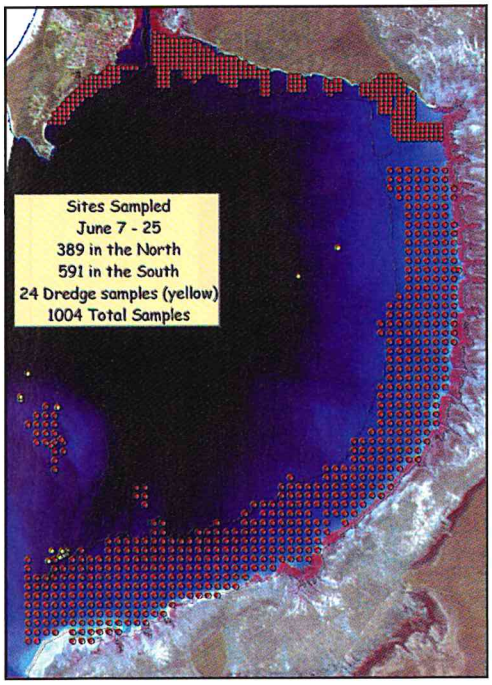


Fig. 1. Roebuck Bay near the town of Broome with sampling effort in dots.

Our team comprised 140 participants of which 106 volunteers (9 Landscope expeditioners, 65 local volunteers, 11 logistical support crew, 11 science volunteers). There were 8 scientific co-ordinators (in addition to the contributors there were Grant Pearson from CALM, Shirley Slack-Smith from the Western Australia Museum, Danny Rogers from Charles Sturt University, and Bob Hickey from Central Washington University). We visited almost 1000 sample stations laid out in a grid with 400 m intersections in the eastern and southern parts of the Bay and 200 m intersections in the north (partly covered in 1997 and 2000). In addition, dredge samples were taken in various parts of the Bay (Fig. 1).

Navigating by GPS, teams of 2-4 people visited each of the stations based upon the geographical coordinates that were pre-assigned to them. At each station 3 corers made of PVC-pipe were pushed down to a depth of 20 cm (less if the corer hit a hard shell layer below which we expect no benthic animals to live), and the core samples, each covering 1/120 m , removed. The samples with a total surface area of 1/40 m were sieved over a 1 mm mesh and the remains retained on the sieve placed into a plastic bag, to which a waterproof label indicating the station was added. At the same time a sediment sample was taken with a depth of 10 cm and a diameter of 4.4 cm (sur-

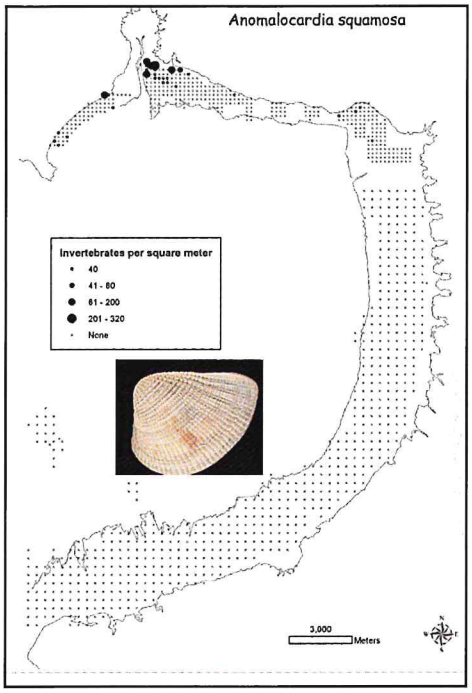


Fig. 2. Distribution of Anomalocardia squamosa in Roebuck Bay in June 2002.

face area = 1/650 m), stored in a labelled plastic bag and kept at outside temperature for transport to the laboratory. In the field, records were made of the nature of the sediment (varying from mud to coarse sand), the presence or absence of shell layers and a visible oxygenated layer, the penetrability (depth of footsteps made by an average person, in cm), and the presence of visible large animals on the mud surface, the sort of animals (sand dollars, mudskippers) that are easily missed by our sampling technique. The sheets also allowed us to record which of the predetermined stations were actually visited, the names of the observers and the times of sampling.

The 'biological samples' were taken back to the Broome Bird Observatory, stored in a fridge at 4°C for a maximum of 1.5 days, and sorted in low plastic trays. All living animals were then kept in seawater, again at 4°C for a maximum of one day, upon which they were examined under a microscope and all invertebrates were assigned to a single taxonomic category. At the same time the maximum length (in case of molluscs and worm-like organisms), or the width of the core body (in brittle stars), was measured in mm. The latter information will be used to produce predictions of the benthic biomass values using existing predictive equations. Of all the different taxa, a reference collection was made for more detailed study of the species at a later stage.

In the course of digging up, sieving and sorting the mudsamples from all the stations, we identified and measured more than 12,000 individual invertebrates. These animals represented 205 taxa at taxonomic levels ranging from species (bivalves, gastropods, brachiopods and echinoderms), families (polychaete worms, crustaceans and sea anemones) to phyla (Phoronida, Sipuncula, Echiura, Nemertini, Hemichordata).

In total 48 species of bivalves were found in the quantitative samples. In the quantitative samples, Siliqua pulchella had the highest score of the bivalves with a presence of 16% of the stations, especially in the muddy regions in the east. This abundant species (because of its fragile shell it is never found on the beach) does not receive mentioning in the two recent Australian bivalve books, reflecting the fact that Australian mudflats were not very well studied up to now. The family Tellinidae and Veneridae contain the highest number of species, with respectively 11 and 10 species. Most of the Veneridae were rather rare, except for Anomalocardia squamosa (Fig. 2). In the family Tellinidae, however, 5 species are rather common, especially Tellina amboynensis (Fig. 3). Another rather common species, Tellina 'exotica rose' was not found in our previous surveys of the bay in 1997 and 2000 (Fig. 4). Still another Tellina species newly recorded in the bay was discovered by accident on a sand bank in the south when a hovercraft stranded with

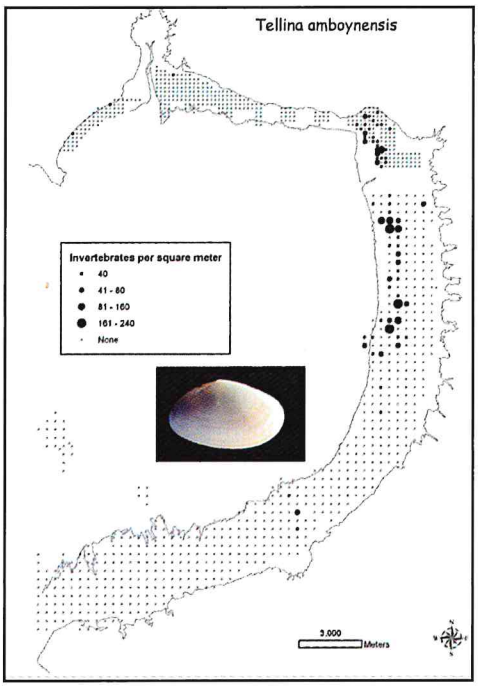


Fig. 3. (left) Distribution of Tellina amboynensis in Roebuck Bay in June 2002.

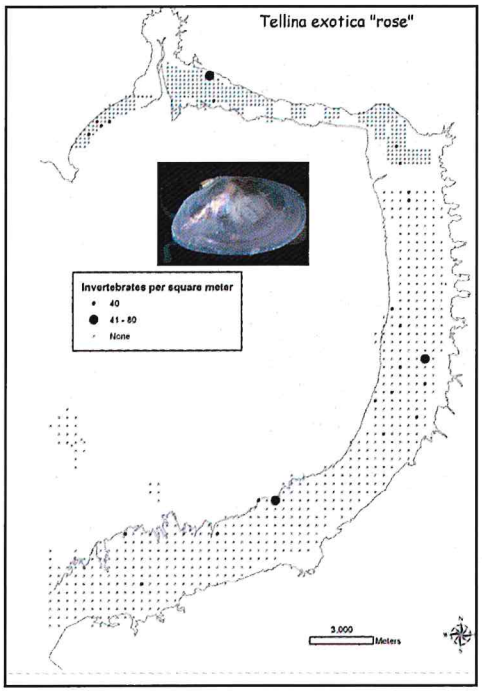
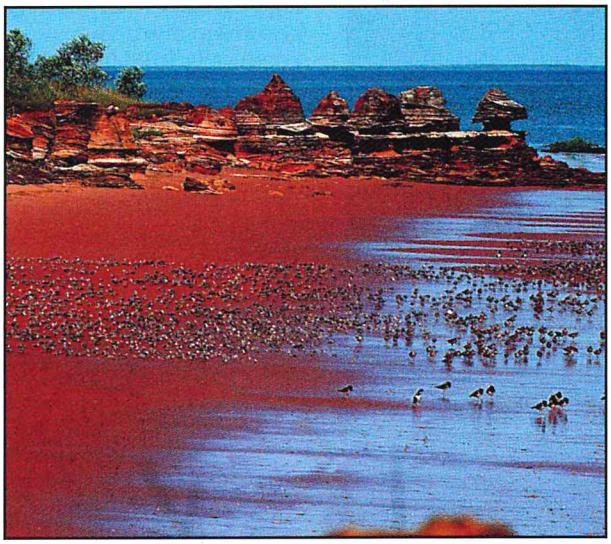


Fig. 4. (right) Distribution of Tellina 'exotica rose' in Roebuck Bay in June 2002.

photo's by Jan van de Kam

skirt problems. These two new findings of Tellina species makes the question why there are that many species of these family in the bay even more intriguing. Tanya Compton, a PhD student with the University of Groningen and NIOZ, started her 4 year research during SROEBIM to resolve part of this biological problem.

Roebuck Bay is famed for its shorebirds. The importance of the area as a feeding ground for non-breeding shorebirds was the original stimulus for the research now in progress on the benthos of the intertidal flats. This being the case, it seemed like a good idea to map the shorebirds of the bay as we mapped the benthic fauna, to see how the distribution of birds and benthos are related. To map the birds, the northern bay was divided into grid squares, each 200 m long; in the centre of each grid square was a benthos sampling site. Birds in each grid square were identified and counted, a combination of GPS and an optical method being used to judge where the boundaries of each grid square occurred. In southern and eastern Roebuck Bay a 400 m benthos grid was used. Ideally bird mapping should be done on receding tides by observers who time their transects so they reach the waterline at the slack water period of low tide. This approach reduces the scatter in the data caused by birds moving in response to tidal changes. In the southern bay there were logistical constraints that meant we had to map on rising tides. In the eastern bay, very muddy substrates prevented teams from performing traditional surveys on foot. However, we managed to get a reasonable idea of how many birds were feeding at the sea-edge in the eastern bay by spending two days in the hovercraft, mapping the birds at the shoreline during low tide.



The Great Knot distribution map (Fig. 5) illustrates perhaps the most startling trend shown in the distributional data. In previous surveys, large numbers of Great Knots had always been found feeding at the sea edge along the northern shores of Roebuck Bay. During June 2002 hardly any Great Knots were found in this area. This was not because of a lack of birds; Great Knots have long delayed maturity in Roebuck Bay, so dry season counts should be reasonably high, consisting as they do of not only one-year old immatures, but also two-year olds and some three-year olds. Indeed, large numbers of Great Knots were found roosting on the easternmost northern beaches. However, these birds probably came from the eastern coast of Roebuck Bay, where large numbers of Great Knots were seen feeding along the sea-edge during surveys performed from a hovercraft. The causes of this eastwards shift in the feeding distribution of Great Knots, which was mirrored in several other shorebird species, is not yet clear. There had certainly been some changes in the western flats of Roebuck Bay — most noticeably a loss of seagrass meadows on the Dampier Creek flats, perhaps as a result of cyclone Rosita in April 2000. Perhaps there were also changes in benthic composition that made these western flats a less attractive place to feed?

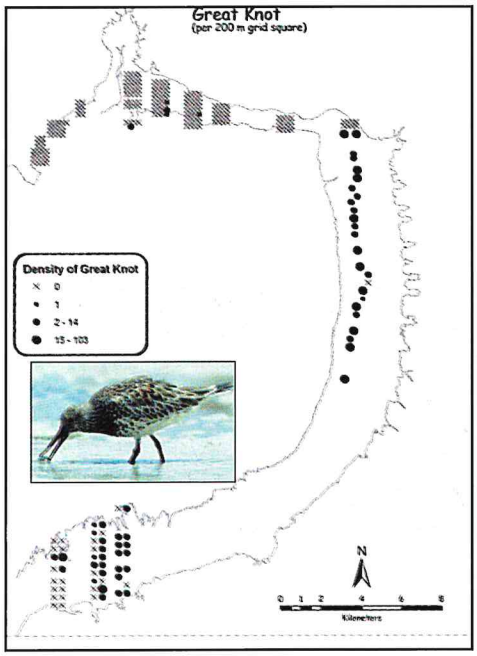


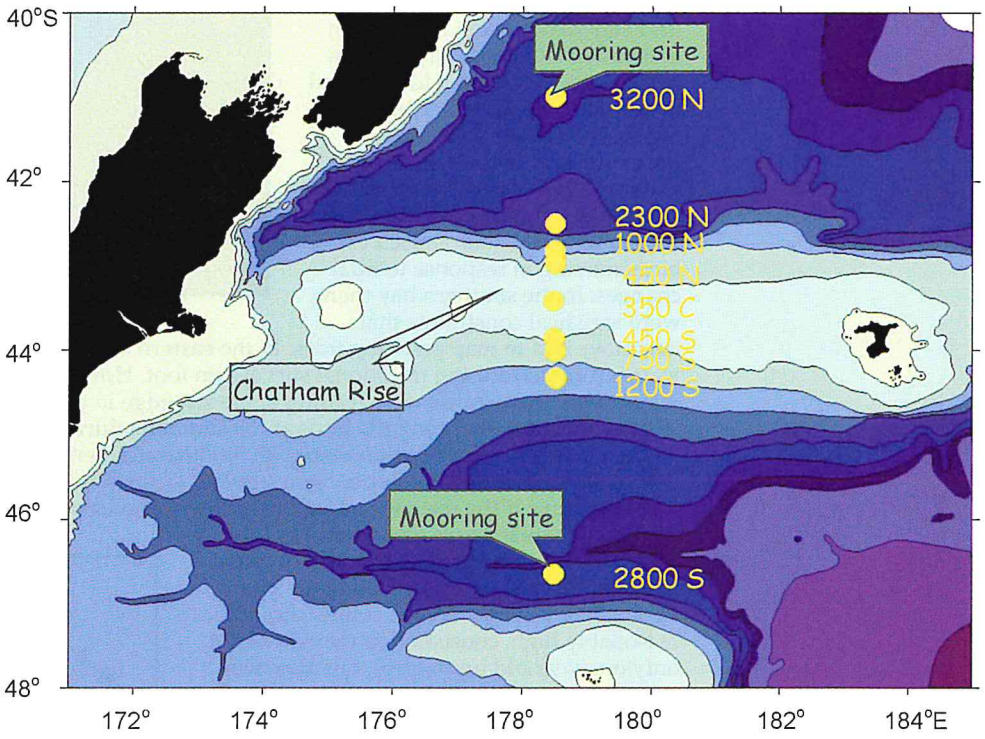
Fig. 5. Distribution of Great Knots Calidris tenuirostris in Roebuck Bay in June 2002.

FROGS: FRONTAL ORGANIC MATTER GOVERNING BENTHIC ECOSYSTEM STRUCTURES (NEW ZEALAND)

Contributors: Gerard Duineveld, Marc Lavaleye & Rob Witbaard

In a cooperation between NIWA (National Institute of Water and Atmospheric Research, New Zealand) and NIOZ, 3 cruises with the RV. Tangaroa were carried out in Oct. 2001 and in March and November 2002 to the oceanic Subtropical Front east of New Zealand. The purpose of this multi-annual NIWA project is to study the spatial and temporal variation in the particle export from the front to the deep sea floor and the ways in which this affects the composition and activity of the benthic community. As these frontal zones are considered to act as a strong regional carbon sink in the global carbon cycle, it also serves a global interest to study these systems in much more detail. The study area was east of New Zealand where the STF is topographically fixed by the relatively shallow Chatham Rise (CR). Above the Chatham Rise warm nutrient-poor but Fe-rich subtropical water meets colder nutrient rich, and Fe-poor subantarctic water. The Chatham Rise is an important area of deep-sea fisheries, which is indicative of the high biological production in the overlying waters. Apart from the commercial fish stocks, however, little was known on the sediment and the infauna at the rise and about the influence of the overlying front on biodiversity in general.

A strange isopod (Acutiserolis sp.) of 4 cm from 2300 m depth.

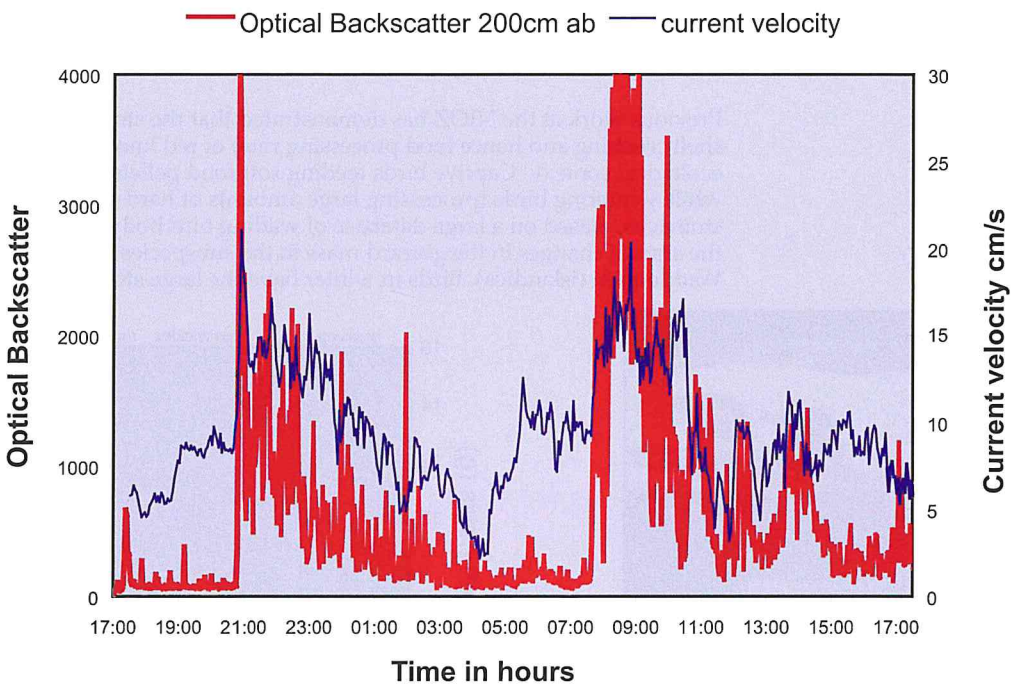


The Chatham Rise, east of New Zealand, with the sampled stations on a north-south transect. The ALBEX-landers have been deployed at about 3000m for more than a year at the two "mooring-sites".

The Orange Roughy, a commercial deep-sea fish in New Zealand waters

In combination with and in close vicinity of NIWA sediment trap moorings, two ALBEX landers were deployed for a total period of 1 year. Instrument packages on the NIOZ landers consisted of flux chambers, sediment trap, optical backscattering sensors, current meters and video. The combined deployments of NIWA and NIOZ instruments will enable us to trace the fate of particles and events occurring in the top of the water column down to the seafloor. In conjunction with these measurements, an inventory was made of the benthic infauna and epifauna across Chatham Rise by scientists of NIWA, Dunedin University and NIOZ using grabs and trawls. The role of individual taxa in the sequestering algal carbon was assessed by in-situ experiments with labeled algal tracers and gut contents analyses of algal pigments and derivatives.

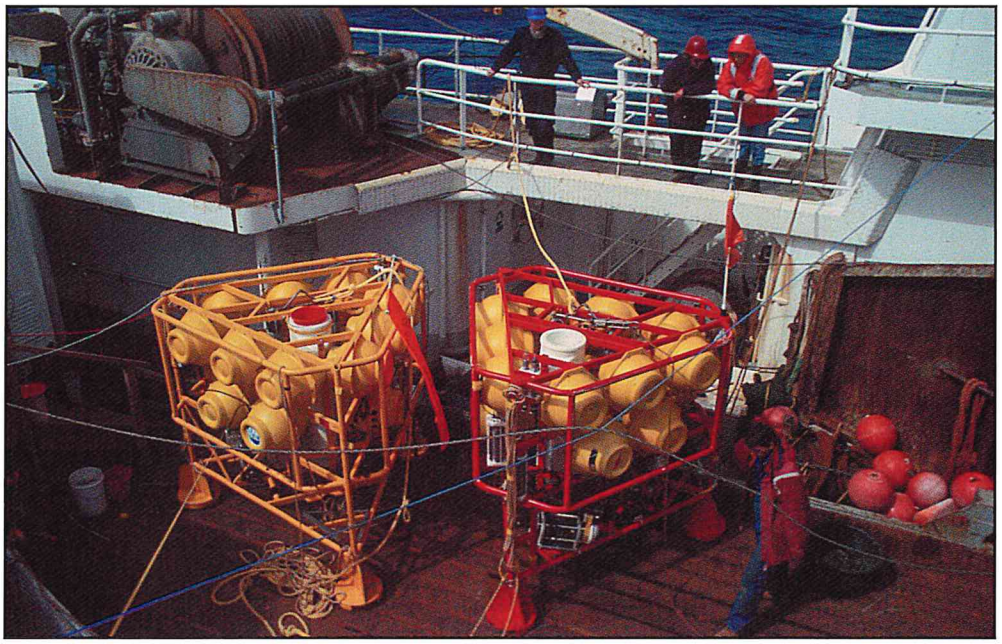
The benthic epifauna on the slopes of Chatham Rise was sampled and filmed with a NIOZ video trawl at depths between 350 m and 2800 m the latter being the first records from these large depth. Not surprisingly several species new to the New Zealand fauna were found. Trawling showed an enhanced epifauna biomass on the upper part of the southern slope of CR between 350 and 1200 m depths.



