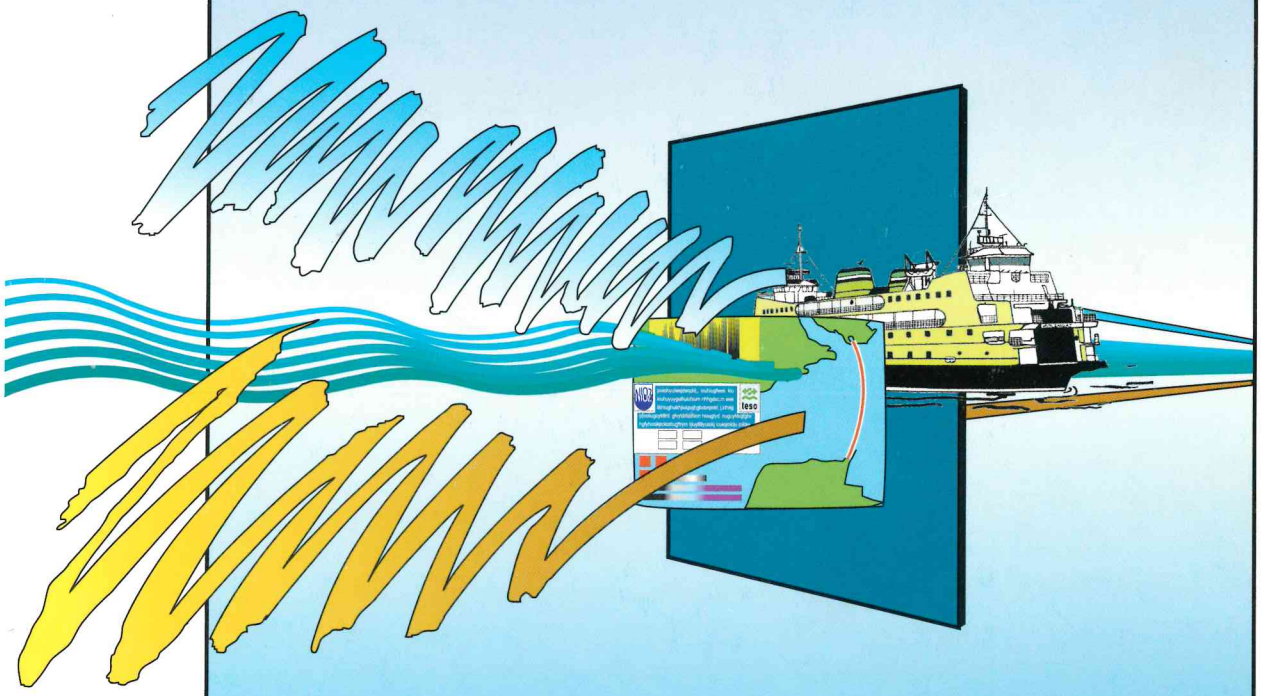
ANNUAL Report 1998



NETHERLANDS INSTITUTE FOR SEA RESEARCH (NIOZ)