A one day record of the optical backscatter and currentmeter signal measured with the ALBEX-lander at the 750S station to show the close relation between resuspension and current velocity.

The same zone was found to be covered with an exceptionally thick layer of diatomaceous fluff during the cruise. Such dumps had not been recorded previously and might not be incidental judging from the elevated biomass. Part of the phytodetritus is consumed by the benthic organisms, as we found in animal guts and in the level of sediment oxygen fluxes. However, we observed that tidal currents caused rhythmic resuspension of the fluffy layer (Fig. #) and further transport most likely to much deeper water surrounding CR. Downward transport of the phytodetritus implies a delayed transfer of carbon back to the productive surface layer. The data from the 1 y deployment of the NIOZ landers at 3000 m depth north and south of CR will show whether this transport takes place and the effect it has on the activity of the abyssal sediments.

A seacucumber (Elpidiidae) recorded swimming at 3000 m depth.

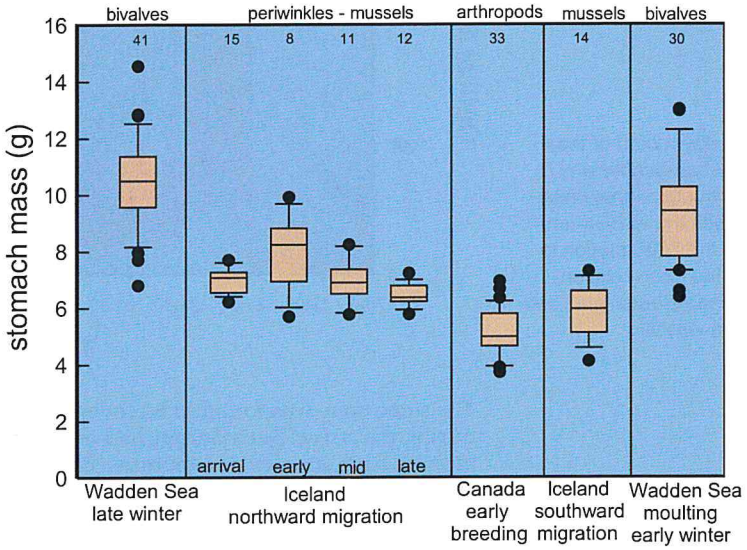


The two ALBEX-landers on board of the RV Tangaroa (NIWA, New Zealand)

FEEDING ECOLOGY AND THE DIGESTIVE TRACT: COMPARISONS AMONG WADERS

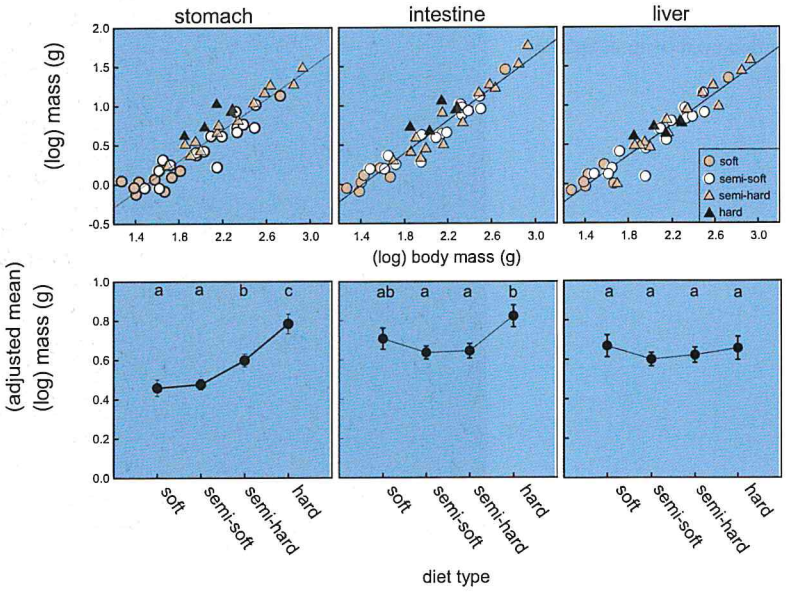
Contributors: Phil Battley & Theunis Piersma

Previous work at the NIOZ has demonstrated that the stomach size (which is important for shell crushing and hence food processing rate) of red knots Calidris canutus depends on the ecological context. Captive birds feeding soft food pellets have stomachs that are very small, while wintering birds (processing large amounts of hard-shelled molluscs) have much larger stomachs. Based on a large database of wading bird body composition we can now summarise the annual changes in the gizzard mass in the subspecies of knot that winters in the Dutch Wadden Sea (islandica). Birds in winter have the large stomachs typical of the 'high-energy



Changes in the stomach mass of red knots of the subspecies islandica through the annual cycle, with indications of diet type and general activity. Sample sizes are given above each box. The photo by Jan van de Kam shows knots foraging on snow-free tundra; a time of the year that their stomachs are small.

hard-prey' situation. Stomachs get smaller before migration to Iceland, increase during refuelling then reduce again to minimise mass during flight. On the breeding grounds in Canada, when prey are soft and energy demand is lower than in winter, gizzards remain small. It is only once birds are back in The Netherlands, with rising energy demands and hard prey, that stomachs enlarge again. Data such as these are currently being integrated into models that predict gizzard mass on the basis of energy demand and prey quality (Jan van Gils, MEE). We are nearing the point of being able to model digestive organ mass, which has important functional and energetic implications, for different subspecies or populations of knots around the globe.

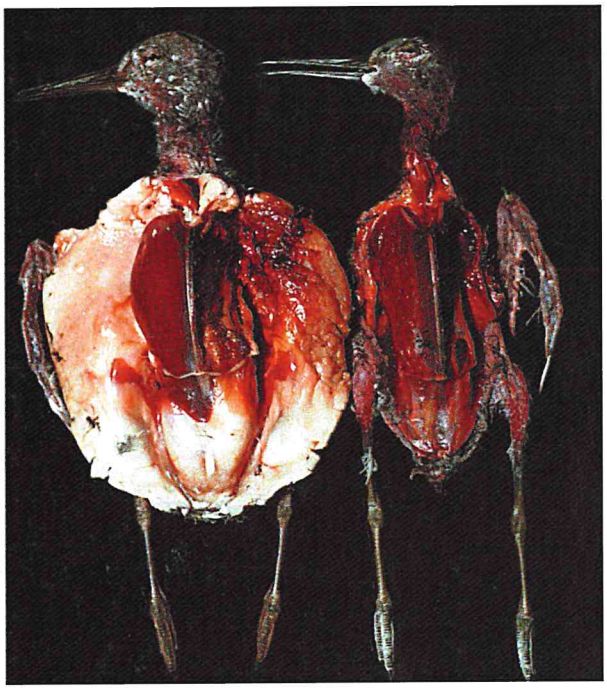


Allometry of the fresh masses of stomach, intestine (the entire but emptied intestinal tract) and liver in 41 species of wader from four different families, assigned to four different diet 'hardness' categories. For three species with large body size differences between the sexes (ruff, Eurasian curlew and bar-tailed godwit), males and females were handled as separate entities, bringing the effective sample size to 44 taxa. The lower three panels show the log mean organ masses adjusted for differences in body mass for the four diet categories. Diet categories sharing the same letter do not differ statistically. Covariance analyses found no evidence for organ mass differences at the family level.

Within knots, there is a clear, strong relationship between prey type and gizzard mass. In an interspecific comparison we tested whether such effects are evident across a wide range of shorebirds, and in organs other than the gizzard. For 41 species of shorebird that have been compositionally analysed (around one fifth of the world's waders), we categorised the diet of each of species on the basis of stomach and intestine contents and reports in the literature. A priori we assigned scores to the diets, ranging from 1 (only soft prey items such as polychaete worms, or extracted shell flesh as in oystercatchers), 2 (a mix of soft prey and soft-cased arthropods), 3 (mainly arthropods) to 4 (predominantly hard-shelled mollusc prey). In view of an interspecific correlation between stomach and intestine size shown previously from a smaller number of wader species (approximately half that of this analysis), a harder diet should also lead to a larger intestine.

The second figure shows the allometric scaling of organ mass against body mass (both log-transformed). For stomach mass, increasing diet hardness clearly leads to a heavier stomach, with the adjusted stomach mass for species eating hard-shelled prey being more than double that of species eating soft prey. The mollusc-eating species (category 4) had larger intestines than the species with intermediate diets (2 and 3). As expected, there were no differences in the relative size of the liver between the different diet categories (liver mass is generally correlated with energy turnover and fat metabolism than with prey characteristics).

The finding that hard prey leads to larger intestines suggests a mechanical 'protection' role rather than a strict processing effect (within species, intestines are known to change size as a result of changes in food intake). The mollusc-eating species (red and great knots, surfbirds, purple and rock sandpipers) all crush their prey in their gizzards, and the hard and sharp fragments are passed through the gut. It is presumably the specific prey types, rather than the general hardness, that influences the changes in intestine size. Given that the digestive organs are energetically expensive, there may be additional maintenance costs associated with feeding on hard prey. Incidentally, the red knot had proportionately the heaviest stomach of any species studied, explaining why it is also the species with the clearest gizzard mass reductions before migration.



Great Knots being dissected. The fat bird on the left was caught before migration from Australia; the lean bird on the right had just arrived after a long flight to China.

THE NETHERLANDS MARINE RESEARCH FACILITIES (MRF)

Contributor: Marieke J. Rietveld

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

In June 2002 the updated Long Term Plan on seagoing Marine Facilities 2001 — 2005 was submitted to the NWO advisory Committee for Marine Facilities (CMF). The Long Term Plan will be updated every year.

In 2002 the National Programme consisted of:

1. PASS-2/BIODEEP, Palaeoceanographic, Palaeoclimatic, Palaeo-environmental and diagenetic Aspects of Sapropel formation in the Eastern Mediterranean with emphasis on the most recent S1 (PASS-2). Project manager and cruise leader Dr. G.J. de Lange, Institute of Earth Sciences, Utrecht University. The project is the sea-going contribution to the EU-programme Sapropels and Paleoceanography (SAP) in combination with the EU-project BIODEEP. The overall aim is a better understanding of the (paleo)functioning of the Eastern Mediterranean and to determine the role in the global environment by studying the characteristic biogeochemical processes. The Project is a co-operation with Italian research groups. This year field work took place on board of the Italian research vessel URANIA.

2. PLUME & BLOOM, the Role of non-phytoplankton food for zooplankton in the North Sea. Project manager and cruise leader Dr. M. Baars (NIOZ). This multidisciplinary Frisian Front programme concentrates on both the nutrient, turbidity and plankton dynamics in the East Anglian Waters as well as on the resulting blooms and secondary pelagic consumption and production downstream over the Frisian Front. In 2002 a 12-day research cruise was carried out on board R/V PELAGIA in August.

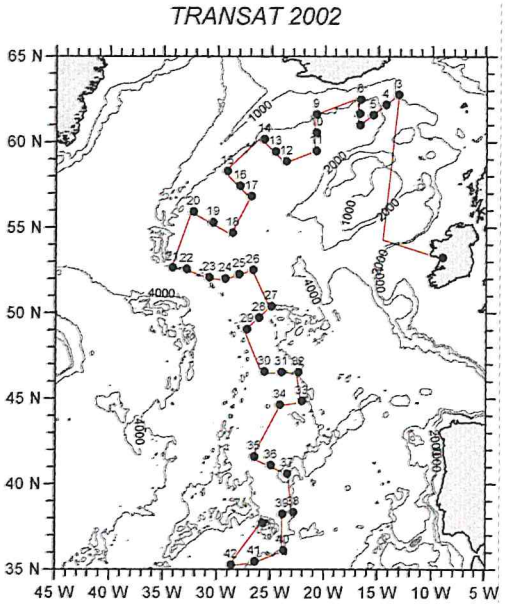
3. CANOBA (The Continental Shelf Pump: a pilot study in the North Sea). Project manager and chief scientist Dr. H. Thomas (NIOZ). This project aims to test the hypothesis of a continental shelf pump for the uptake of CO2 from the atmosphere and the subsequent transport to the open ocean in the North Sea. Two 26 day cruises were carried out on board RV PELAGIA, one in the winter (February/early March) and one in spring (May) covering the whole of the North Sea.

4. EMIR (Enhanced Carbon Mineralisation rates in permeable sandy sediments). Project manager and chief scientist Dr. ir. W. van Raaphorst (NIOZ). This project studies the role of sandy sediments in carbon cycling. A 17 day cruise was carried out on board RV PELAGIA in June 2002 in the nearby North Sea.

5. TRANSAT (Transformation of dissolved organic matter (DOM) in the North Atlantic Deep Water and intermediate waters). Project manager Prof.dr. G. Herndl (NIOZ). This project aims to determine the structural changes in the bacterioplankton community and the dissolved organic matter (DOM) in the North Atlantic Deep Water (NADW) over a timespan of around 50 years. A cruise was held in the North Atlantic Ocean from the Greenland/Iceland/Norwegian (GIN) Sea towards the Azores during 26 days on board R/V PELAGIA covering a distance of approximately 5000 km.

6. FORAMS (The role of Foraminifera in Benthic Food Webs and the Marine Carbon Cycle). Project manager Dr. L. Moodley (NIEE-CEME). The purpose of this project is to establish the role of foraminifera in the benthic carbon cycle and food web using stable isotope tracers in mesocosm experiments. A 6 day cruise was performed on RV PELAGIA in mid April.

7. MOMAP (Mortality of marine phtoplankton in ecosystems with contrasting trophic status (oligotrophic vs eutrophic)). Project manager Dr. Corina Brussaard (NIOZ). This project has three main goals: first to elucidate the ecological role of phytoplankton cell lysis in systems along a large trophic gradient. Secondly, to identify and understand the mechanisms controlling phytoplankton mortality. Thirdly, to comprehend the effects of environmentally relevant variable on the different algal mortality processes. A 14 day cruise on board RV PELAGIA was done in the second half of April.



Map of the transect sailed for the TRANSAT cruise from the GIN sea to the Azores.

Advice to GB-ALW for the National Programme 2003:
For the ongoing TRANSAT project (Transformation of dissolved organic matter (DOM) in the North Atlantic Deep Water and intermediate waters; project manager Prof.dr. G. Herndl, NIOZ) a cruise was advised in the North Atlantic Ocean from Bermuda towards the Greenland/Iceland/Norwegian (GIN) Sea during 26 days on board R/V PELAGIA.
For the ongoing MOMAP project (Mortality of marine phytoplankton in ecosystems with contrasting trophic status (oligotrophic vs eutrophic); project manager Dr. Corina Brussaard, NIOZ) a 14 days cruise on board RV PELAGIA was advised to take place in July in the North Sea.

The 2003 cruise for the long term PASS-2 project (project manager Dr. G. de Lange, UU) will take place on board the Italian RV UNIVERSITATIS in an 16 day cruise in June/July in the Mediterranean.

For the new BADE project (Bacterioplankton cell death: the diel variations in microbial activity in the surface layers of the Western Mediterranean Sea gyre as influenced by ultraviolet radiation; project manager Prof.dr. G. Herndl, NIOZ) a 21 day cruise was advised in the Western Mediterranean on board RV PELAGIA.

For the ODP proposal 549-Full2 (project manager Dr. J.W. Zachariasse, UU) a preparative cruise was advised in June 2003 for 12 days on board the UK research vessel RRS CHARLES DARWIN.

For the new EUROCORES projects EUROMARGINS and MEDIFLUX/NAUTINIL cruises were advised on RV PELAGIA for 30 days on the Rockall/Porcupine and in the Shetland Channel for EUROMARGINS and on the French RV L'ATALANTE with the submersible NAUTIL of IFREMER for 30 days in the Eastern Mediterranean and Nile Delta for NAUTINIL.

For the NWO big-investment grant for the LOCO project (Long-Term Ocean Climate Observations) three cruises were advised. One cruise for LOCO/IW (Internal Waves; project managers Dr. H. van Haren and Dr. L. Maas, NIOZ) in February/March for 26 days in the Canary Basin on board RV PELAGIA; one cruise for LOCO/North Atlantic (project manager Dr. H. van Haren, NIOZ) for 4 days in the Irminger Sea in combination with the NIOZ CLIVAR cruise CAMP in the North Atlantic on board RV PELAGIA and for LOCO/Mozambique (project manager Dr.ir. H. Ridderinkhof, NIOZ) in November for 6 days on board the UK research vessel RRS CHARLES DARWIN in the Mozambique Strait.

M.J. Rietveld, member and secretary of ISOM, participated in the 16th meeting of the International research Ship Operators Meeting (ISOM), at FIMR in Helsinki, Finland. She also participated in the 4th European Research Vessel Committee (ERVO) meeting in Bergen, Norway.

The total effort in terms of ship days and personnel involved in 2003 is given in the table.

Project		ship days	scientists	students	MRF support	others
1	PASS-2/BIODEEP	18	6		4	
2	PLUME&BLOOM	12	7	2	5	2
3	CANOBA-3	26	2	7	2	
	CANOBA-4	26	4	7	2	
4	EMIR-2	17	8	2	4	
5	TRANSAT	26	9	3	3	
6	FORAMS	6	9		1	
7	MOMAP	14	9	4	2	
	Total	145	54	25	23	2

DATA MANAGEMENT GROUP

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

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

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

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

The year 2002 can be characterized by a consolidation and continuation of DMG's main activities: data collection, —processing and - archiving, data exchange through Internet and other media and end-to-end datamanagement.

Staff of the DMG participated in three cruises, notably in the TRANSAT and the ROCS-cruises, as well as in several 24-hours cruises within the Marsdiep-project. Part of the post processing of the CTD data for these and other cruises, was carried out by the DMG.

During the MOMAP and IRONAGES cruises, the DMG assisted the scientists onboard with the delivery and interpretation of remote sensing data and other information, in cooperation with M. Wernand.

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.

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

During 2002 finalised CTD data from several cruises have been added to the central Codis database, which now contains over 3500 CTD profiles. A structure has been developed to incorporate VMADCP and LADCP data into the Codis database.

In 2002 the Wadden Sea Colour web site was added to the project websites which are built and maintained by the DMG (see annual report 2001). For this web site dedicated data retrieval software has been developed.

To increase efficiency and to enable an easier and more powerful maintenance, most project web sites have been ported to Dreamweaver.

Many of these web sites used to be dynamically linked to FTP areas, permitting easy data exchange amongst participants of a particular project. But the installation in 2002 of new firewall software, prohibiting the use of the FTP protocol, made a new approach necessary. All project web sites using FTP were redesigned using the htaccess protocol, ensuring the same facilities and functionality for the scientists.

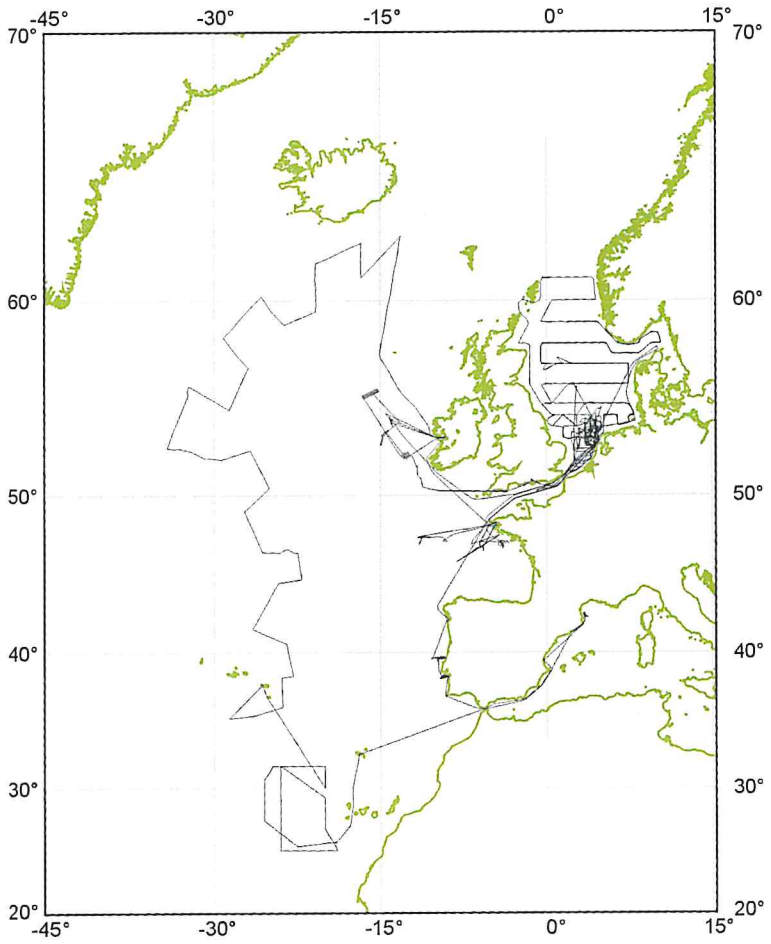
Many requests for data, both from within the institute as from outside, were answered. These request are very diverse and range from questions on whales to requests for complete cruise data sets. Answering these requests fits perfectly in the end-to-end-datamanagement philosophy, adopted by the DMG since its inception. This philosophy has gained world wide acceptance, as was made clear during the Ocean Data Symposium at the end of the year in Brussels. Two members of the staff participted in this oceanographic data management symposium.

The DMG represents NIOZ and the Dutch academic oceanographic community within the National Oceanographic Data Committee (NODC). T. F. de Bruin is the NODC Secretary.

As participant in the NODC, NIOZ participates actively in international projects and bodies like the EU-Seasearch project, the IOC Committee on International Oceanographic Data and Information Exchange (IODE) and the ICES-Marine Data Management group.

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

An additional task of the DMG is the development and maintenance of the Netherlands Antarctic Data Inventory (NADI, http://www.nioz.nl/projects/antarctica) for the Antarctic research projects in the Netherlands. In 2002 two more Antarctic dataset descriptions (DIFs) were added to the NADI database. As many as 14 new Antarctic data sets have been identified. One member of the staff represented the Netherlands at the annual meeting of the Joint Committee on Antarctic Data Management (JCADM) in Shanghai (China). During this meeting he was elected Deputy Chief Officer.



R.V. Pelagia cruises in 2002

Cruise number	Project	Departure	Arrival	Specific area	Chief scientist
64PE189	BIVALFF	Feb. 4, Texel	Feb. 8, Texel	Frisian Front	Drs. G. Duineveld
64PE190	CANOBA	Feb. 11, Texel	Mar. 8 Texel	North Sea	Dr. H. Thomas
64PE191	IRONAGES	Mar. 11, Texel	Apr. 2, Texel	Bay of Biscay	Prof. Dr. H. de Baar
64PE192	BIVALFF	Apr. 8, Texel	Apr. 12, Texel	Frisian Front	Drs. G. Duineveld
64PE193	FORAMS	Apr. 12, Texel	Apr. 19, Texel	Skagerrak	Dr. L. Moodley
64PE194	MOMAP	Apr. 19, Texel	May 3, Texel	North Sea	Dr. C. Brussaard
64PE195	CANOBA	May 6, Texel	May 31, Texel	North Sea	Dr. H. Thomas
64PE196	EMIR	Jun. 3, Texel	Jun. 18, Texel	Southern North Sea	Dr. W. van Raaphorst
64PE197	EcoGeomound	Jun 20, Texel	Jul. 14, Galway	Rockall & Porcupine Bank	Dr. T. van Weering
64PE198	ROCS	Jul. 16, Galway	Jul. 20, Galway	Malin Shelf	Dr. H. van Haren
64PE199	Charter Thales	Jul. 21, Galway	Aug. 15, Texel	n.a.	n.a.
64PE200	Plume & Bloom-6	Aug. 16, Texel	Aug. 27, Texel	Frisian front	Dr. M. Baars
64PE201	ROCS	Aug. 30, Texel	Sep. 5, Galway	Malin Shelf	Dr. H. van Haren
64PE202	TRANSAT	Sep. 7, Galway	Oct. 3, Ponta Delgada	N. Atl. Ocean	Prof. Dr. G. Herndl
64PE203	IRONAGES	Oct. 4, Ponta Delgada	Oct. 30, Valencia	N. Atl. Ocean	Dr. K. Timmermans
64PE204	CANYONS	Nov. 2, Valencia	Nov. 27, Texel	Mediterranean, N. Atl. Ocean	Dr. T. van Weering
64PE205	BIVALFF	Dec. 2, Texel	Dec. 6, Texel	North Sea	Drs. G. Duineveld

WORLDWIDE EVERY 6 HOURS

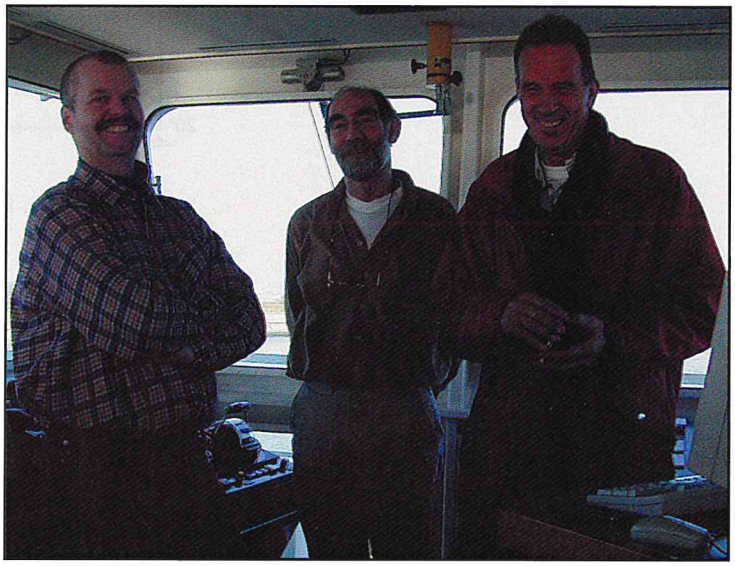
Reliable and accurate weather forecasts depend heavily on good-quality observations from all over the world oceans. Worldwide every 6 hours, thousands of weather reports are exchanged over the Global Telecommunications System (GTS) by more than 7000 ships. This is the Voluntary Observing Ship (VOS) programme of the World Meteorological Organisation (WMO).

Changing a sensor is not an easy task when a sensor such as the anemometer is mounted on the top of a mast, 25 meters above sea level. (photo: Taco de Bruin)

The Pelagia has been a Selected Ship within the VOS programme since the fourth quarter of 1999. In co-operation with the Royal Netherlands Meteorological Institute (KNMI) she was then outfitted with state of the art meteorological sensors, designed for continuous sampling under adverse conditions (see also Annual Report 2000).

Though it is not a competition, the number of weather reports sent in by a ship is recorded and a ranking is made at the end of each year. In 1999 the crew of the Pelagia sent in only one weather report. The Pelagia ended as number 232 in a list of 234 Dutch civilian and navy ships. In 2000 however, 645 weather reports were sent in, resulting in a tenth place on a list of 251 Dutch ships. This upgoing trend continued in 2001. The crew of the Pelagia sent in 914 weather reports, taking second place in a list of 247 Dutch ships. For some reason yet unknown, the year 2002 showed an overall decline in the number of weather reports. R.V. Pelagia contributed 522 weather reports, resulting in the ninth second place in a list of 242 Dutch VOS ships.

Because of the number of weather reports, but more importantly because of the quality of the weather observations combined with the fact that the Pelagia operates mainly in so-called 'data-sparse areas', the Royal Netherlands Meteorological Institute (KNMI) requested in 2002 to include the Pelagia in the VOSClim programme. The VOSClim is an ambitious programme set up by the WMO, to 'provide a high-quality set of marine meteorological observations'. Currently the Pelagia is the only Dutch vessel in this international programme of 60 specially selected ships (status of November 2002).



All happy faces with the good results of the Pelagia. From left to right: deputy master John Ellen, master Hans Groot and Port Meteorological Officer, Jan Schaap. (photo: Taco de Bruin)

THE EDITORIAL OFFICE OF THE JOURNAL OF SEA RESEARCH

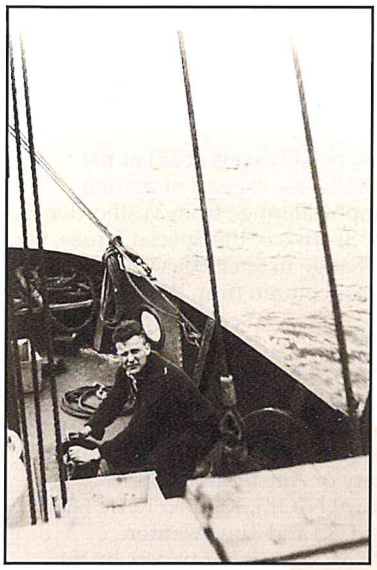
Contributors: C.J.M. Philippart, B. Bak-Gade, J.J. Beukema, G.C. Cadée & W. van Raaphorst

In 2002, the Journal published volumes 47 and 48, each consisting of four issues and together comprising 44 papers. Following the trend of the last few years, most (18 out of 26) of the papers published in the regular issues of the Journal dealt with diverse aspects of marine coastal macrozoobenthic communities, covering a wide geographical range from Vestfjorden, Norway (68 °N) to the Beagle Channel in Tierra del Fuego (54 °S). Two of the Special Issues, viz. 47 (3/4) and 48 (4), were dedicated to Processes of Vertical Exchange in Shelf Seas (PROVESS), an interdisciplinary study of vertical fluxes throughout the water column from the sea surface to the seabed.

Another Special Issue of 2002 (Volume 48 — Issue 3) embodied Part I of the Proceedings of the Symposium "Structuring Factors of Shallow Marine Coastal Communities", which was held in November 2001 to celebrate the 40th anniversary of the Journal and the 125th anniversary of the institute. This issue was published in October 2002, i.e. within one year after the symposium was held. It comprises contributions by Jef Huisman (University of Amsterdam, The Netherlands), Gerhard Cadée (Royal NIOZ), Jan Beukema (Royal NIOZ), Karsten Reise (AWI Sylt, Germany), John Widdows (Plymouth Marine Laboratory, UK) and Tim Wootton (University of Chicago, USA). The second part of the Proceedings, containing papers by the other speakers at the symposium, will be published in spring 2003 (Volume 49 - Issue 2).

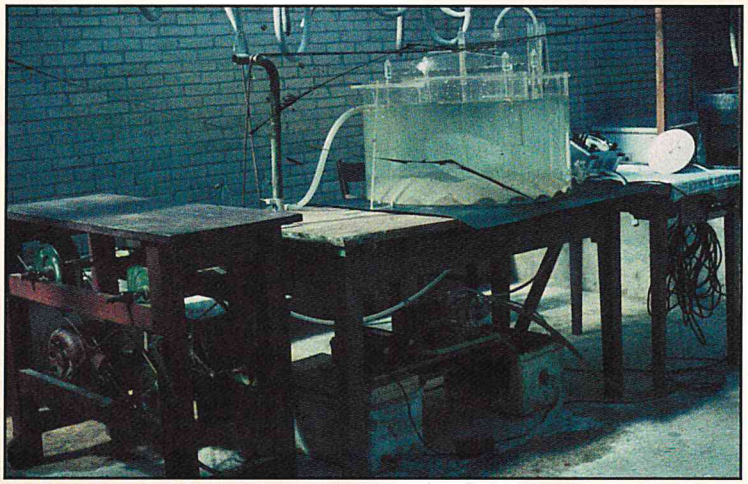
Tragically, the year 2002 will be remembered most for the fatal traffic accident of our colleague and editor Wim van Raaphorst. Wim joined the editorial board of the Journal of Sea Research in 1999. As members of the editorial office, we have always admired his wide scientific expertise and interests, his sincerity and his empathy. These qualities made him an inspiring colleague, an ideal editor, and a joy to work with. Even after he had accepted the position of head of the Department of Marine Chemistry and Geology at NIOZ in 2001, he continued his editorial work with the same dedication and enthusiasm. We will always be grateful for his contributions, both on a professional and a personal level.

Wim van Raaphorst (right) chairing the JSR-Symposium in November 2001.



MIGRATION AND ORIENTATION WERE HIS LIFE...

In 1961 Frederik Creutzberg finished his four years of ZWO-financed research on the migration of elvers into the Wadden Sea, took his Ph.D. (his promotor being the Groningen University Professor G.P. Baerends) and went to Curacao, where he was stationed by NIOZ as director of CARMABI, the Caribbean Marine Biological Institute. Even before his thesis 'On the orientation of migrating elvers (Anguilla vulgaris Turt.) in a tidal area' had been finished, Creutzberg had already become an internationally known zoologist and the author of two publications in Nature: 'Use of tidal streams by migrating elvers' (1958) and 'Discrimination between ebb and flood tide in migrating elvers by means of olfactory perception' (1959). He had been the first and the only who succeeded to unravel another small part of the ever puzzling migration of the eel Anguilla vulgaris since Johannes Schmidt traced the larvae almost 40 years earlier on their 4500 km long journey across the Atlantic.

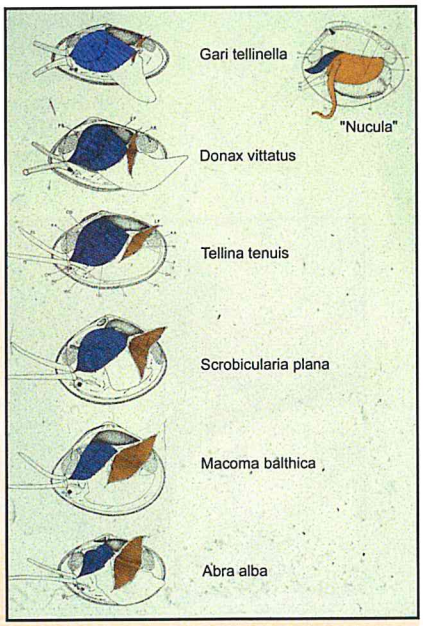


After having demonstrated with a plankton net in the western Wadden Sea's main tidal inlet that elvers 'are carried inward by the flood at higher water levels, and go down to the bottom during the ebb tide so that they are not carried back seaward', Creutzberg designed a 'carousel' (a device that could produce an almost laminar circular current) to study the elver's behavior more closely. The elvers, swimming with the current in a carousel filled with water from the open sea, went immediately to the bottom when water from Lake IJssel was added. There was no such response when the water from Lake IJssel was previously filtered through charcoal. This proved, that the elvers discriminated between ebb and flood by olfactory perception and not by salinity as had been assumed so far.

Freek Creutzberg led the CARMABI for nine years and returned to NIOZ in 1970. In the meantime, NIOZ had moved from Den Helder to Texel, where he was appointed head of a new biological department initially called 'Migration'. Within short, the name was changed to 'Ecology and Migration' and later to 'Autecology', reflecting the changes that took place at NIOZ in the seventies after the arrival of the new biology director J.J.Zijlstra. Initially Creutzberg took up his eel research again, focussing this time on the adults which migrated seaward ('running eels') in still massive numbers each autumn. He attributed the observed peaks in migratory activity when the moon was full (a phenomenon known since long from the fyke-fishery along the enclosure dam in Lake IJssel), as well as the seaward orientation of the movement itself, to low frequency underwater sound waves. These would be produced by the breaking of the surf on the beaches and be strongest at springtide; their peaks had even been recorded more than 100 km inland during seismic investigations. Creutzberg considered them as the underwater guide-post for the migrating eels. However, the arrival of the newly built North Sea trawler RV"AURELIA" at NIOZ in 1972 forced him to leave his eel experiments and concentrate fully on the benthic fauna of the Southern North Sea.

Running' eels from Lake IJssel, introduced in the experimental setup at night, distributed evenly over all four exit tubes. During full moon, however, the eels appeared to aggregate in the (randomly chosen) tube which ended in the sea. According to Creutzberg, the only possible information that could pass the black closing membranes at the end of the tubes to inform the eels on the direction of the sea were sound waves.

Creutzberg's benthic investigations in the Southern North Sea with R.V."AURELIA" started with a detailed survey of the motile epifauna of the Dutch part of the continental shelf. Beginning in 1972, a grid of ca 50 stations was sampled initially four times a year and later twice yearly by making hauls with a narrow meshed 6-m beamtrawl, using the Decca to estimate the sampled surface. The 'AURELIA-cruises' focussed on the abundance and the distribution of predominantly non-commercial benthic fish populations, crustaceans and echinoderms, of which little was known at the time. All data were accurately put down in ten NIOZ internal reports with distribution maps and length-distributions of most abundant species (of which there were in total more than 300). The 'AURELIA-cruise reports' are still frequently used today. However, keeping Creutzberg entirely from doing his migration research was impossible. He started new plankton catches in the Marsdiep and new experiments in the carousel and demonstrated that the mass immigration of plaice larvae (Pleuronectes platessa L.) into the Wadden Sea in early spring was a second example of active tidal transport based on olfactory perception. Besides, he wrote the extensive chapter 'Invertebrates' of the series 'Spatial orientation in animals' published in Marine Ecology.

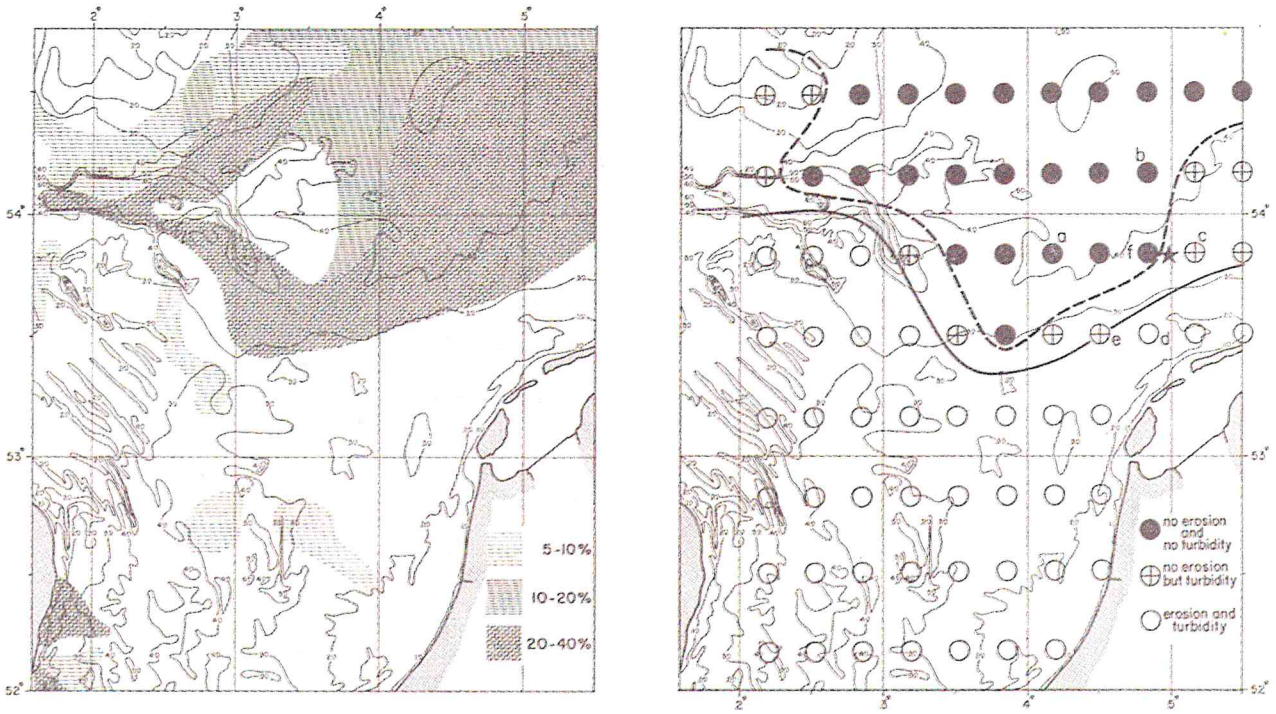


Apart from the net-hauls, all stations of the 'Aurelia-cruises' were sampled with a bottom grab for macrobenthos and grain size and silt content of the sediment. These data revealed a separation of the research area in a southern sandy part populated by predominantly filter feeding benthos, in contrast to the northern more muddy part inhabited by deposit- and subsurface deposit feeders. A narrow transition zone in-between appeared to have a rich benthic fauna (with a biomass comparable to that of the Wadden Sea) with a striking zonation of species and feeding types. In bivalve species, the surface of the foot was compared to the surface of the gill as a measure of their feeding-type.

Creutzberg was convinced that the nature of the benthic fauna depends in the first place on the quantity and the quality of the food reaching the seabed and with that, on the hydrography of the area. This explained, in his view, to a large extent the relation between grainsize of the sediment and species composition of the benthos. Therefore, the measuring of profiles of temperature and Chlorophyll (using Nansen bottles) and current velocities over whole tidal cycles (which was done at 'anker'-stations in the night with an electric torch, a piece of seaweed and a chronometer) became a fixed part of his benthos program. His growing interest in the hydrography and his discussions with Henk Postma led to a cooperation of the two in an experiment in again....the carousel, this time used to explain the observed typical distribution of mud in the Southern North Sea. Their hypothesis, that strong tidal currents and wave action would prevent sedimentation in the shallow Southern Bight, whereas suspended organic matter and silt could begin to settle out as soon as the north- easterly residual current had brought the water across the 30-m depth line, proved to be right.

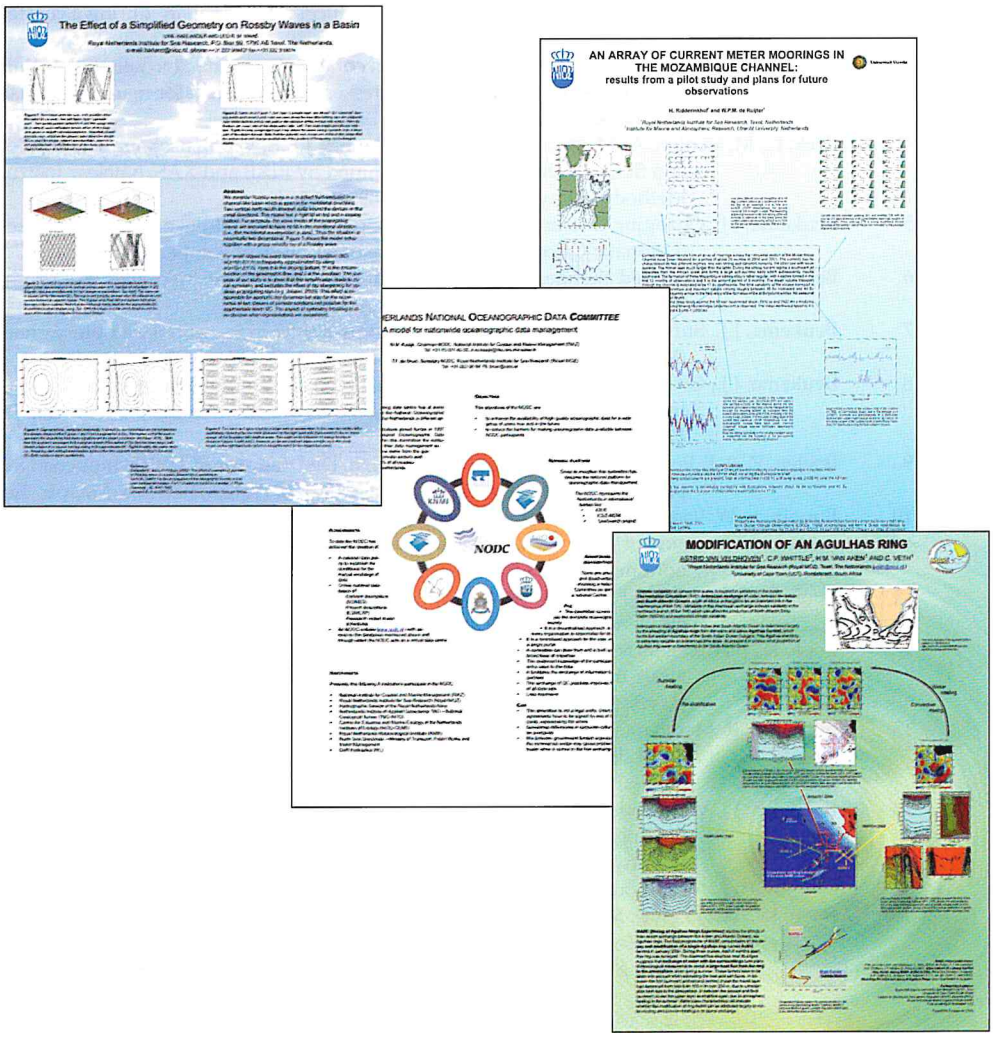
After eight years of (epi)benthos sampling in the Southern North Sea, Creutzberg restricted his field research to the Frisian Front. During the previous 'Aurelia cruises' a puzzling phenomenon had been observed, being a band of higher Chlorophyll concentrations along the southern edge of the Oyster Grounds in summer, approximately along the 30-m depth line. This Chlorophyll maximum corresponded basically with the tidal mixing front, and was initially explained as a a pelagic frontal phenomenon. Echosounding and IKMT- catches showed sprat concentrations (Sprattus sprattus) in the frontal zone; colleagues came back with exciting figures on a concentration of Guillemots (Uria aalge). Quite mysteriously however, the Chlorophyll band stayed at its fixed position above the rich bottom zone when the tidal mixing front moved to the south during the expansion and, to the north during erosion of the summer-stratified area. During the 1984 EMBS in Inverness (Scotland), Creutzberg presented his finding of what was most likely a new type of benthic/pelagic coupling and was awarded with the price for the best presentation.