NETHERLANDS INSTITUTE FOR SEA RESEARCH

ANNUAL REPORT 1998

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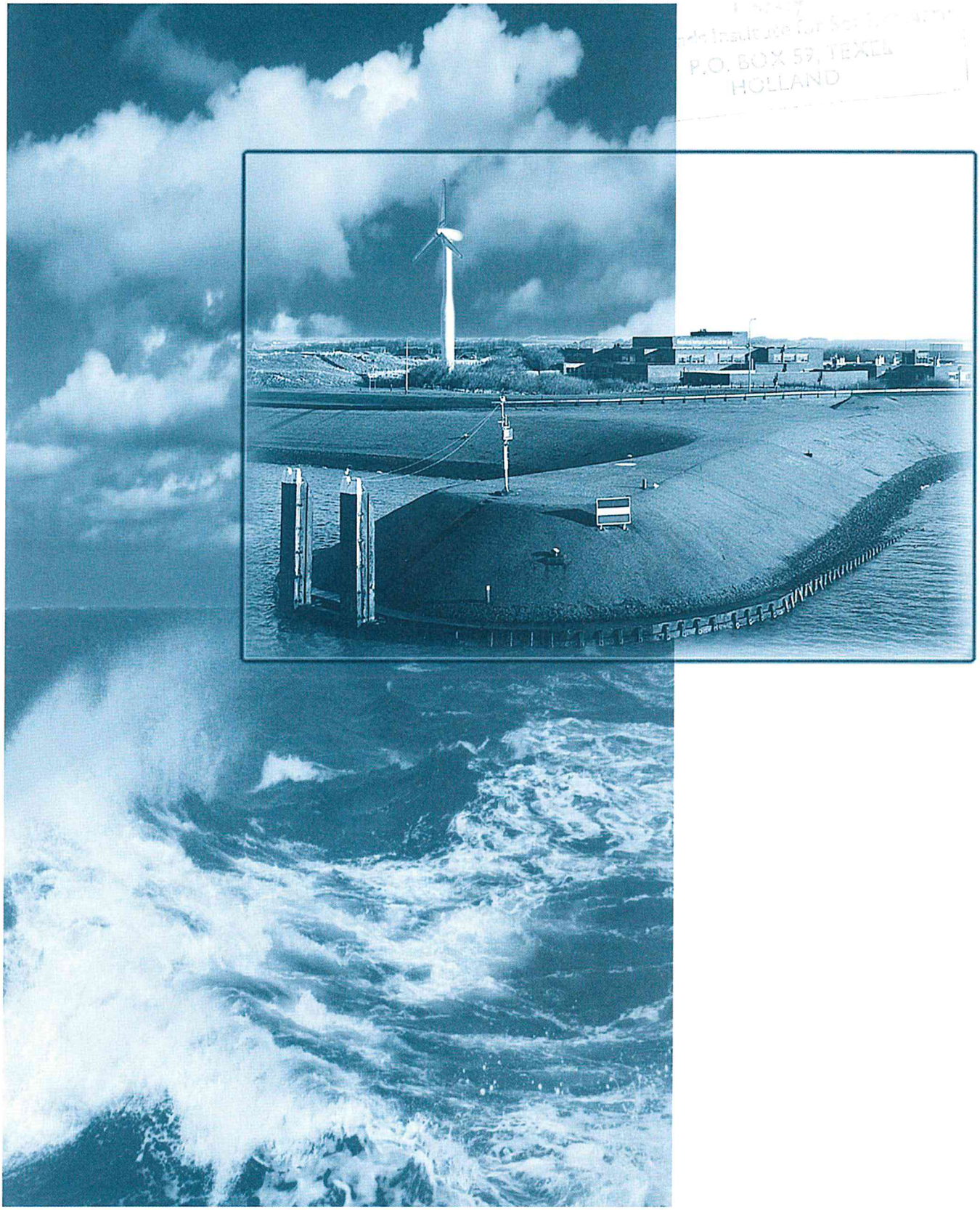


NETHERLANDS INSTITUTE FOR SEA RESEARCH (NIOZ)

CONTENTS

Juvenile whelks reared in the laboratory.
Photo: Hans Kralt.