After numerous shorter visits to the Frision Front, in 1986 two vessels (RV "TYRO" and RV "AURELIA") went for over a month to the area for joined research by the physical, chemical and biological departments (the project 'FFP'). The expectation was that with the simultaneous collection of so many different data in a restricted area, the factor(s) causing the 'Chlorophyll Curtain' could not be missed. However, there was no Chlorophyll maximum in the frontal zone in 1986, and although the bottom in the transition zone was still muddy, there was hardly more benthos than elsewhere and not much of a zonation in feeding types either. During the following years the benthic front faded away almost completely, the first signs of its recovery not showing up before 2000. Frederik Creutsberg, who in 1987 reached the age of 65 and retired from NIOZ, did not try to blame climate change or the North Atlantic Oscillation (NAO), but spoke the memorable words: 'I believe that I reached my retirement just in time!'



With the carousel Postma and Creutzberg determined the critical current speed (0.9 kn.) below which suspended silt from the Oyster Grounds began to settle on the bottom and, also the current speed required to resuspend the material after different consolidation times. With this information and the maximum tidal velocity data for the Southern North Sea, they produced a 'theoretical silt distribution' (left) which appeared to agree surprisingly well with the actual distribution of mud (right).

2. Publications and Presentations



PUBLICATIONS
Dissertations

Boelen, P. Sun dazed to the core. RUG.
Edelaar, W.C.M. The ecology and evolution of anti-predation traits in a burrowing bivalve, Macoma balthica. University of Groningen, 172 pp.
Epstein, N., Coral reefs: Aspects of management, Conservation and restoration. University of Amsterdam. 95 pp.
Grutters, M.M.C.H. Early diagenesis of amino acids in NE Atlantic continental margin sediments. Utrecht University, 96 pp.
Goeij, P. De Burying depth as a trade-off in the bivalve Macoma Balthica. 120 pp.
Koning, E. Biogenic silica cycling in the upwelling area on the Somalian Margin. Utrecht University, 152 pp.
Pausz, C. Dissolved organic matter utilization by marine bacterioplankton. University of Vienna, Austria, 141 pp.
Van Der Meer, M.T.J. Structure and isotopic composition of bacterial lipids: Insights into distribution and carbon acquisition mechanisms of bacteria in hot spring microbial mats. University of Utrecht, 91 pp.
Van Der Zee, C. Early diagenesis of Mn, Fe and P in European continental margin sediments. Utrecht University, 176 pp.
Vermeij, M.J.A., Evolutionary ecology of the coral genus Madracis: an illustration of the nature of species in scleractinian corals. University of Amsterdam. 255 pp.

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Oral Presentations

Arrieta, J.M., M.G. Weinbauer & G.J. Herndl. Induction of bacterial ectoenzymatic activity in response to iron fertilization. 8th Symposium on Aquatic Microbial Ecology, Taormina, Italy, 25-30 October.

Baars, M.A. A plume river across the southern North Sea. ICES Workshop 'Contrasting approaches to understanding eutrophication effects on phytoplankton', The Hague, 11 March.

Baars, M.A. Plume & Bloom. An English river across the southern North Sea. CANOBA Workshop, Texel, 23 October.

Bak, R.P.M. Allocthonous storm generates displaced damage on deep reefs in Bonaire (N.A.). Annual meeting International Society for Reef Studies, Cambridge, UK, 5 september.

Bak, R.P.M. Changes on a Caribbean reef: the fringing reefs of Bonaire. Pew Fellows Annual Meeting Bonaire (NA), 22 September.

Bak, R.P.M. Coral Reef (Tropical Marine Biology) Lecture series, University of Amsterdam, January.

Bak, R.P.M. Developments in coral and reef fish populations since 1972 in Bonaire. Bonaire (N.A.), 24 September.

Battley, P.F. & T. Piersma. Intertidal food webs and the role of shorebirds. Lecture NEBROC Course, NIOZ, 17 October.

Beckmann, B., T. Wagner, P. Hofmann, G. Scheeder & J.S. Sinninghe Damsté. Coniacian-Santonian black shale formation in the tropical Atlantic (ODP Site 959, Ivory Coast/Ghana): cyclic variations in the composition of organic matter. CSCOP-TSOP Meeting, Baniff, Canada, 31 August — 4 September.

Beckmann, B., T. Wagner, P. Hofmann, G. Scheeder & J.S. Sinninghe Damsté. Cyclic fluctuations in the composition of organic matter in OAE3 black shales (ODP Site 959, off Ivory Coast/Ghana). Conference on Cretaceous Climate and Ocean Circulation, Florissant, Colorado, USA, 14-17 July.

Besemer, K., M. Moeseneder, J.M. Arrieta, G.J. Herndl & P. Peduzzi. Bacterial diversity of floodplain pools. 8th Symposium on Aquatic Microbial Ecology, Taormina, Italy, 25-30 October.

Beukema, J.J. Observations on a small population of individually marked Calopteryx haemorrhoidalis: site fidelity, homing ability, and along-stream movements resulting in larval-drift compensation. European Meeting of the World Dragonfly Association, Leiden, 1 June.

Blinova, V., A. Stadnitskaia, J.S. Sinninghe Damsté, M. Baas & T.C.E. van Weering. Lipid composition from gas-related sediments and mud volcanic deposits of the Sorokin Trough, NE Black Sea. Preliminary results. International conference and tenth post-cruise meeting of the Training-Through-Research programme. Aveiro, Portugal, 30 January-2 February.

Bonnin, J., W. Van Raaphorst & G.-J. Brummer. Intense mid-slope resuspension of particulate matter in the Faeroe-Shetland Channel. EGS meeting, Nice, France, 21-26 April.

Booij, K. & J.P. Boon. Contaminant research at NIOZ. ISACOM-0 workshop. Nantes, France, 9-11 June.

Booij, K. The basic environmental chemistry and ecotoxicology behind the MARPOL treaty. Marine Environmental Awareness Course, NIOZ, 13 March, 6 November, 20 November.

Booij, K. The basic environmental chemistry and ecotoxicology behind the MARPOL treaty. Marine Environmental Awareness Course, NIOZ, 13 March, 6 November, 20 November.

Boon, J.P. & B.N. Zegers. PBDE flame retardants: Analysis, Occurrence in the Western European Environment, and Toxicity. 32nd International Symposium on Environmental Analytical Chemistry (ISEAC32), Plymouth, UK, 18-20 June (invited lecture).

Boon, J.P. & H.J.W. De Baar. An overview of the environmental problems associated with gaseous emissions from ships (CO_2, SO_x, NO_x & CFCs). Marine Environmental Awareness Course 11-14 March.

Boon, J.P., B.N. Zegers & C.C. ten Hallers-Tjabbes. Is water transport of Persistent Organic Pollutants (POPs) more important than atmospheric transport ? International Workshop on the global and regional transport of POPs, Lancaster, UK, 7-9 October (invited lecture).

Boon, J.P., B.N. Zegers & C.C. Ten Hallers-Tjabbes. The influence of hydrographic factors on the transport of contaminants (polybrominated diphenyl ethers and organotins). Plenary lecture at the annual meeting of the ICES Marine Chemistry Working Group, Berlin, Germany, 4-8 March.

Bos, O.G. & I. Hendriks. Surviving the larval stage: Pelagic life and settlement of intertidal bivalves. Seminar Department of Marine Biology, University of Groningen, 10 April.

Bos, O.G. Recruitment variation of Macoma balthica: testing the Match-Mismatch hypothesis. II European Malacological Congress, Vigo, Spain, 9-13 September.
Bos, O.G. Rocky shore ecology. Lecture NEBROC Course, NIOZ, 17 October.
Bos, O.G. Zwerven door de Waddenzee. Experts meet Experts, NIBI Expertise Centrum Biologie, Ecodrome, Zwolle, 18 November.
Bos, O.G. Zwerven door de Waddenzee. Meimaand Natuurmaand, Ecomare, Texel, 7 May.
Boyé, M., J. Nishioka, P. Croot, P. Laan, K.R. Timmermans, S. Takeda & H.J. De Baar. Colloidal Fe accounts for a significant part of dissolved organic Fe-complexes in the Southern Ocean. 2002 Ocean Sciences Meeting, Honolulu, Hawaii, 11-15 February.
Boyé, M. P. Croot, J. Nishioka, P. Laan, K.R. Timmermans & H.J.W. De Baar. Distribution and fate of iron during Southern Ocean iron release experiment. 27th General Assembly of the European Geophysical Society, Nice, France, 21-26 April.
Bozec, Y. Carbon Cycling in the North Sea. Verweij-PhD meeting, NIOZ, 28-29 January.
Bozec, Y., D.C.E. Bakker, H.J.W. De Baar, A.J. Watson & S. Kringstad. Inorganic carbon changes during a southern ocean iron release experiment: effects of iron, hydrography and meteorology. EGS 27th Assembly, Nice, France, 21-26 April.
Bozec, Y., H.J.W. De Baar, D.C.E. Bakker & A. Watson. Inorganic Carbon changes during southern ocean iron release experiment: effect of iron, hydrography and meteorology. NAC VI, 6e Nederlands Aardwetenschappelijk Congres, Veldhoven, 18-19 April.
Bozec, Y., H.J.W. De Baar, D.C.E. Bakker & A. Watson. Inorganic Carbon changes during southern ocean iron release experiment: effect of iron, hydrography and meteorology. EGS 27th General Assembly, Nice, France, 22-26 April.
Brussaard C.P.D. What is the fate of ungrazed Phaeocystis in the water column? Ecology and impact assessment of Phaeocystis blooms in the Eastern Channel and Southern Bight of the North Sea. First regional conference on the ecology and impact assessment of Phaeocystis blooms in the Eastern Channel and Southern Bight of the North Sea. Oostende, Belgium, 27-29 November.
Brussaard, C.P. D. The ecological role of viruses in phytoplankton bloom dynamics - a mesocosm study on Phaeocystis globosa as example. Uppsala, Sweden, 6 September.
Brussaard, C.P.D. Novel viruses for Phaeocystis globosa. 3rd Int. Algal Virus Workshop, Hiroshima, Japan, 24-28 May.
Brussaard, C.P.D., M. Veldhuis & P. Ruardij. Virus induced mortality of Phaeocystis globosa: a mesocosm study and modeling exercise. ASLO / AGU 2002 Ocean Science Meeting, Honolulu, Hawaii, 11-15 February.
Brussaard, C.P.D., S.M. Short & C.A. Suttle. Gene sequences of viruses infecting Phaeocystis reveal they are closely related to viruses that infect other prymnesiophytes. American Society of Limnology and Oceanography - Summer Meeting, Victoria, Canada, 10-14 June.
Cadée, G.C. Primary production. NEBROC course, NIOZ Texel, 18 October.
Cadée, G.C. Tropical drift seeds on the Dutch coast. Landelijke Jongeren KNNV, NIOZ, Texel, 19 May.
Cadée, G.C. 30 Years phytoplankton research in the Marsdiep. Ned. Vlaamse Kring van Diatomisten, Edam, 19 April.
Cadee, G.C. Drift seeds. Nationaal Herbarium Leiden, 24 January.
Cadée, G.C. Driftseeds from the coast of Texel. IVN afd. Texel, Den Burg, Texel, 4 March.
Cadée, G.C. Herring gulls as consumers of recent invaders Ensis americanus and Crassostrea gigas in the Wadden Sea. Strandwerkgemeenschap, Haarlem 19 January.
Cadée, G.C. Molluscan life on a tidal flat. Schelpenwerkgroep Fries Natuurmuseum, Texel, 5 October.
Camphuysen, C.J. The Prestige oil spill, Galicia 2002. Lecture Department of Marine Ecology, NIOZ, 19 December.
Camphuysen, C.J. Dissecting seabirds in emergency situations, with special reference to the Prestige oil spill. A Coruña University, A Coruña, Spain, 25 November.
Camphuysen, C.J. Marine pollution monitoring: seabirds as indicators of chronic oil pollution and the effects of plastic debris on marine wildlife. Marine Environmental Awareness Course, Royal Netherlands Institute for Sea Research, Texel, 5 and 19 November.
Camphuysen, C.J. MARPOL for the sharks? Historical review of MARPOL to EU directive — How is the sea doing? Congres "Invoering EU richtlijn voor verwijdering scheepsafval" Blijdorp, Rotterdam, 27 November.
Camphuysen, C.J. Mass mortality of Common Eiders Somateria mollissima in relation to commercial fisheries in the Wadden Sea. Seaduck specialist meeting, Roosta, Estonia, 19 April.
Camphuysen, C.J. Oil spills, chemicals and plastics in the sea and their effects on seabirds and sea mammals: MARPOL Annex I en V in another light. MARPOL cursus NIOZ, Texel, 12 March.
Camphuysen, C.J. Seabirds and cetaceans at sea: an introduction to offshore census techniques. Course Ecological Mapping and Monitoring, Leiden University, 16 September.
Camphuysen, C.J. Seabirds and cetaceans at sea: offshore census techniques. BIOLA, Hamburg, Germany, 6 December.
Camphuysen, C.J. Seabirds exploiting sandeel in the northwestern North Sea. BIOLA, Hamburg, Germany, 6 December.

Camphuysen, C.J. Seabirds exploiting sandeel in the northwestern North Sea. WP3 progress report 2002. IMPRESS bi-annual meeting, CNRS Strasbourg, France, 7 November.

Camphuysen, C.J. Seabirds foraging strategies and diurnal patterns in seabirds at sea. WP3 progress report 2002. IMPRESS bi-annual meeting, Pittodrie House, Aberdeenshire, U.K. 11 April.

Camphuysen, C.J. Seabirds foraging strategies and diurnal patterns in seabirds at sea. European Seabirds at Sea (ESAS) group meeting, Aberdeen, U.K., 13 April.

Camphuysen, C.J. Southern right whales near South-Africa. Beluga Expeditions promotions, Artis, Amsterdam, 5 October.

Camphuysen, C.J. Whales in the North-European waters. Beluga Expeditions promotions, Artis, Amsterdam, 5 October.

Camphuysen, C.J., M.F. Leopold & P. Duiven. The rehabilitation of oiled Common Guillemots Uria aalge in The Netherlands. Recoveries of Guillemots ringed in The Netherlands: the survival of rehabilitated oiled seabirds. MEDMARAVIS International conference on oil pollution and conservation of biodiversity, Porto Torres, Sardinia, 17-20 October.

Daan, R., Environmental effects of oil- and gas drillings in the North Sea workshop on the oil- and gas industry in the Netherlands. Van Hall Instituut ,Leeuwarden, 8 February.

De Baar, H.J.W. Lecture series introductory oceanography, Groningen, 11-20 February.

De Baar, H.J.W. Ferrous Fertilization of the Southern Ocean. Mini-Symposium Instituut voor Aardwetenschappen, Utrecht, 21 February.

De Baar, H.J.W., T. Van Oijen, M.J.W. Veldhuis & M.A. Van Leeuwe. Carbohydrate production and consumption in phytoplankton subjected to iron fertilisation in the Southern Ocean. 6e Nederlands Aardwetenschappelijk Congres (NAC), Veldhoven, 18-19 April.

De Baar, H.J.W., V. Smetacek & A.J. Watson. Ferrous Fertilization of the Southern Ocean. 6e Nederlands Aardwetenschappelijk Congres (NAC), Veldhoven, 18-19 April.

De Baar, H.J.W., V. Smetacek & A.J. Watson. Ferrous Fertilization of the Southern Ocean. EGS 27th Assembly, Nice, France, 21-26 April.

De Baar, H.J.W., Ferrous Fertilization of the Southern Ocean. Utrechtse Geologen Vereniging, 26 September.

De Baar, H.J.W. Three lectures introductory course marine sciences NEBROC program, NIOZ, Texel, 10 October.

De Baar, H.J.W. Emissions of harmful substances out of the smoke stacks of ships. Marine Environmental Awareness Course for the Maritime Schools, NIOZ. **Texel, November**

De Baar, H.J.W. Objectives of the iron certification excercise. International SCOR-EU-US workshop on results of first pilot study for production and validation of certified standard for iron in seawater. San Francisco, 5 December.

De Bruin, T.F. Antarctic datamanagement in The Netherlands. Annual meeting of the Joint Committee on Antarctic Data Management (JCADM), Shanghai, China, 15 - 19 July.

De Bruin, T.F. JGOFS related datasets in The Netherlands. JGOFS IPO and DMTT Data Management meeting, Ispra, Italy, 28 June.

De Bruin, T.F. The Joint Committee on Antarctic Data Management - Report to SCAR Standing Science Group on Geosciences. SCAR-XXVII, Shanghai, China. 19 July

De Bruin, T.F. The Netherlands national report to the ICES Working Group on Marine Data Management. ICES-WGMDM annual meeting, Helsinki, Finland, 17-19 April.

De Leeuw, J.W. & G.J.M. Versteegh. Zongedreven klimaatverandering. Lezing voor KNAW, Amsterdam, 26 november.

De Leeuw, J.W. Klimaatverandering: wat weten we wel en wat weten we niet? Lezing voor Hogeschool Amsterdam, Amsterdam, 20 November.

De Stigter, H.C., M. White, H. De Haas & T. Van Weering. Hydrography and hydrodynamics of carbonate mounds in the Rockall Trough area. ACES 2nd Annual Workshop, Tjärnö, Sweden, 21-24 March.

De Stigter, H.C., S. Schmidt & T. C.E. Van Weering.The Nazaré Canyon, sediment trap or conduit to the deep sea? Sediment accumulation and transport in the Nazaré Canyon. Canyon Workshop, Sitges, Spain, 8-10 April.

Duineveld, G., M. Lavaleye & H. de Stigter. Whittard canyon and the adjacent continental slope (Goban Spur, NE Atlantic). Sitges, Spain, 8-10 April

Dutz, J. Uptake of transparent exopolymer particles (TEP) by marine copepods. Ocean Sciences Meeting, Honolulu, Hawaii, USA, 11-15 February.

Dutz, J. Effects of inorganic minerals on feeding, egg and fecal pellet production by two marine coastal copepod species. ASLO Summer Meeting, Victoria, Canada, 12 June.

Epping, E. Application and limitation of Liquid Ion eXchange (LIX) sensors in environmental sciences. Microsensor analysis in environmental sciences-workshop, Rønbjerg, Denmark, 27 April - 11 May.

Epping, E. Benthic landers for in situ biogeochemical observations and experiments. Microsensor analysis in environmental sciences-workshop, Rønbjerg, Denmark, 27 April -11 May.

Epping, E. Organic carbon mineralisation in two contrasting coastal marine sediments. Technical University Delft, Kluyver Laboratory, 10 December.

Epping, E. Photosynthesis and the dynamics of oxygen consumption in a microbial mat as calculated from transient oxygen microprofiles.Microsensor analysis in environmental sciences-workshop, Rønbjerg, Denmark, 27 April -11 May.

Epping, E., C. Van der Zee, K. Soetaert & W. Helder. Oxidation and burial of organic carbon in sediments of the Iberian margin and Nazaré Canyon (NE Atlantic). University of Århus, Denmark, 1 May.

Forster, A., M.M.M. Kuypers, L. Bombardiere, P. Farrimond, H. Jenkyns, H. Tsikos & J.S. Sinninghe Damsté. Investigations of enhanced organic matter burial during the Cenomanian/Turonian boundary event and the related positive carbon-isotopic excursion: implications for the OAE 2 for the global carbon cycle? Workshop on Cretaceous Climate and Ocean Dynamics, Florissant, CO, USA, 14-18 September.

Gerkema, T. Metamorphosis of internal tides: reflections on the dual role of the thermocline. EGS 27th General Assembly, Nice, France, 25 April.

Gerkema, T. Modal interaction and decay of internal solitary waves. EGS 27th General Assembly, Nice, France, 24 April.

Haese, R., C. Meile, C. Hensen, J. Werne, J.S. Sinninghe Damsté, P. Van Capellen & G. de Lange. Carbon geochemistry of methane-rich sediments: The significance of anaerobic methane-oxidation and gas hydrate formation. Ocean Sciences Meeting, Hawaii, 11-15 February.

Harlander, U. Die Berechnung des Wetters: Eine Skizze zur Geschichte der numerischen Wettervorhersage. "Physikalisches Kolloquium", University of Leipzig, Germany, 8 November.

Harlander, U. Rossbywellenausbreitung in Ozean und Atmosphaere. "Physikalisches Kolloquium", University of Leipzig, Germany, 10 April.

Harlander, U. Rossbywellenausbreitung: Variationen der klassischen linearen Theorie. Invited talk at the "Physikalisches Kolloquium" of the University of Mainz, Mainz, Germany, 11 July.

Harlander, U. & L.R.M. Maas. Strahlen-Moden-Dualismus: Rossbywellen. Talk at the "Arbeitskreis fuer Theoretische Meteorologie", Innsbruck, Austria, 25-29 September.

Harlander, U. Barriers for neutral Rossby waves in zonal flows. EGS 27th General Assembly, Nice, 22-26 April.

Harlander, U. Rossby waves in zonal flows with pseudo critical levels. AGU, Washington DC, USA, 28-31 May.

Heinrich, H., U. Harlander & W. Metz. Nonlinear forcing of stratospheric planetary waves. EGS 27th General Assembly, Nice, France, 22-26 April.

Herndl, G.J., G. Kramer, M.T. Perez, K.E. Stoderegger & J.M. Arrieta. Bacterioplankton exopolymers and their role in the oceanic DOM cycling. 8th Symposium on Aquatic Microbial Ecology, Taormina, Italy, 25-30 October.

Herndl, G.J. & J.M. Arrieta. A new avenue to link prokaryotic diversity and function: the live separation of complex marine prokaryotic communities by capillary electrophoresis - potential and limitations. Ocean Sciences Meeting, Honolulu, Hawaii, USA, 11-15 February.

Herndl, G.J. Bacterioplankton DOM production: a significant source of new DOM in the ocean? Univ. of Quebec at Montreal, Canada, 24 January.

Herndl, G.J. Bacterioplankton exopolymer production and the oceanic carbon cycling. Univ. of Hamburg, Germany, 22 January.

Herndl, G.J. Microbial ecology. ACCESS meeting, Alfred-Wegener Institute for Marine and Polar Research, Bremerhaven, Germany, 21-23 November.

Herndl, G.J. Sunburn of the ocean: complex interactions between physics, photochemistry and the biota determine the influence of UV on the oceanic carbon flux. Univ. of Quebec at Montreal, Canada, 25 January.

Holmes, S. P. Larval dispersal and panmixia. Port Erin Marine Laboratory seminar series.

Holmes, S. P. Marine invertebrate reproduction and population genetics. TNO seminar series.

Hosegood, P. Ekman-induced turbulence over the continental slope in the Faeroe-Shetland Channel. Buys Ballot Symposium, Nijmegen, 7-8 November.

Jansen, J.H.F. General palaeocenography. NEBROC Course. 9 October.

Jansen, J.H.F. Non-linear 15 ky front movements in the South Atlantic and Southern Ocean. 6e Nederlands Aardwetenschappelijk Congres, Veldhoven, 18-19 April.

Jansen, J.H.F. Paleoceanography of the South Atlantic, continental climates, atmospheric circulation, and connections to Antarctica. International Workshop Linking continental environmental Quaternary history of Southern Africa with ocean currents and Antarctica. Rondebosch, Cape Town, 17 May.

Jansen, J.H.F. Results NEBROC past 4 years, Focus on South Atlantic, Africa (South America) Bremen - NIOZ. NEBROC Delmenhorst, 25 February.

Kolonic, S., B. Beckmann, M. Böttcher, W. Kuhnt., M. Kuypers, G. Scheeder & J.S. Sinninghe Damsté. Organic petrological characterization of Cenomanian/Turonian black shales in the Tarfaya-Layoune Basin (SW Morocco): implications on early sulfurisation of sedimentary organic matter. CSCOP-TSOP Meeting, Banff, Canada, 31 August — 4 September.

Kolonic, S., J.S. Sinninghe Damsté, M. Böttcher, M. Kuypers, W. Kuhnt, B. Beckmann, G. Scheeder & T. Wagner. Geochemical characterisation of Cenomanian/Turonian black shales from the

Tarfaya Basin (SW Morocco): paleoenvironmental controls on early sulfurisation of sedimentary organic matter. AAPG Annual Meeting, Cairo, Egypt, 27-30 October.

Kolonic, S., S.C. Turgeon, H. Tsikos, M.M.M. Kuypers, H. Brumsack, M. Böttcher, El H. Chellai, J.S. Sinninghe Damsté, H. Jenkyns, S. Kasten, W. Kuhnt & T. Wagner. Geochemical characterization of Cenomanian/Turonian black shales from the Tarfaya Basin (SW Morocco): Relationships between palaeoenvironmental conditions and early sulphurization of sedimentary organic matter. CSCOP-TSOP Meeting, Banff, Canada, 31 August - 4 September.

Koning, E. Biogenic silica and diatom species as tracers for paleo-upwelling in a Somalian Margin core. 6e Nederlands Aardwetenschappelijk Congres, Veldhoven, 18-19 April.

Kramer, G.D. & G.J. Herndl. Production and utilization of chromophoric dissolved organic matter (DOM) by marine bacterioplankton. 8th Symposium on Aquatic Microbial Ecology, Taormina, Italy, 25-30 October.

Kuypers, M.M.M., R.D. Pancost, S. Schouten, I.A. Nijenhuis & J.S. Sinninghe Damsté. Mechanisms and biogeochemical implications of the mid-Cretaceous global organic burial events. Invited lecture at the Gordon Conference on Organic Geochemistry, Plymouth, New Hampshire, USA, 28 July — 1 August.

Lassen, S.J., T.O. Richter, H.C. De Stigter, T.C.E. Van Weering & H. De Haas. Holocene millennial-scale surface and bottom water variability, Feni Drift, NE Atlantic Ocean: foraminiferal assemblages. 27th General Assembly of the European Geophysical Society, Nice, France, 21-26 April.

Lavaleye, M., G. Duineveld & H. de Stigter. Report about the ACES results at the Galicia Bank. ACES annual workshop, Tjarno, Sweden, 21-24 March.

Lavaleye, M.S.S. The macrofauna of Roebuck Bay. Landscope expedition, Broome Bird Observatory, Broome, Western Australia, 8 June.

Lavaleye, M.S.S. The macrofauna of Roebuck Bay. Celebration of the Bay conference, Broome, Western Australia, 9 June.

Lavaleye, M.S.S. Marine habitats: Deep seas. NEBROC-ECOLMAS, introductory course in marine sciences. NIOZ, 17 October.

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

Maas, L.R.M. Wave attractors due to symmetry breaking in stratified and/or rotating fluids. Université Joseph Fourier, Grenoble, France, 28 February.

Maas, L.R.M. A simplified model for rotating, inviscid laterally-driven convection. University Utrecht, 20 September.

Maas, L.R.M. On wave attractors in stratified and/or rotating fluids. Conference on mathematical theory and modelling in atmosphere-ocean science, Oberwolfach, Germany, 22 August.

Maas, L.R.M. On wave attractors in stratified and/or rotating media. INTAS-project kick-off meeting, University of Oslo, 4 October.

Manders, A.M.M. & L.R.M. Maas. 3-D Behaviour of an inertial wave attractor in a rectangular tank with a sloping boundary. AGU, Washington DC, USA, 28-31 May.

Manders, A.M.M. & L.R.M. Maas. Spatial behaviour of an inertial wave attractor in a rectangular tank with a sloping boundary. EGS 27th General Assembly, Nice, 22-26 April.

Manders, A.M.M., T. Gerkema, L.R.M. Maas & H. Ridderinkhof. Internal waves in the Mozambique Channel. EGS 27th General Assembly, Nice, 22-26 April.

Menzel, D., P.F. Van Bergen, E.C. Hopmans, S. Schouten & J.S. Sinninghe Damsté (2001). Palaeoenvironmental Indications of Enhanced Primary Productivity during Pliocene Sapropel Formation. AGU Fall Meeting, San Francisco, USA, 10-14 December 2001.

Ober, S., R.L. Groenewegen, H.J. Boekel, E.J.H. Keijzer, J.D.J. Derksen & M. Laan. A new way of oceanographic watersampling. Inmartech conference, JAMSTEC, Yokosuka, Japan, 8 October.

Pancost, R.D., A. Esser, B. Van Dongen, H. Morgans-Bell, J.S. Sinninghe Damsté & H.C. Jenkyns. Organic-matter source variation and its impact on organic-carbon preservation in the Kimmeridge Clay Formation (Upper Jurassic, Dorset, southern England); Invited talk at the Geological Society of London Meeting on Organic-carbon burial, climate change and ocean chemistry (Mesozoic-Paleogene), London, UK, 9 —11 December.

Philippart, C.J.M. & E. Veerman. Darwin op het wad: hoe doe je dat? Meimaand-Natuurmaand, OSG, Texel, 24 May.

Philippart, C.J.M. & R. Dekker. Tidal flats: there is more to mud than meets the eye. NEBROC Course, Texel, 17 October.

Philippart, C.J.M. Shellfish and climate. Lecture work visit DLO-PPO, NIOZ, Texel, 3 September.

Philippart, C.J.M. Surviving on a mudflat. Probus lecture, Gouda, 6 November.

Philippart, C.J.M., G.C. Cadée, W. van Raaphorst & R. Riegman. Nutrient budgets of the western Wadden Sea. ICES-RIKZ Eutrophication Workshop, The Hague, 11-13 March.

Philippart, C.J.M. Prioriteit Thema 2: Dynamiek van schelpdierbestanden in een geëxploiteerd marien ecosysteem. NWO-Prioriteit Symposium, The Hague, 22 October.

Philippart, C.J.M., H.M. van Aken, J.J. Beukema, O.G. Bos, G.C. Cadée & R. Dekker. Recruitment in intertidal shellfish. Alterra Lunch lecture, Texel, 29 October.

Piersma, T. 'Coastal' versus 'inland' shorebird species: interlinked fundamental dichotomies between their life- and demographic histories? Seminar Centre for Ecological and Evolutionary Studies, University of Groningen, Haren, 6 November.

Piersma, T. Bird eye's view of modern biology. Invited lecture in Course Orientation on Biology and Society, University of Groningen, 18 December.

Piersma, T. Comparative flyway studies in Red Knots. Jahresversammlung Deutsche Ornithologen Gesellschaft, Münster, Germany, 28 September.

Piersma, T. Dispersal and migration. Lecture for undergraduate course on 'Experimental ecology', Centre for Ecological and Evolutionary Studies, University of Groningen, 26 March.

Piersma, T. Fuel storage rates before northward flights in Red Knots world-wide: evidence for environmentally induced constraints? Smithsonian Institute symposium 'Birds of Two worlds', Washington, D.C., USA, 8 March.

Piersma, T. Fuel storage rates before northward flights in Red Knots world-wide: relation with intertidal benthic food resources. NIOZ Colloquium, Texel, 8 May.

Piersma, T. Human disturbance of foodweb structure in the Dutch Wadden Sea. Invited Evening Lecture, European Science Foundation Exploratory Workshop 'Trophic interactions in a changing world', Texel, 5 April.

Piersma, T. Introduction to the ecology of Roebuck Bay and the science done here. Day of the Bay, Community Hall, Broome, Austalia, 9 June.

Piersma, T. Migrating waterbirds as integrators of global environmental information. BOU/ECSA Conference 'Climate change and coastal birds', University of Hull, U.K., 23 March.

Piersma, T. Shorebirds between tundra and equator: a complex interaction between habitat and bird. Lecture for course Integrative Water Management, University of Antwerp, Belgium, 17 April.

Piersma, T. Summary of Day of the Bay. Community Hall, Broome, Australia, 9 June.

Piersma, T. The changing foodweb of the Wadden Sea and the role of humans. Lecture for training workshop of teachers at Van Hall Institute - Leeuwarden, NIOZ, Texel, 6 May.

Piersma, T. The story of the Red Knot. Lecture for undergraduate course on 'Experimental ecology', Centre for Ecological and Evolutionary Studies, University of Groningen, 26 March.

Polunin, N.V.C. & I.D. Williams. Grazer clues to reversing phase shifts on Caribbean reefs. International Society for Reef Studies (ISRS) European Meeting, 15 September.

Queguiner, B., R.T. Barber, S. Blain, P.W. Boyd, M.A. Brzezinski, H.J. De Baar, V.M. Franck, D.M. Nelson, D.A. Hutchins, P.N. Sedwick, K.R. Timmermans & P. Tréguer. Bottom-up control of primary production in the Southern Ocean: the co-limitation question with regard to the availability of Fe, Si, and light. Ocean Sciences Meeting, Honolulu, Hawaii, 11-15 February.

Reinthaler, T. & G.J. Herndl. Seasonal dynamics of organic carbon remineralization by heterotrophic bacteria in the southern North Sea. 8th Symposium on Aquatic Microbial Ecology, Taormina, Italy, 25-30 October.

Reneerkens, J. & T. Piersma. Food for birds in the Wadden Sea, and recent developments. European Spoonbill Workshop, Texel, 21 April.

Reneerkens, J., T. Piersma & J.S. Sinninghe Damsté, Make-up in migratory shorebirds? Adaptive value of seasonal variation in preen waxes. Symposium presentation. 23rd International Ornithological Congress, Beijing, China, 12 August.

Richter, T.O., S.J. Lassen, H.C. De Stigter, T.C.E. Van Weering & H. De Haas. Holocene millennial-scale surface and bottom water variability, Feni Drift, NE Atlantic Ocean: Carbonate record and bottom current strength. Abstract and oral presentation 27th General Assembly of the European Geophysical Society, Nice, France, 21-26 April.

Ridderinkhof, H. Dutch activities in the south west Indian ocean. Zaanlands Lyceum, Zaandam, 9 December.

Ridderinkhof, H. First results from an array of current meter moorings in the Mozambique Channel. University of Cape Town, Cape Town, 27 March.

Ridderinkhof, H. Moored current observations in the Mozambique Channel. Utrecht University, 30 May.

Scheffers, S.R., G. Nieuwland, R.P.M. Bak & F.C. van Duyl. Bacterial removal and nutrient dynamics within the coral reef framework. Symposium of the International Society for Reef Studies (ISRS), Cambridge, UK, 5 September.

Schefuß, E., J.H.F. Jansen, S. Schouten & J.S. Sinninghe Damsté. Advances in tracing sea surface temperatures, marine productivity and vegetation changes with organic proxies. Gordon Research Conference on Chemical Oceanography, Oxford, Britain, 11-16 August.

Schefuß, E., J.H.F. Jansen, S. Schouten & J.S. Sinninghe Damsté. Advances in tracing sea surface temperatures, marine productivity and vegetation changes with organic proxies. Gordon Research Conference on Chemical Oceanography, Oxford, Britain, 11-16 August.

Schmidt, S., H.C. De Stigter & T.C.E. Van Weering. Short-term sediment dynamics in canyon: example of the Nazaré Canyon, North-East Atlantic. Abstract and oral presentation Canyon Workshop, Sitges, Spain, 8-10 April.

Schouten, S. & M. Kienhuis. Isotopic measurements of carbonates and dissolved inorganic carbon. Benelux IRM Users Meeting, Groningen, 7-8 March.

Schouten, S., E.C. Hopmans, E. Schefuß & J.S. Sinninghe Damsté. New organic proxies based on archaeal biomarkers. EGS XXVII General Assembly, Nice, France, 21-26 April.

Schouten, S., E.C. Hopmans & J.S. Sinninghe Damsté. A new organic paleothermometer for the mid Cretaceous greenhouse-world. Gordon Research Conference Organic Geochemistry, Holderness, N.H., USA, 29 July-2 August.

Schouten, S., E.C. Hopmans & J.S. Sinninghe Damsté. An organic paleothermometer for sea surface temperatures during the mid Cretaceous. Cretaceous Black Shale meeting, Colorado, USA, 15-19 July.

Schouten, S., E.C. Hopmans & J.S. Sinninghe Damsté. Geochemical and environmental importance of marine archaea. Geochemistry seminar, University of Utrecht, 4 April and 6th Conference Geochemistry of the Earth, Hawaii, USA, 20-24 May.

Schouten, S., E.C. Hopmans, E. Schefuss, C. Wuchter & J.S. Sinninghe Damsté. A new organic SST proxy based on archaeal lipids. EGS, Nice, France, 22-26 April.

Sinninghe Damsté, J.S. Application of chemical fossils in biogeology. Talk for the Biogeology committee, KNAW, 21 May.

Sinninghe Damsté, J.S. Moleculaire Fossielen: Sleutels tot Evolutie en Biogeochemische Kringlopen. Invited lecture at the Biogeology symposium, KNAW, 11 October.

Sinninghe Damsté, J.S. Non-extreme archaea in the ocean. Invited lecture at the University of Wageningen, 10 October.

Sinninghe Damsté, J.S. Organic geochemistry and ODP/IODP. Lecture at the IODP symposium, University of Utrecht, 4 April.

Sinninghe Damsté, J.S., B. Van Dongen & S. Schouten Preservation of carbohydrate carbon through sulfurisation resulted in deposition of the extremely TOC-enriched Kimmeridge Blackstone Band. Invited lecture at the Geological Society of London Meeting on Organic-Carbon Burial, Climate Change and Ocean Chemistry (Mesozoic-Paleogene), London, UK, 9-11 December.

Sinninghe Damsté, J.S., S. Schouten, S. Rampen, B. Abbas & G. Muyzer. Age-diagnostic biomarkers of diatoms: An alternative approach using lipid and ribosomal RNA analyses. Invited lecture at the Gordon Conference on Organic Geochemistry, Plymouth New Hampshire, USA, 28 July — 1 August.

Smittenberg, R.H., E.C. Hopmans, S. Schouten, J.H. Hayes, T.I. Eglinton, M.J. Whiticar & J.S. Sinninghe Damsté. Validation of compound specific ^{14}C dating using the varved sediment of Saanich Inlet, Canada. Paleoceanographic seminar series, Department of Geology and Geophysics, Woods Hole Oceanographic Institution, MA, USA, 17 January.

Stadnitskaia, A., J.P. Werne, J.S. Sinninghe Damsté, M. Baas, E. Hopmans, M.K. Ivanov & T.C.E. Van Weering. Distribution and stable carbon isotopic composition of biomarkers in seep carbonate crusts. The Sorokin Trough, NE Black Sea: Preliminary. International conference and tenth post-cruise meeting of the Training-Through-Research programme. Aveiro, Portugal, 30 January-2 February.

Stadnitskaia, A., J.S. Sinninghe Damsté, I. Belenkaia, C. Pierre & J.P. Werne. Methane-related authigenic carbonate formation: Molecular, mineralogical and isotopic evidence. The gulf of Cadiz, NE Atlantic. International conference and tenth post-cruise meeting of the Training-Through-Research programme. Aveiro, Portugal, 30 January-2 February.

Stadnitskaia, A. Hydrocarbon gases and lipids from sediments related to submarine fluid discharge, the Sorokin Trough, NE Black Sea. Workshop on methane fluxes in the ocean margin sediments: microbiological and geochemical control. Max Planck Institue for Marine Microbiology, Bremen, Germany, 10-12 December.

Stoderegger, K.E. & G.J. Herndl. Assessment of bacterial cell surface properties in bacterial cultures. 8th Symposium on Aquatic Microbial Ecology, Taormina, Italy, 25-30 October.

Strous, M., J. Fuerst, J.S. Sinninghe Damsté, M. Wagner & M.S.M. Jetten. Energy conservation and ultrastructure in anammox Meeting on the physiology, regulation and biochemistry of electron transfer in microbial catabolism, Terschelling, 9 April.

Strous, M., J. Fuerst, J.S. Sinninghe Damsté, M. Wagner & M.S.M. Jetten. Biodiversity and genomics of anaerobic ammonium oxidation. C1-Gordon, Connecticut college, USA, 8 July.

Strous, M., J. Fuerst, J.S. Sinninghe Damsté, M. Wagner & M.S.M. Jetten. Anaerobic ammonium oxidation - a missing link with global impact. Biodiversity Course, MBL, Woods Hole Oceanographic Institution, MA, USA, 15 July.

Strous, M., J. Fuerst, J.S. Sinninghe Damsté, M. Wagner & M.S.M. Jetten. Anaerobic ammonium oxidation - a missed link with global impact. Wageningen University, 12 September.

Strous, M., J. Fuerst, J.S. Sinninghe Damsté, M. Wagner & M.S.M. Jetten. Anaerobic ammonium oxidation - a missed link with global impact. Universiteit Utrecht, 28 November.

Stuut, J.-B.W. Late Quaternary climate variability in SW Africa: grain size of terrigenous sediments from Walvis Ridge and Walvis Slope as a proxy for wind strength and aridity. 6e Nederlands Aardwetenschappelijk Congres, Veldhoven, 18-19 April.

Teira, E., J. Abalde, M.T. Álvarez-Ossorio, A. Bode, C. Cariño, A. Cid, E. Fernández, N. González, J. Lorenzo, J. Valencia & M. Varela. Planktonic carbon budget in a coastal wind-driven

upwelling system (NW Iberian Peninsula). 8th Symposium on Aquatic Microbial Ecology, Taormina, Italy, 25-30 October.

Ten Hallers-Tjabbes, C.C. A Case Study in Communicating Science: TBT and Global Decision Processes. Submitted by the World Conservation Union (IUCN) at the London Convention Scientific Group - 25th Meeting. 27 — 31 May 2002, Document LC/SG 25/9

Ten Hallers-Tjabbes, C.C. Antifouling, TBT and the marine environment. Lecture at Environment awareness course, NIOZ, 13 March, 6 November and 19 November.

Ten Hallers-Tjabbes, C.C. A case study in communicating science to raise awareness of impact of TBT in relation to global decision processes. Science Day of London Convention Scientific Group - 25th Meeting. 27 — 31 May.

Ten Hallers-Tjabbes, C.C. Environmental impact of TBT-antifouling. Workshop on Marine Pollution Prevention and Environmental Management in Ports in the Wider Caribbean Region. UNEP-IMO workshop, Ocho Rios, Jamaica, 20-24 May.

Terra, G.M. Experiments on an idealized cooscillating tidal basin. Buys Ballot-symposium, Berg en Dal, 6-8 November.

Thomas, H. & Y. Bozec. The continental shelf pump hypothesis — a case study in the North Sea. EGS 27th General Assembly, Nice, France, 22-26 April.

Thomas, H., J. Pempkowiak, F. Wulff, K. Nagel, Y. Bozec, H.J.W. De Baar, K. Elkalay, M. Frankignoulle, W. Kühn, H. Lenhart, A. Moll, J. Pätsch, G. Radach, L.-S. Schiettecatte & A. Borges. CO_2 supply from the North Sea and the Baltic Sea to the North Atlantic Ocean — evidence for the continental shelf pump. University of California Los Angeles, Los Angeles, USA, 4 December.

Thomas, H., J. Pempkowiak, F. Wulff, K. Nagel, Y. Bozec, H.J.W. De Baar, K. Elkalay, M. Frankignoulle, W. Kühn, H. Lenhart, A. Moll, J. Pätsch, G. Radach, L.-S. Schiettecatte & A. Borges. CO_2 supply from the North Sea and the Baltic Sea to the North Atlantic Ocean — evidence for the continental shelf pump. AGU Fall meeting, San Francisco, USA., 6-10 December.

Vahl, W.K. Foraging and Interference. Lecture course Experimental Ecology, University of Groningen, Haren. 25 March.

Vahl, W.K. Interference competition in waders. Max Planck Institute, Plön, Germany, 4 April.

Vahl, W.K. Interference competition in waders: an experimental approach. EGI Conference, Edward Grey Institute for Ornithology, Oxford, 2 - 5 January.

Vahl, W.K. Interference competition in waders: an experimental approach. Verweij Dagen, Graduate School Functional Ecology, Texel. 28 — 29 January.

Van Bennekom, A.J. La fondation du station de la biologie marine dans les Pays Bas, un cas special dans L'Europe. Marine laboratory of Tamaris, 19 September.

Van Bleijswijk, J., & G. Muyzer. Genetic diversity of oxygenic phototrophs in microbial mats exposed to different levels of oil pollution. MATBIOPOL Meeting, Barcelona, 12-16 February.

Van Breugel, Y., S. Schouten, E. Erba & J. S. Sinninghe Damsté. Biogeochemistry of the Aptian Selli Event: Examination of the negative carbon isotope spike. 223rd ACS National Meeting, Orlando, Florida, USA, 7-11 April.

Van Den Bergh, G.D. Recent sediments and sedimentation in the Red River Delta. Red River Delta Final Workshop, Hanoi, Vietnam, 23-26 July.

Van der Veer, H.W. Body size scaling relationships in flatfish as predicted by dynamic energy budgets (DEB theory). 5th International Symposium on Flatfish Ecology, Douglas, Isle of Man, 3 — 7 November.

Van Dongen, B.E., S. Schouten & J.S. Sinninghe Damsté. Enhanced preservation of organic matter in the Kimmeridge clay formation through natural sulfurization of carbohydrates. Nederlands Aardwetenschappelijk Congres (NAC), Veldhoven, 18-19 April.

Van Duyl, F.C., S.R. Scheffers, M. Driscoll & F.I.M. Thomas. Inorganic nutrient cycling in cryptic habitats on coral reefs. Symposium of the International Society for Reef Studies (ISRS), Cambridge, UK, 5 September.

Van Haren, H. Deep-ocean internal wave spectra. EGS 27th General assembly, Nice, France, 22-26 April.

Van Haren, H. The hydrography of the North Sea. CANOBA workshop, NIOZ, 23-24 October.

Van Oijen, T.; M.J.W. Veldhuis, M.A. Van Leeuwe & H.J.W. De Baar. Carbohydrate production and consumption in phytoplankton subjected to iron fertilisation in the Southern Ocean. EGS 27th Assembly, Nice, France, 21-26 April.

Van Veldhoven, A.K., H.M. van Aken, C. Veth. Observations of a young Agulhas ring, during MARE. EGS 27th General assembly, Nice, France 22-26 April.

Van Weering, T.C.E. Carbonate mounds at the SW and SE Rockall Trough Margins, NE Atlantic Ocean. University of Tubingen, 14-15 February.

Van Weering, T.C.E. Carbonate mounds in Margin settings- is the present the key to the past? Symposium on occasion of retirement of W.W. Hay, Geomar, Kiel, 18 December.

Van Weering, T.C.E. Karbonaten van de diepzee; koudwater koraalriffen langs de NE continentale helling. Studievereniging GVA, Amsterdam. 13 December.

Veldhuis, M.J.W. Detecting (living) particles in ballast water. Ballast water Workshop, Royal Haskoning, Rotterdam, 26 November.

Veldhuis, M.J.W. & C. Brussaard. Growth dynamics in Phaeocystis globosa. Meeting of SCOR-WG 120, Marine Phytoplankton and Global Climate Regulation: The Phaeocystis spp. cluster as a model. University of East Anglia (UEA), Norwich, UK, 7-9 March.

Veldhuis, M.J.W. Analysis of free living particles in the pelagic system applying flow cytometry. Institute of Oceanography and Fisheries, Split, Croatia, 2 December.

Veldhuis, M.J.W. Growth and mortality in harmful algae blooms. NSF-EU workshop on HABs. Trieste, Italy, 4-9 September.

Veldhuis, M.J.W. Phytoplankton: a unique type of particles in the ocean: potential and limitation of their fluorescence properties. Analysis of single cells in the marine phytoplankton. Alfred-Wegener Institute for Marine and Polar Research, Bremerhaven, Bremerhaven, Germany, 15-21 April.

Veldhuis, M.J.W. Single cell particle-analysis in the ocean: does it result in new insights? Laboratory of Ecophysiology, Stazione Zoologica "A. Dohrn", Naples, Italy, 1 March.

Veldhuis, M.J.W. The advantage of living in a colony: a case study. First regional conference on the ecology and impact assessment of Phaeocystis blooms in the Eastern Channel and Southern Bight of the North Sea. Oostende, Belgium, 27-29 November.

Volkov, D. Annual and inter-annual variability of the sea level in the northern North Atlantic Ocean. EGS 27th General assembly, Nice, France, 22-26 April.

Volkov, D. Low frequency change of the sea level in the North Atlantic. International workshop on satellite altimetry. Wuhan, China, 8-15 September.

Wagner, T., B. Beckmann, S. Flögel, P. Hofmann & J.S. Sinninghe Damsté. Coniacian-Santonian (OAE3) black shale formation and African climate variability: a reference section from the eastern tropical Atlantic at orbital time scales (ODP Site 959, off Ivory Coast/Ghana). Conference on Cretaceous Climate and Ocean Circulation, Florissant, Colorado, USA, 14-17 July.

Wernand, M.R. Guidelines for ship-borne auto-monitoring of coastal and ocean color. Ocean optics XVI conference, Santa Fe, USA, 18-22 November.

Wernand, M.R. Who is afraid of blue, yellow and red. Dealing with marine optics and remote sensing. University of Oldenburg, Oldenburg, Germany, 10 June.

Werne, J., T. Lyons, D.J. Hollander & J.S. Sinninghe Damsté. Compound specific sulfur isotope constraints on organic sulfur formation. Invited presentation at the Minnestota Mass Spectrometry Group Meeting, Duluth, MN, USA, 13 September.

Werne, J., T. Lyons, D.J. Hollander & J.S. Sinninghe Damsté. Compound specific sulfur isotope constraints on organic sulfur formation. Invited presentation, University of Minnesota Quaternary Paleoecology seminar series, St. Paul, MN, USA, 3 April.

Werne, J., T. Lyons, D.J. Hollander & J.S. Sinninghe Damsté. Reduced sulfur in euxinic sediments of the Cariaco Basin: Sulfur isotope constraints on organic sulfur formation. Ocean Sciences Meeting, Hawaii, 11-15 February.

Werne, J., T. Lyons, D.J. Hollander & J.S. Sinninghe Damsté. Compound specific sulfur isotope constraints on organic sulfur formation. Invited presentation, Dept. of Chemistry seminar series, Winona State University, Winona, MN, USA, 6 December.

Werne, J.P., D.J. Hollander, T.W. Lyons & J.S. Sinninghe Damsté. Linking organic sulfur to inorganic sedimentary sulfur, microbial processes, and global cycles. Invited presentation at the GSA Fall Meeting, Denver, USA, 26-30 October.

West, S. Surface water conditions in the Northern Benguela region (SE Atlantic) during the last 450 ky reconstructed from assemblages of planktonic foraminifera. 6e Nederlands Aardwetenschappelijk Congres, Veldhoven, 18-19 April.

Winter, C. Bacteriophages and their role in controlling bacterioplankton abundance and diversity. Colloquium, Max Planck Institute for Limnology, Plön, Germany, 28 November.

Winter, C., A. Smit, G.J. Herndl & M.G. Weinbauer. Do bacteriophage influence species richness of prokaryotic communities? Voorjaarsvergadering Nederlandse Vereniging voor Medische Microbiologie, Papendal, Arnhem, 9-10 April.

Winter, C., A. Smit, T. Szoeke-Dénes, G.J. Herndl & M.G. Weinbauer. Temporal dynamics of viral infection of bacterioplankton in the North Sea. Verwey-Meeting, NIOZ, 28 January.

Winter, C., A. Smit, T. Szoeke-Dénes, G.J. Herndl & M.G. Weinbauer. Temporal dynamics of viral infection of bacterioplankton in the North Sea. Ocean Sciences Meeting, Honolulu, Hawaii, 11-15 February.

Winter, C., A. Smit, T. Szoeke-Dénes, G.J. Herndl & M.G. Weinbauer. Modeling temporal dynamics of viral infection of bacterioplankton using artificial neural network methodology. 8th Symposium on Aquatic Microbial Ecology, Taormina, Italy, 25-29 October.

EXTERNAL PROFESSIONAL FUNCTIONS

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

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

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.P. Boon
- member ICES Marine Chemistry Working Group
- Member "commissie voor de milieu-effect rapportage (CMER)".
- Member of the committee 'Maximum allowable concentrations of PCBs in soil and sediment' of the Dutch Health Council (Gezondheidsraad).
- Member of the reading committee and opponent for the Ph.D thesis "Pyrene metabolites in isopods (Crustacea) as biomarker for PAH exposure in terrestrial ecosystems" of G.J. Stroomberg (Institute for Environmental Sciences, Free University (VU) Amsterdam). Promotion at the 26th September.

T.F. de Bruin
- secretary National Oceanographic Data Committee (NODC)
- Deputy Chief Officer - Joint Committee on Antarctic Data Management

G.J.A. Brummer
- Coordinator "Divalent cations: development and validation of proxy relationships" (NWO/DFG)
- Member NWO/ALW 'Gebruikers-adviesgroep verankerde systemen'
- External advisor EuroClimate-EuroCores (ESF)
- External examiner University of Edinburgh, Scotland, UK

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

C.J. Camphuysen
- board member Dutch Seabird Group (NZG), section Netherlands Ornithologists' Union (NOU)
- editor Atlantic Seabirds
- editor and secretary editorial team Ardea
- member editorial board Marine Ornithology
- co-ordinator Dutch beached bird survey (NZG/NSO)
- member ICES Working Group on Seabird ecology (WGSE)
- chairman European Seabirds At Sea Database co-ordinating group (ESASD)
- member Scientific Panel Sustainable Ecosystems Institute, Oregon
- consultant, Camphuysen Seabird Research (CSR Consultancy)
- Member MINOS Beirat (Tönning, Germany)

R. Daan
- member workinggroup 'Monitoring rond Mijnbouwinstallaties'

H.J.W. De Baar

- Professor of oceanography, University of Groningen
- Associate editor Marine Chemistry
- Member, SCOR Working Group 109 Biogeochemistry of Iron in Seawater
- Life Member Clare Hall College, Cambridge
- Chairman, Panel 3 (Ocean and Atmosphere Sciences) of NWO/ALW open competition
- Chairman, Netherlands SCOR Committee of Royal Academy of Sciences (KNAW)
- Chairman, Netherlands Task Group on international SOLAS program of SCOR
- Member, Scientific Steering Committee Netherlands-Bremen Oceanography (NEBROC)
- Member, MAB/SCOPE/IGBP Committee of Royal Netherlands Academy of Sciences (KNAW)
- External adviser BELCANTO (Belgian research Carbon uptake in the ANTarctic Ocean)
- Coordinator, Iron Resources and Oceanic Nutrients - Advancement of Global Environment Simulations (IRONAGES, EU FP 5 Climate key action)

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

G.C.A. Duineveld

- member ICES Benthos Ecology working group

W. Helder

- chairman " Gebruikers Advies groep (GAG-ALW) Auto-analysers" (NWO)
- member Steering Committee UK-NERC programme Benthic Boundaries (BENBO)
- chairman ALW-apparatuur committee

G.J. Herndl

- Professor, biological oceanography, RUG
- editor of Aquatic Microbial Ecology
- member of the editorial board of Marine Ecology
- member of the scientific committee of NEBROC
- Coordinator of the EU project COMET
- Appointed reviewer for the Norwegian Science Foundation for Aquatic and Terrestrial Microbiology and Biotechnology
- Member of the Nominating Committee of the ASLO
- Chair of the Microbial Ecology Section of CIESM

J.H.F. Jansen

- member Scientific Committee IGBP-PAGES-IMAGES 2 (The Intern. Marine Past Global Change Study)
- Member NOC (Nederlandse Ocean Drilling Program Committee)

W.C.M. Klein Breteler

- member users group Quantimet (Image Analysis)

H.J. Lindeboom

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

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

M. Mulder
- member workinggroup 'Monitoring rond Mijnbouwinstallaties'

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

C.J.M. Philippart
- editor-in-chief Journal of Sea Research
- coordinator NWO project "Temporal scales of sustainable use of marine ecosystems"

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

H. Ridderinkhof
- member "programmacommissie NCK"
- member Committee `Milieueffectrapportage'
- member 'Beleidsadviescommissie Aardwetenschappen ALW'
- member EUROGOOS-NL

M.J. Rietveld
- member and secretary 'International research Ship Operators Meeting' (ISOM)
- member Marine Facilities Tripartite Group (MFTG)
- member European Research vessel Operators (ERVO)
- member ESF working group on high sea research fleets

J.S. Sinninghe Damsté
- associate scientist University of Utrecht, faculty of Earth Sciences
- associate editor Organic Geochemistry
- Session convenor Gordon Conference on Organic Geochemistry
- Member of the Klankadviesgroep Euromargins
- Co-ordinator of EC Network C/T-Net

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

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

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

A.J. Van Bennekom
- member 'Deutsche Arbeits Kreis Geschichte der Meeresforschung'

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

H. van Haren
- Guest-editor J. Sea Research special issue on 'Processes of vertical exchange in shelf seas' (PROVESS).
- Convenor 27th General Assembly EGS session OA4'Internal waves in deep ocean and shelf seas'.

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

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

W. Van Raaphorst
- member Dutch LOICZ commission
- editor Journal of Sea Research
- member SCOR working group 114 on permeable sediments
- member NWO/ALW "gebruikers advies groep geoapparatuur"
- member NWO/ALW programme-commission Dutch-Flemish cooperation
- member "Raad van toezicht" IPO-LOICZ

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

M.J.W. Veldhuis
- Coordinator of the EU project BIOHAB
- member working group JGOFS-NL
- member advisory board SARSIA
- associate member SCOR working group 120: Phaeocystis

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

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

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

Course marine ecosystems (RUG), 10-28 June. During the first week lectures were given at RUG on the ecological provinces of the world's oceans in general and the North Sea in particular. The second and the third week were devoted to practical work at NIOZ, particularly in the BIO and MEE. The program comprised research on the metabolism of selected benthic organisms and pelagic communities. Sampling was performed in the North and Wadden Sea with the R/V Navicula.

Introductory course in the "Marine Biology" for UU, 11-15 November. In this course, organized by BIO and MEE, the students were introduced to the fauna and flora of the intertidal and subtidal sediments and the water column. Simple experiments on the metabolic activity of selected organisms were performed also. At the end of the course the students presented their work in brief lectures followed by a general discussion.

Thomas, H. CANOBA/North Sea workshop 23-24 October

Gerkema, T. Geophysical fluid dynamics, NEBROC-course, NIOZ, 7 October.

Verwey days, 28-29 January. Contact person at NIOZ: Dr. Jaap van der Meer.

Marine Environmental Awareness (MarEnA) Courses for the Dutch Maritime Schools for figher Professional Education in Amsterdam (HvA-IMT), Rotterdam (HRO), Vlissingen (Hogeschool Zeeland) and Terschelling (Maritime Institute Willem Barentsz). Three courses were given in 2002, one of them being the l International course, allowing for the participation of foreign maritime professionals. These courses are organized jointly by Royal NIOZ and EcoMare, and are funded by the ProSea foundation. Course dates: 11-14 March, 4-7 November, and 18-21 November. Contact persons at NIOZ: Dr. J.P. Boon and drs. M.H. Bik.

Vrije Universiteit Amsterdam, faculty Biology and Earth Sciences. Course organized by Dr. R. Thijssen. 23-29 September.

Photo: Bert Aggenbach.

NEBROC-ECOLMAS introductory course in marine sciences. As part of the established international NEBROC (Netherlands-Bremen Oceanography) co-operation in marine sciences between Royal NIOZ and four institutions in Bremen-Germany (Alfred Wegenr Institute for Polar and Marine Sciences, the University of Bremen, the Max Planck Institute for Merobiology (MPI), and the Centre for Marine Tropical Ecology (ZMT), a two week course is given each year. This course introduces Ph.D. students to a wide field of marine sciences. Contact persons at NIOZ: Dr. J.P. Boon and ms. A. Markesteyn. Course dates: 7-18 October.

Ph.D. days of the Research School 'Biodiversity'. The Ph.D. students of this Research School presented their work to each other and their supervisors. Contact person at NIOZ: Prof. dr. R.P.M. Bak. Dates: 9-10 December.

The course Introduction to Oceanography is part of the Marine Biology curriculum at the University of Groningen (RUG) and was attended by 23 students majoring marine biology. H.J.W. de Baar at RUG gave the introductory lectures at Groningen from 11-18 February. This

was followed by a suite of practical projects at NIOZ from 19 February to 5 March. This included field work at the tidal flats and aboard RV Navicula in the Wadden Sea and the North Sea. For the first time the practical course was set up into two integrated themes, one focusing on the biogeochemistry of the semi-enclosed Mok Bay, the other on estuarine mixing and processes in the open Wadden Sea. This was very successful for the Mok Bay theme, while there still is some room for further integration of the open Wadden Sea theme. P. Laan served as overall coordinator of the practical course at NIOZ. The enthusiasm and commitment of a great number of NIOZ scientific and supporting staff once again was the key to an overall very stimulating course. (Contact person: H.J.W. de Baar).

3. Guest scientists, visitors and students

The NIOZ Guest house. Photo: B. Aggenbach

GUEST SCIENTISTS

- Björn-van Praagh, H. , University of Lund, Sweden.
- Bombardiere, L. (20-1-02 — 29-1-02)
- Kolonic, S., University of Bremen, Germany.
- Koski, M., Finnish Institute of Marine Research, Helsinki, Finland, 1 January-31 June
- Mayo Enriquez, I., Laboratorio de Oceanografia Biologica, Universidad de Las Palmas de Gran Canaria, Las Palmas, Spain, 1 January — 30 May
- Mendes, L. Department of Zoology, University of Lisboa, Portugal (1 January - 31 December)
- Menzel, D., University of Utrecht.
- Pausz, C., University of Vienna, Austria, 1 January- 31 July
- Perez, M. Centre de Recherche en Ecologie Marine et Aquaculture (CREMA-CNRS), L'Houmeau, France, 15 July- 3 August, 17 November — 3 December
- Sprangers, M., UU
- Stoderegger, K., University of Vienna, Austria, 1 January- 31 October
- Tsikos, H., University of Oxford
- Van Bergen, P., University of Utrecht.
- Varela, M., Instituto Español de Oceanografia, A Coruña, Spain, 15 October — 15 December
- Wagner, T., University of Bremen
- Wakeham, S., Skideway Institute of Oceanography, Savannah, USA.
- Wolters, H. Alfred-Wegener Institute for Polar and Marine Research, Bremerhaven, 1 July- 3 September

VISITORS

- Baker, A.J. Royal Ontario Museum and University of Toronto, Toronto, Canada
- Bickert, T., Fachbereich GeowissenschaftenUniversity Bremen, Germany.
- Bijma, J., Carbon Group, AWI, Bremerhaven, Germany
- Boyd, H. Canadian Wildlife Service, Ottawa, Canada
- Corvaisier, R., Institut Universitaire Européen de la Mer, Brest, France
- Forster, S., Institute for Baltic Research, Warnemünde, Germany
- Fuller, R., British Trust for Ornithology, Thetford, UK
- Furnes, G., University of Brergen, Norway
- Gillings, S. British Trust for Ornithology, Thetford, UK
- Hibiya, T., University of Tokyo, Japan
- Karasov, W.H. University of Wisconsin, Madison, WI, USA
- Kuijpers, Dr. A., Geological Survey of Denmark, Copenhagen.
- Marinov, S. Institute of Oceanography and Fisheries, Split, Croatia
- Nagasawa, M., University of Tokyo, Japan
- Niwa, Y., University of Tokyo, Japan
- Post, Prof. A., Department of Marine Microbiology, Interuniversity Institute of Marine Science. Eilat, Israel
- Rocha, C., University of Algarve, Faro, Portugal
- Schneider, Dr R.R., Fachbereich GeowissenschaftenUniversity Bremen, Germany.
- Serizawa, N., Tsurumi Seiki Company, Japan
- Solic, Dr. M., Institute of Oceanography and Fisheries, Split, Croatia
- Soriano Giron, C., Institut Universitaire Européen de la Mer, Brest, France
- Strous, M., University of Nijmegen
- Suttle, C. University of Vancouver, BC, Canada
- Taylor, I.R. Charles Sturt University, Albury, NSW, Australia
- Van Duin, A.C.T., University of Newcastle, UK.
- Vázquez, Dr. J.A., Animal Physiology Laboratory, University of the Bask Country, Leioa-Bilbao Spain

UNDERGRADUATE UNIVERSITY STUDENTS

- Andresen, H. University of Bremen, Germany
- Benda, M.
- Bronk, J., Mondriaan College, Delft.
- Damen, R., Hogeschool Rotterdam.
- Dammers, N., UU
- De Haas, S. Hogeschool Leiden.
- Dullemen, D. van, van Hall Institute, Leeuwarden
- Ellen Weerman
- Escudero, G.B. RUG
- Frade, P., University of Lisboa, Portugal
- Gassner, F. Noordelijke Hogeschool Leeuwarden / Van Hall Instituut Leeuwarden.
- Haftka, J., Utrecht University (Geochemistry).
- Ines Seabra, M , University of Lisboa, Portugal
- Jacinto, R., University of Lisboa, Portugal
- Kraan, C. RUG
- Liefhebber, D., Hogeschool Larenstein, Velp
- Lok, T., University of Groningen, Haren
- Mienis. F., VU
- Mirja Rasi
- Stadnitskaya, A.
- Van Breukelen, M., VU
- Van Den Berg, W.J., UU
- Van Der Geest, M., University of Amsterdam
- Van der Meer, F., LUW
- Van Hooidonk, R., University of Amsterdam
- Vos van Avezathe, A., Saxion Hogeschool IJsselland, Deventer.
- Waska, H., University of Vienna
- Ypma, G., UU
- Zwier, A.

4. Support Services

Photo: Bert Aggenbach

THE TECHNICAL SUPPORT SERVICES

Contributors: Theo Buisman, Harry de Porto, Marieke J. Rietveld, Klaas Timmermans

Research Vessel "PELAGIA"

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

The largest sea-going facility is R/V PELAGIA, a 66 m multipurpose research vessel developed for oceanographic research in coastal seas, on continental shelves and in the blue ocean. R/V Pelagia (built 1991) is specially designed as a multipurpose research vessel. It is a very stable platform and has most favourable nautical properties. She has over 11 years experience in CTD-deployment, biological sampling methods, seismic surveys, coring activities (box-, multi-, piston, gravity, vibro-, CPT) as well as in deployment and recoverage of deep-sea moorings and bottom landers. In 2002 R/V PELAGIA is certified under the International Safety Management (ISM) Code.

Marine Facilities Tripartite Group

Royal NIOZ was pleased with the invitation to join the Marine Facilities Tripartite Group (MFTG) and accepted the Terms of Reference of the Tripartite Agreement initiated by NERC (UK), IFREMER (FR) and BMBF (Germany). The MFTG's primary objective is bartering ship-time and exchange major marine equipment without the need to exchange money. This arrangement has significant advantages. It allows scientists access to a wider range of facilities and equipment than would otherwise be possible, and also it reduces wasted time, and therefore wasted costs on long transit passages.

Cruise programme 2002

The year began with an extensive engine overhaul of R/V Pelagia that took all of the month of January. The cruise programme started on 4 February and went on continiuously during the year until 6 December. Pelagia sailed 300 days in the North Sea, North Atlantic and the Mediterranean for the National Programme, for the EU programmes IRONAGES, ECO-MOUND/GEOMOUND and STRATAFORM, for the NIOZ projects BIVALFF and ROCS, and as a charter for Thales Underwatersystems, France. To accommodate these cruises diplomatic clearance has been obtained from UK, Ireland, Norway, Germany, Denmark, Sweden, Belgium, Iceland Portugal, France, Marocco and Spain. Besides calls at homeport Texel port calls for change of crew and scientific party as well as (un)loading scientific equipment took place three times in Galway (Ireland), twice in Brest (France), and in Ponta Delgada (Azores — Portugal), Funchal (Madeira — Portugal) and Valencia and Vigo (Spain).

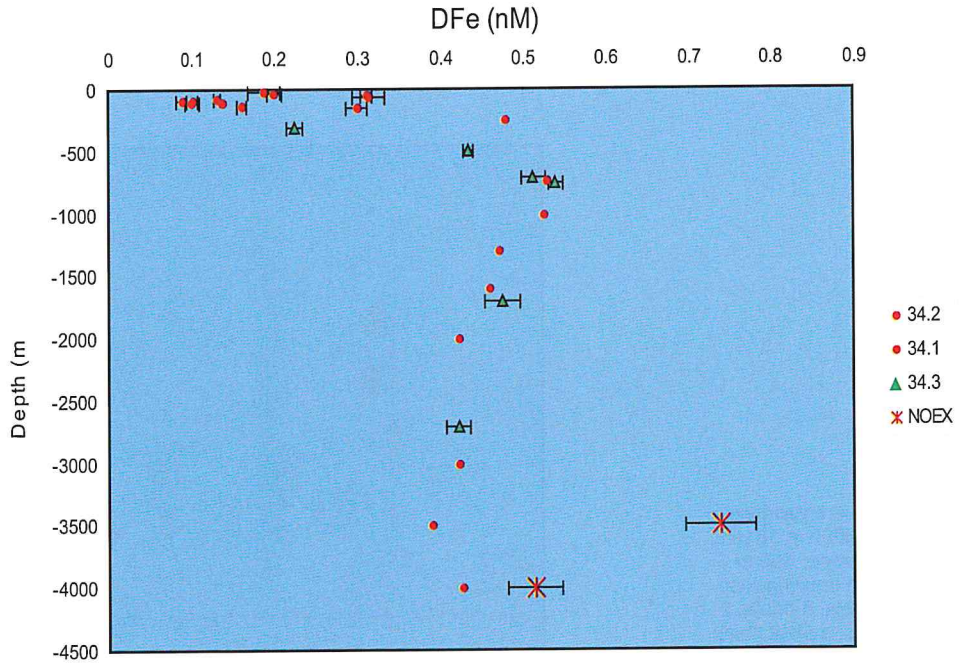
For the transport of containers and equipment to and from ports of call, NIOZ bought a new ultra modern articulated truck that extends the range of action and improves the logistic flexibility considerably. For the transport of the containerized Kley France Winch with cable a new flatbed-trailer guarantees safe transportation.

Recovery of a moored sedimenttrap

The recovery of two moorings deployed by the Pelagia in the Gulf of Aden in Spring 2001 that was planned to take place in Autumn 2001 with the French Marion Dufresne was cancelled because of the war situation in the area. Of one mooring the Argos beacon signalled that the mooring was drifting and/or that the beacon had been recovered by a local fisherman. The beacon could be followed crossing the Gulf apparently on a small boat that came out to be based on the island of Abd-al-Kuri West of Socotra. NIOZ decided to ask for help from the Dutch Navy that was operational in the Arabian Sea in the framework of the anti-terrorist war, for recovery of the moorings on the way back home. One mooring with sediment traps could be successfully recovered by HMs Van Amstel early June. The other did not respond any more to the release signal, and is considered lost. A small NIOZ team embarked in Dubai on HMs Van Amstel to assist the recovery operation and disembarked at the end of the operation in Suez.

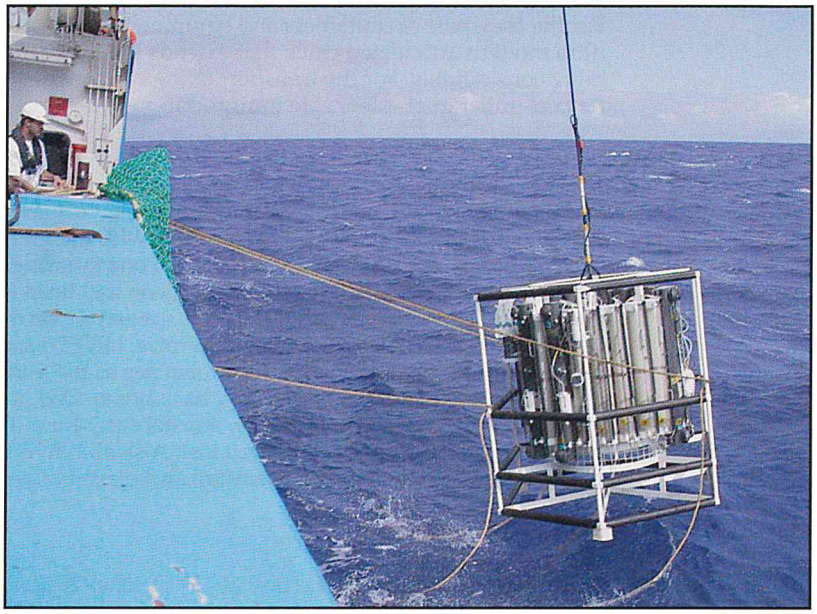
Successful test Ultra Clean CTD system

During The IRONAGES III cruise (3 - 31 October 2002, Ponta Delgada - Valencia), the clean Kevlar wire of the KleyFrance winch, and the clean CTD frame were used for the first time on board R/V Pelagia to collect trace metal clean samples. A comparison with the traditional method, attaching Go-Flo bottles on a Kevlar wire, demonstrated that the new system does give comparable — uncontaminated- results. That is, if Go-Flo bottles are mounted on the clean CTD frame. The NOEX bottle will need better cleaning and maintenance in order to collect uncontaminated samples. The two specially prepared NOEX bottles gave the best results, albeit still higher Fe values than the Go-Flo bottles. With these promising results it should not be forgotten that after each CTD cast the Go-Flo bottles have to be removed from the CTD frame, and have to be mounted and sampled inside a clean container. This requires considerable manpower, and could be dangerous as well during bad weather. Next step would be a clean facility to collect uncontaminated samples from the excellent combination of clean wire and clean frame.



Depth profile of station 34: dissolved iron (DFe) versus depth. The red dots (station 34.1 & 34.2) represent data from bottles that were mounted onto the CTD frame. The green triangles (station 34.3) represent data obtained from the traditional GoFlo method (mounting the bottles individually onto a Kevlar line). Also two data points from NIOZ NOEX bottles are included (station 34.1). Data from Patrick Laan (Royal NIOZ) and Geraldine Sarthou (University of Brest).

INMARTECH 2002



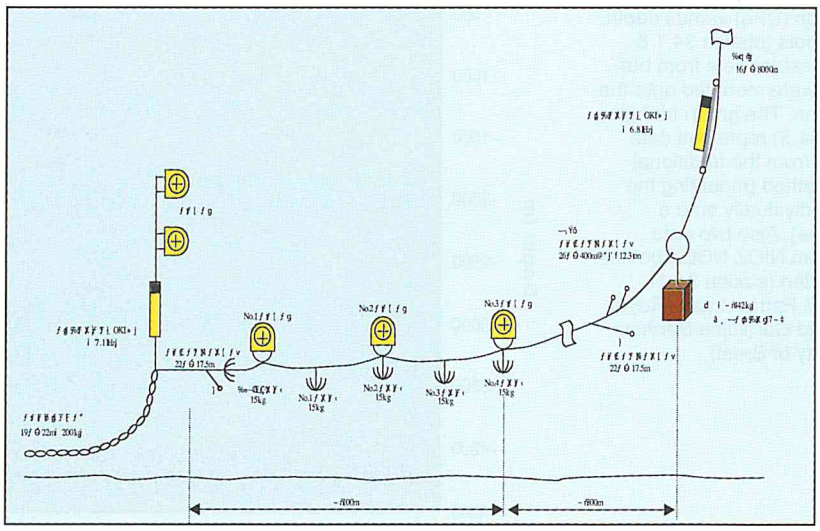
Ultra clean CTD system with two types of bottles in action during the IRONAGES-III cruise.

A NIOZ team participated the INMARTECH 2002 that was held at the Headquarters of the Japanese Marine Science and Technology Centre (JAMSTEC) in Yokosuka and organized by JAMSTEC, Marine Works Japan, Nippon Marine Enterprises, and Global Ocean Development Inc.

The NIOZ multi-valve closing system for CTD bottles found much interest with colleagues, especially from the USA.

The Japanese entangling device for lost deep sea mooring recovery that was presented by NME was of specific interest to the NIOZ team. The device had proven to be very effective during tests to catch a 63m transponder mooring system from depths over 5000 m. The use of two transponders to record the 'catch' of the mooring and a nylon trawling rope with grapnels to bring the mooring to the surface intact, could improve the present NIOZ dredging system for recovery of lost moorings substantially.

As a result of the INMARTECH 2000 a piston core system of NIOZ design was sold this year to the National Institute of Water & Atmospheric Research (NIWA) in New Zealand. Also the transfer of knowledge on the low noise diesel-electric propulsion system of R/V Pelagia to Irish technicians from the Marine Institute involved in the design and building of the 65 m R/V Celtic Explorer that was built at a Dutch shipyard in 2002, resulted in a great success. R/V Celtic Explorer has a propulsion system of the same Dutch brand as R/V Pelagia with a very low acoustic signature, and has proven to be well under the accoustic ICES CRR 209 requirements and now is probably the most silent ship in the world.



The Japanese entangling device with 8000 m 16 mm steel towing rope, 400 m 26 mm nylon trawling rope with 5 grapnels, 6 floats, 2 transponders, a pivot chain and a depression weight.

5. Sociaal Jaarverslag

ALGEMEEN

Het jaar 2002 was een veelbewogen jaar, een jaar van afzien en afscheid, soms blijmoedig te dragen - na al dat stof en lawaai zal de nieuwbouw verrijzen - en soms met weemoed om de vele collega's die van de NIOZ Regeling gebruik maakten, maar dan ineens een afscheid met groot verdriet en rouw, om Wim van Raaphorst, hoofd van de afdeling MCG, die in het najaar dodelijk verongelukte met de fiets op weg naar huis. Hij wordt door allen zeer gemist.

Er waren echter ook goede momenten. Met de nieuwbouw is het uiteindelijk toch nog goed gekomen. Welliswaar werd de geplande opleveringsdatum niet gehaald, maar het resultaat stemt tot tevredenheid. De nieuwe kantine is een fantastische lichte ruimte en de bonus die met de ingebruikneming door de directie werd verstrekt van gratis koffie en thee wordt zeer gewaardeerd. Het Aquariumgebouw is geheel gerenoveerd en is nu een state-of-the art zeewater-experimenteer faciliteit. Onze buren van ALTERRA zijn inmiddels medebewoners geworden. In het voorjaar van 2003 zal de nieuwbouw officieel, feestelijk en in stijl worden geopend.

Er is een druk vaarprogramma gevaren met de Pelagia van circa 300 dagen, in de Noordzee en op de Noord-Atlantische Oceaan, van de Noorse Zee tot de Azoren en van Groenland tot het Canarische Basin, en verder in de Westelijke Middellandse Zee. Door de inzet van de kapitein en zijn bemanning, de walondersteuning en de logistieke en technische ondersteuning aan boord, in de havens en in de werkplaatsen is dit programma een succes geworden.

De financiële situatie is nog steeds weinig rooskleurig. Het overleg tussen de besturen van het Koninklijk NIOZ en NWO, dat met enig optimisme was gestart in het begin van het jaar, mocht niet tot enige conkrete besluitvorming leiden. Er wordt gepraat, er worden afspraken gemaakt en dan weer vragen gesteld, notities opgesteld, toelichting gegeven, consessies gedaan, maar er was aan het eind van 2002 nog geen enkel resultaat. Hopelijk biedt 2003 meer perspectief.

BESTUUR EN WETENSCHAPCOMMISSIE

Bestuur Stichting NIOZ

Per 31 december 2002 was het bestuur als volgt samengesteld:

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

Het bestuur kwam in het verslagjaar 2002 zesmaal met de directie in vergadering bijeen, op 22 januari, 18 maart, 8 mei, 20 juni en 9 december in Amsterdam en op 24 september te Texel. Op 23 september werd gezamenlijk gedineerd met de Wetenschapcommissie, directie en afdelingshoofden.

De vergaderingen werden namens de algemeen directeur van NWO bijgewoond door Dr. H. Weijma.
Genotuleerd werd door mevrouw C.S. Blaauboer-de Jong.

Wetenschapcommissie NIOZ

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

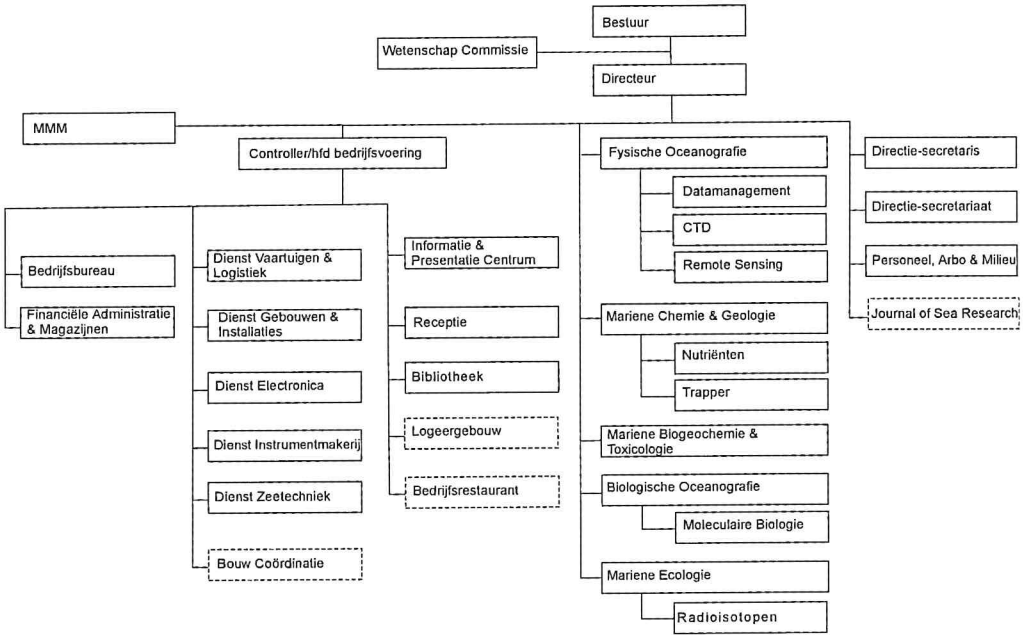
De Wetenschapcommissie was per 31 december 2002 als volgt samengesteld:

Prof.dr. W. van Delden, voorzitter	Vakgroep Genetica, faculteit Biologie Rijksuniversiteit Groningen
Prof.dr. J.-P. Henriet	RCMG/Mariene Geologie, Universiteit Gent, België
Prof.dr. J. Simpson	School of Ocean Sciences/UCNW, Bangor, UK
Prof.dr. R.J. Law	Centre for Environment Fisheries and Aquaculture Science (CEFAS), Burnham on Crouch, UK

Prof. dr. Karin Lochte	Institut für Meereskunde (IfM), Universität Kiel, Duitsland
Prof. dr. P. Herman	Afdeling Spatial Ecology, NIOO-CEME, Yerseke

De Wetenschapcommissie kwam in 2002 bijeen op 23 -24 september te Texel. Genotuleerd werd door mevrouw C.S. Blaauboer-de Jong.

ORGANOGRAM



PERSONEELSLIJST 31-12-02

DIRECTIE

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

Directiesecretariaat

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

STAFEENHEDEN

Mens en Mariene Milieu

Lindeboom H.J. Dr.	11.4 uur	senior onderzoeker

Personeels-, Arbo en Milieuzaken

Vooys P.C.		hoofd	
Mulder-Starreveld J.P.	28.5 uur	medewerker	
Bredewold J.J.H.		personeelsfunctionaris	
Kuip T.	22.8 uur	arbocoördinator	m.i.v. 01-12

Financiën en control

Haas R.G. Drs. ir.		hoofd Bedrijfsvoering/Controller	
Kralingen P. van Ing.		engineering, gedetacheerd SRON	
Heerwaarde van C.W.		hoofd fin. administratie	
Biersteker P.C.B.		projectmedew. fin. administratie	
Arkel M.A. van Drs.		projectcontroller	
Wernand-Godee I.	32.3 uur	medew. project-administratie	
Keijser A.	24 uur	medew. financiële administratie	
Tuinen H.A. van		medew. financiële administratie	
Kooijman-Biermans M.H.M.	26.6 uur	medew. financiële administratie	
Poleacov-Maraiala C.	30.4 uur	medew. financiële administratie	
Porto S.W. de		medewerker Inventarisbeheer	tot 01-03
Nieuwenhuizen J.M.		medewerker Inventarisbeheer	
Kalf J.		medewerker Inventarisbeheer	

CORE PROJECT OFFICE (LOICZ/IGBP)

Crossland C.J. Prof. dr.		executive officer	tot 31-12
Kremer H.H. Dr.		deputy executive officer	
Whyte H.A.Y.		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	
Gerkema T. Dr.		onderzoeker	tot 01-11
Harlander U. Dr.		postdoc	
Merckelbach L.M. Dr.		postdoc	m.i.v. 19-08
Manders A.M.M. Drs.		OIO NWO	tot 31-12
Hosegood P.J.		OIO	
Volkov D.		OIO	
Veldhoven A.K. van		OIO	
Terra G.		OIO FOM	
Buijsman M. C.		projectmedewerker	m.i.v. 01-02
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	
Hiehle M.A.		senior laboratoriummedewerker	
Koster R.X. de		systeemanalist	

AFDELING MARIENE CHEMIE EN GEOLOGIE

Raaphorst W. van Dr. ir.		hoofd	tot 07-11
Baar H.J.W. de Prof. dr. ir.	32 uur	wnd hoofd	m.i.v. 08-11
Weering T.C.E. van Dr.		senior onderzoeker	
Jansen J.H.F. Dr.		senior onderzoeker	
Brummer G.J.A. Dr.		onderzoeker	
Timmermans K.R. Dr.		onderzoeker	
Stigter H.C. de Drs.	30.0 uur	projectonderzoeker	
Haas H. de Dr.		projectonderzoeker	tot 31-12
Epping H.G. Dr.		onderzoeker	
Koning F.A. Dr.		onderzoeker	
Thomas H. Dr.		onderzoeker	
Richter T.O. Dr.		onderzoeker	
Croot P.L. Dr.		onderzoeker	tot 01-02
Gerringa A.L. Dr.	19.0 uur	postdoc	
Peeters F.J.C. Dr.		postdoc	tot 01-07
Kramer J. Dr.		postdoc	m.i.v. 05-08
Bergh van den G.		postdoc NWO	
West S. Drs.		OIO	tot 01-11
Loncaric N. Drs.		OIO	
Bonnin J. Drs.		OIO	
Bozec Y.		OIO	
Schefuss E.		OIO NWO	tot 01-06
Gaast S.J. van der		senior onderzoekmedewerker	
Ooijen J.C. van		senior onderzoekmedewerker	
Bakker K.M.J.		onderzoekmedewerker	
Boer W. Ing.		onderzoekmedewerker	
Iperen J. van	8.0 uur	senior laboratoriummedewerker	
Witte A.J.M.	19.0 uur	laboratoriummedewerker	
Laan P.		laboratoriummedewerker	
Wagt B. van der		laboratoriummedewerker	tot 01-05

Weerlee E.M. van		laboratoriummedewerker	
Kemper R.J.H.		laboratoriummedewerker	tot 01-08
Boelens E.		laboratoriummedewerker	m.i.v. 01-01
			tot 01-07
Maatman A.		laboratoriummedewerker	m.i.v. 01-03

AFDELING MARIENE BIOGEOCHEMIE EN TOXICOLOGIE

Boon J.P. Dr.		hoofd	tot 15-10
		onderzoeker	m.i.v. 15-10
Sinninghe Damsté J.S. Dr. ir.	34.2 uur	hoofd	m.i.v. 15-10
Booy K. Dr.	30.4 uur	onderzoeker	
Schouten S. Dr. ir.		projectonderzoeker	
Versteegh G.J.M. Dr.		onderzoeker	tot 31-12
Zegers B.N. Dr.		postdoc	tot 15-11
Hopmans E.C. Dr.		postdoc	
Werne J.P. Dr.		postdoc	tot 01-03
Coolen M.J.L. Dr.		postdoc	
Forster A. Dr.		postdoc	
Herfort L.M.C.C. Dr.		postdoc	m.i.v. 01-11
Dongen B.E. van Drs.		OIO	tot 01-09
Smittenberg R.H. Ir.		OIO NWO	tot 01-12
Breugel van Y.		OIO	
Wuchter C.		OIO	
Weijers J.W.H.		OIO	m.i.v. 01-10
Baas M.		onderzoekmedewerker	
Rijpstra W.I.C.	19.0 uur	onderzoekmedewerker	
Fischer C.V. Drs.	28.0 uur	laboratoriummedewerker	
Bommel R. van		laboratoriummedewerker	
Kienhuis M.V.M.		laboratoriummedewerker	
Panoto F.E.		laboratoriummedewerker	
Rampen S.W.		laboratoriummedewerker	
Mets A.		laboratoriummedewerker	
Gassner F.		laboratoriummedewerker	m.i.v. 01-08
			tot 01-09
Ossebaar J.		laboratoriummedewerker	m.i.v. 01-09

AFDELING BIOLOGISCHE OCEANOGRAFIE

Herndl G.J. Prof.Dr.		hoofd	
Ruardij P. Drs.		onderzoeker	
Baars M.A. Dr.		senior onderzoeker	
Klein Breteler W.C.M. Dr.		senior onderzoeker	tot 31-12
Veldhuis M.J.W. Dr.		senior onderzoeker	
Duyl F.C. van Dr.		senior onderzoeker	
Riegman R. Dr.		senior onderzoeker	tot 01-05
Kuipers B.R. Dr.		onderzoeker	
Bleijswijk J.D.L. van Dr.	19.4 uur	hoofd mol. lab. m.i.v. 01-02	
Dutz J. Dr.		postdoc	tot 01-08
Brussaard C.P.D. Dr.		postdoc	
Arrieta J.M. Drs.		postdoc	m.i.v. 01-03
Teira Gonzalez E.M. Dr.		postdoc	m.i.v. 01-06
ElKalay K. Dr.		postdoc	m.i.v. 15-08
Stoderegger K.E. Dr.	26.6 uur	postdoc	m.i.v. 01-11
Kramer G.D.		OIO-NWO	
Winter C.		OIO	
Reinthaler T.		OIO	
Baudoux A.C.		OIO	
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.	30.4 uur	laboratoriummedewerker	

Abbas B.A.		laboratoriummedewerker	
Pirker H.A.	19.0 uur	laboratoriummedewerker	tot 01-08
Roosken P		laboratoriummedewerker	m.i.v. 01-02
Bossink M.		laboratoriummedewerker	m.i.v. 01-03
Smit A.T.		laboratoriummedewerker	m.i.v. 01-07

AFDELING MARIENE ECOLOGIE

Meer J. van der Dr.		hoofd	
Bak R.P.M. Prof. dr.		senior onderzoeker	
Veer H.W. van der Dr. ir.		senior onderzoeker	
Piersma T. Dr.	36 uur	senior onderzoeker	
Bergman M.J.N. Ir.		onderzoeker	
Duineveld G.C. Drs.		onderzoeker	
Daan R. Dr.		onderzoeker	
Dekker R. Drs.		onderzoeker	
Philippart C.J.M. Dr.	30.4 uur	projectonderzoeker	
Lavaleye M.S.S. Drs.		projectonderzoeker	
Witbaard R. Dr.		projectonderzoeker NWO	
Holmes S.P. Dr.		postdoc	tot 31-12
Williams I.D.		postdoc	
Nugues M.M.		postdoc	m.i.v. 01-02
Battley P.F.		postdoc	m.i.v. 01-04
Camphuijsen C.J.	21 uur	projectonderzoeker	
Dekinga A. Drs. Ing.		project-medewerker NWO	
Bos O.G. Drs.		OIO NWO	
Maier C.		OIO	
Vahl W.K.		OIO RUG	
Amaro T.		OIO	
Cardoso J.		OIO	
Smallegange I.M.	30.4 uur	OIO	
Reneerkens J.W.H.	30.4 uur	OIO	
Compton T.		OIO RUG	m.i.v. 15-04
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	
Koutrik A. van	15.2 uur	laboratoriummedewerker	
Bol-den Heijer A.C.	29.25 uur	laboratoriummedewerker	
Iperen J. van	15.2 uur	senior laboratoriummedewerker	
Waasdorp C.M.		laboratoriummedewerker	
Koolhaas A.N.		toegevoegd onderzoeker	m.i.v. 01-01
			tot 01-04
Brugge M.C.		dierverzorger	m.i.v. 01-11

ONDERSTEUNENDE DIENSTEN

Dienst gebouwen en installaties

Alkema P.R.	35.15 uur	hoofd	
Groot S.P.	22.8 uur	med. werktuigbouw	
Kuip T.		med. werktuigbouw	tot 01-12
Lakeman R.	20.0 uur	med. werktuigbouw	
Daalder R.M.		med. houtbewerking	
Witte R.J.C.		med. houtbewerking	
Trap B.		medewerker	

Receptie

Kikkert A.	20.0 uur	telefoniste/receptioniste	
Starink J.M.	7.0 uur	telefoniste/receptioniste	tot 15-05
Dapper-Maas M.A.	19.0 uur	telefoniste/receptioniste	
Berbée-Bossen J.		telefoniste/receptioniste (inval)	
Boks-Visser H.		telefoniste/receptioniste (inval)	

IPC

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

Bibliotheek

Grippeling R.S.M.	30.4 uur	hoofd	m.i.v. 01-09
Bruining-De Porto M.E.	31.5 uur	medewerker	

Redactie

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

TECHNISCHE DIENSTEN

Instrumentmaken

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

Electronica

Groenewegen R.L. Ing.	30.4 uur	hoofd	
Koster B. Ing.		plv. hoofd	
Franken H. Ing.		hoger electronicus	
Laan M.		hoger electronicus	
Asjes A.J.		medewerker	
Kuiper B.H.		medewerker	m.i.v. 17-06
			tot 26-07

Zeetechniek

Porto H.H. de	senior medewerker
Schilling J.	senior medewerker
Polman W.	medewerker
Bakker M.C.	medewerker
Blom J.J.	medewerker
Wuis L.M.	medewerker
Boom L.	medewerker
Gieles S.J.M.	medewerker
Grisnich P.W.	medewerker
Witte Y.	medewerker
Bonne E.	medewerker (detachering)

Vaartuigen en logistiek

Buisman T.C.J.		hoofd
Groot J.C.		gezagvoerder Pelagia
Ellen J.C.		1e stuurman Pelagia
Duyn M.D. van		2e stuurman Pelagia
Puijman E.A.		2e stuurman Pelagia
Seepma J.		1e werktuigkundige Pelagia
Stevens C.T.		scheepstechnicus Pelagia
Mik G.		scheepskok Pelagia
Betsema G.L.J.		matroos Pelagia
Hogeweg M.T.		1e werktuigkundige Pelagia tot 06-10
Brandsma J.		2e werktuigkundige Pelagia tot 02-11
Slikke R. van der		matroos Pelagia tot 01-05
Maas J.J.M.		matroos Pelagia
Heide R. van der		matroos Pelagia
Meijer N.O.		matroos Pelagia
Boon P.		matroos Pelagia m.i.v. 28-08
Adriaans E.J.		havenmeester/schipper Griend
Star C.J. van der		schipper Navicula

Tuntelder J.C.	scheepstechnicus/kok Navicula	tot 01-09
Vis van der P.C.A	machinist/motordrijver Navicula	
Vries de H.	scheepstechnicus/kok Navicula	m.i.v. 30-09
Jongejan W.P.	komvisser	

ARBEIDSVOORWAARDEN

Collectieve Arbeidsovereenskomst (CAO)

In het derde kwartaal van 2002 is tussen de CAO partijen het akkoord bereikt over de (vierde) Collectieve Arbeidsovereenkomst voor de Onderzoekinstellingen (CAO-OI). De looptijd van deze CAO geldt van 1 juni 2002 tot 1 oktober 2003.

Het akkoord voorziet in een salarisverhoging van 3% per 1 juni 2002. Zoals gebruikelijk werkt deze verhoging door in de pensioenen en uitkeringen.

De uit de vorige CAO overeengekomen eindejaarsuitkering van ¤158,82 bruto is in december 2002 omgezet in een structurele eindejaarsuitkering van 3% van het jaarsalaris. Ook deze uitkering werkt door in het pensioen- en uitkeringsstelsel. Daarnaast is in december 2002 een éénmalige eindejaarsuitkering uitbetaald van 1% van het jaarsalaris.

In aanmerking genomen de salarisverhoging van 1% per 1 maart 2002, als onderdeel van de vorige CAO, is de bezoldiging van het personeel in 2002 structureel met 7% verhoogd.

In het kader van de loonontwikkeling in 2002 zit de sector Onderzoek ten opzichte van de overige Overheidssectoren hierdoor aan de bovengrens.

De sinds het jaar 2000 bevroren tegemoetkoming in de premie voor de particuliere ziektekostenverzekering (ZKOI-bijdrage) is per 1 januari 2002 met 13,8% geïndexeerd. Voor het jaar 2003 wordt deze bijdrage gehandhaafd op het niveau van 2002.

Arbeidsvoorwaarden op maat

Ook in 2002 konden medewerkers gebruik maken van de AVOM-regeling (Arbeids-Voorwaarden Op Maat). De "bron" tijd (verlofuren) was evenals in het voorgaande jaar niet voor de NIOZ-medewerkers beschikbaar vanwege de financiële situatie waarin het NIOZ verkeert.

De belangstelling voor het gebruik maken van de AVOM-doelen is ten opzichte van 2001 aanzienlijk toegenomen.

Voor de aanschaf van een PC hebben 25 medewerkers gekozen, voor de aanschaf van een fiets 12 medewerkers en 1 medewerker heeft extra verlof gekocht.

Opleiding en training

De in het jaar 2001 gegeven impuls aan opleiding en training is in 2002 gestimuleerd.

Zowel op individueel niveau als "in company" zijn er diverse cursussen en trainingen gegeven.

Een aantal opleidingen had betrekking op de bedrijfshulpverlening (EHBO en Bedrijfsbrandweer) en op het werken aan boord van schepen (Advanced Fire Fighting for sea farers) en op het varen met rubberboten met motoraandrijving. Voor dit laatste is men wettelijk verplicht om in het bezit te zijn van het zogenaamde Klein Vaarbewijs.

Er werd een cursus gehouden voor het werken met de software pakketten Power point en Word. Voor de medewerkers van de technische diensten zijn cursussen georganiseerd voor het veilig werken aan apparatuur en installaties (VCA — NEN 3140).

Verder zijn er trainingen gehouden op het gebied van werkoverleg, klantgericht optreden en voor het voeren van functionerings- en beoordelingsgesprekken.

In het najaar is de training MIOO (Management in onderzoeksorganisaties) begonnen onder begeleiding van het bureau Leeuwendaal, bestemd voor alle afdelings- en diensthoofden.

Uit onder meer een aanbod van opleidingen en trainingen zal geïnventariseerd worden welke als noodzakelijk respectievelijk gewenst worden beschouwd. Aan de hand hiervan zal er een opleidingsplan (-programma) worden uitgewerkt.

Onderzoek nieuw systeem van functiewaardering

Binnen de sector van de Werkgeversvereniging Onderzoekinstellingen (WVOI) wordt sinds jaren gebruik gemaakt van het functiewaarderingssyteem van het Ministerie van Binnenlandse Zaken (de zogenaamde "Beredeneerde Vergelijking"). Dit systeem is echter sinds 1994 niet meer geactualiseerd en dus sterk verouderd.

CAO-partijen zijn overeengekomen om voor de sector Onderzoek een eigen systeem van functiewaardering te ontwikkelen. Voor dit project is een stuurgroep functiewaardering opgericht. Het project wordt inhoudelijk en procedureel begeleid door het adviesbureau Berenschot. Naar verwachting zal het nieuwe systeem van functiewaardering per 1 juli 2003 worden ingevoerd

Individueel Klachtrecht

De Uitvoeringsregeling Individueel Klachtrecht biedt werknemers de mogelijkheid om klachten, over een gedraging door of vanwege de werkgever bespreekbaar te maken en te doen onderzoeken. In 2002 zijn er bij de Klachtadviescommissie geen klachten ingediend.

ARBO-JAARVERSLAG

Inleiding

In dit verslag wordt gerapporteerd over de belangrijkste activiteiten op het terrein van arbo en milieu die in 2002 hebben plaatsgevonden. Omwille van de leesbaarheid is de rapportage zo beknopt mogelijk gehouden.

Beleid

In dit jaar heeft de Arbo en milieucoördinator het instituut verlaten door het bereiken van de pensioengerechtigde leeftijd. De als gevolg hiervan ontstane vakature is in het najaar vervuld na een interne sollicitatieprocedure.

Arbo- en Milieucommissie

De Arbo- en Milieucommissie fungeert inmiddels enkele jaren binnen het NIOZ. De commissie heeft een adviserende en signalerende taak naar Directie en Ondernemingsraad op het gebied van veiligheid en milieu. De commissie is breed van samenstelling. Geledingen uit de technische dienst, de wetenschappelijke afdelingen, haven en vaartuigen, ondernemingsraad (feitelijk de leden van de OR-Veiligheidscommissie), bedrijfsvoering en personeels-, arbo- en milieuzaken zijn in de commissie vertegenwoordigd.

De commissie is in 2002 drie keer bijeen geweest. Onderwerpen die aan de orde zijn gesteld betreffen o.a. de nieuwbouw, de op Texel uitgevoerde milieuhandhavingsactie, het bezoek van de Arbeidsinspectie aan het NIOZ, het brandveiligheidsonderzoek en het te ontwikkelen rookbeleid.

Ongevallen

In de oceaanloods op het haventerrein liep een werknemer hoofd- en rugletsel op. Bij het zoeken naar attributen, tussen opgeslagen laboratoriummaterialen, viel er een stapel tafels en ander los materiaal op hem. Na behandeling bij de eerste hulp kon de persoon zijn werkzaamheden hervatten.
Bij montagewerkzaamheden zijn twee werknemers door een reformladder gezakt. Hierbij ontstond geen letsel. Wel is hiervan melding gedaan bij de Arbeidsinspectie en naar aanleiding hiervan worden in het voorjaar 2003 alle draagbare klimmaterialen gekeurd.

Veiligheids- en milieuzaken

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

Via de gehuurde container is door de firma SITA 3.335 kg klein gevaarlijk afval afgevoerd waarvan 1.000 kg koelvloeistof en 250 kg bluspoeder. De overige belangrijkste componenten waren oplosmiddelen, giftige chemicaliën, laboratoriumafval, batterijen en TL buizen.

Bedrijfsgezondheidszorg

Drie leden van de brandweerploeg werden gekeurd en geschikt verklaard.

Ziekteverzuim

Wederom is er in 2002 sprake van een daling van het ziekteverzuimpercentage. Ten opzichte 2000. Volledigheidshalve wordt opgemerkt dat de verzuimpercentages uitsluitend betrekking hebben op het kalenderjaar 2002.

	WP	M	V	NWP	M	V
1999	5.5	5.4	5.8	5.5	5.5	5.1
2000	5.6	5.8	4.9	8.6	6.9	15.6
2001	3.7	4.0	2.5	5.7	4.1	12.9
2002	3.5	3.5	3.4	5.0	3.1	13.9

Bedrijfshulpverlening

Ten behoeve van de EHBO voorziening zijn dertien personen op herhalingscursus geweest voor het eenheidsdiploma EHBO van het Oranje Kruis. De cursus werd gegeven op het instituut door DHTC. De ploeg is dit jaar versterkt met vier personen, die hun diploma behaalden waardoor de totale sterkte op zeventien personen kwam. Van deze zeventien zijn er acht varende op de schepen.

De leden van de bedrijfsbrandweer oefenden naast de maandelijks oefeningen ook bij DHTC voor het blussen met kleine blusmiddelen en het lopen met ademlucht in een onder rook staand oefengebouw.
De ploeg bestaat momenteel uit twaalf personen. In 2002 zijn er twee nieuwe leden aangesteld als aspirant brandwacht.

De jaarlijkse controle van de brandmeldinstallatie en alle brandmelders is verricht evenals de controle van de kleine blusmiddelen en de zes adembeschermingsapparaten van de brandweerploeg.

Door afronding van de nieuwbouw, die ook betrekking heeft op de brandmeldcentrale en het brandmeldsysteem is er instructie gegeven voor de bedrijfsbrandweer door de firma Siemens. Het systeem is ten opzichte van het oude uitgebreid met een ontruimingsalarm en een gestuurd ventilatiesysteem.

In verband met de nieuwe regelgeving voor controle en onderhoud van kleine blusmiddelen, welke regelgeving niet meer toestaat dat een apparaat ouder is dan 20 / 25 jaar, zijn er in totaal 64 brandblusapparaten vervangen. De oude apparaten worden éénmalig gebruikt voor training van personeel.

Investeringen

Voor het komende jaar is er ten opzichte van eerdere jaren meer beschikbaar voor investeringen. Er zal onder meer geïnvesteerd worden in communicatiemiddelen voor de bedrijfsbrandweer, het keuren en inspecteren van draagbaar klim- en hijsmateriaal. Ook wordt de afvoer van reguliere afvalstoffen en chemicaliën geoptimaliseerd.

Vergunningen

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.
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. In 2002 is er in totaal 82.454 m^3 water afgevoerd.

Bestuur
Ter versterking van het huidige bestuur is Elda Panoto (MBT) erbij gekomen, daarnaast legt Irene Wernands haar functie als penningmeester neer. Hierbij willen we haar bedanken voor haar jarenlange inzet als penningmeester.

Activiteiten
Het jaar 2002 was een actief jaar voor de personeelsvereniging.

In de winter van 2001/2002 hebben we tevergeefs gewacht op natuurijs. Dus zijn we in januari met 50 man afgereisd naar de schaatsbaan in Alkmaar. Hier is vervolgens via hindernisbanen gebleken dat er vreselijk veel onverwacht schaatstalent binnen het NIOZ aanwezig is.
In juli werd het jaarlijkse kinderevenement gehouden. Dit keer werd er een verhaal verteld door een maffe vogel in een 3D-poppenkast. Dat klinkt ingewikkeld en dat was het ook maar de kleintjes vonden het prachtig. Ter afsluiting werden er weer heel wat pannekoeken gegeten.

Het was al lang geleden dat er iets groots door de pv, voor zijn leden geregeld was. Daarom vonden we het tijd worden voor een echt uitje. We besloten er is helemaal uit te gaan en kwamen zo in Limburg terecht. Dit werden twee actieve dagen waarin gestept of gefietst is en kano gevaren en/of gezwommen. Als cultureel aspect en opwarmertje, was er een bezoek aan de Brouwerij van de Hertog Jan bieren. Door het goeie weer en de goeie verzorging werden deze twee dagen een toppertje.

In november was er weer een culturele bijdrage van de pv. Er werd het realistisch toneelstuk "pas de deux" van Hugo Claus opgevoerd in Question plaza.

In december was er uiteraard weer een chocolade letter voor de leden. Voor de kerstborrel hebben de jongens van zeetechniek en ieder die geholpen heeft zichzelf overtroffen door de werkplaats van zeetechniek om te toveren in een geweldige gezellige schaatsbaan. Na een hapje, drankje en heel veel vis werd het jaar 2002 afgesloten.