Regarding public awareness about the role of the ocean, 1998 has been a very important year: it was the international year of the ocean, the year of the movie of the Titanic and, last but not least, a year with a very strong El Niño. Hence, a large number of national and international activities, such as the world exhibition at Lisbon dedicated to the oceans, have been undertaken and a strong interest from the media for ocean-related phenomena hopefully didn't miss its impact. NIOZ contributed to this by making the small research vessel Navicula available for a Wadden Sea cruise for scholars who won a national ocean-related contest, by opening its doors for the public during a succesfull open-day with lectures and demonstrations, and by starting a research project in collaboration with the TESO company that runs the ferry between the Dutch mainland and Texel. Through instrumentation installed on the ferry continuous data series with respect to salinity, temperature, the current velocity field and fluorescence are obtained for the Marsdiep tidal inlet. Part of these data are presented on-line on a large screen at the ferry and are available for institutions world-wide for educative and other purposes via the NIOZ web site. On the long term these data will improve our knowledge about processes contributing to the transport of water and particulate matter through sea-arms, such as the Marsdiep.

In 1998 5 PhD students defended their theses succesfully, whereas the number of publications, reports, oral presentations and posters was substantially higher when compared with the previous year. The greater part of the scientific output was related with the major research themes defined several years ago, i.e. the transport of energy and matter in the ocean now and in the past, and is concerned with (palaeo)climatic change, sustainable use of the marine environment and, more generally, with a better understanding of water movements, food webs and the role of dissolved and particulate matter in coastal seas and the oceans.

A NIOZ-wide multidisciplinary research theme: 'Processes at the Continental Slopes (PROCS)' started in 1997 and will be continued thanks to external funding. Within this project four departments work together to integrate physical, chemical, geological and biological expertise to better understand relationships between internal waves, nutrient and sediment transport and primary production.

One of our publications (in Nature) reported on the occurrence of polybrominated biphenyls (PBB's), flame-retarding chemicals, in deep-sea animals. The presence of these and other anthropogenic compounds in deep-sea and polar animals, sometimes in very high amounts, is frightening and mechanisms of transport and accumulation of these human-made compounds should be addressed.

A major EC-subsidized project related to the effects of fisheries on the North Sea and Irish Sea ecosystems (IMPACT) was finished. Six years of co-operation between 12 European institutes yielded a lot of detailed information on this topic and clearly indicated the ecological impact of beam-trawl fisheries on individual fishes and other organisms and on populations of organisms. The final report caused a lot of scientific and political discussions.

In another final report Jaap Sinninghe Damsté summarized a.o. 136 scientific publications related to the NWO-subsidized PIONIER project 'Molecular Palaeontology of Marine Sediments'. Based on the results obtained over the 5 years the project was running, a second phase of this research related to palaeo-ecosystem dynamics is warranted.

Another NIOZ report written by the late Ab Dral nicely summarizes the history of NIOZ from 1876 till 1945.

The international co-operation with the four German institutes at Bremen (Univ. Bremen, ZMT, MPI) and Bremerhaven (AWI), indicated as NEBROC, was further strengthened through a workshop in February and by the appointment of ultimately 11 post-docs (many of them with a 5 year's contract) and PhD students. Moreover, the first NEBROC basic course on Marine Sciences, in principal open for all European PhD students, was given at Texel during the second half of November for 27 PhD students of many different nationalities. The students took courses, performed practical work, made excursions and told each other during evening sessions what kind of research they were performing.

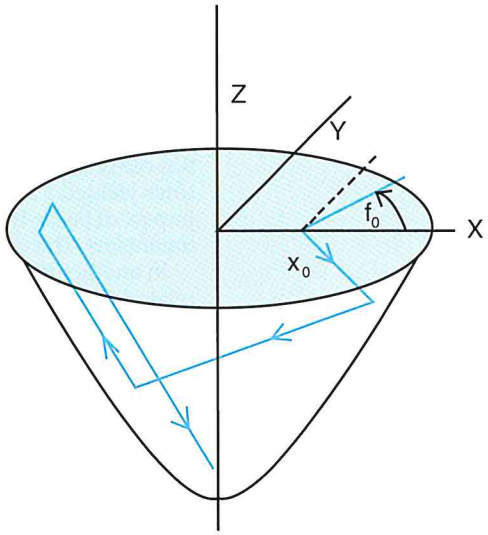
As usual, the research departments optimally benefitted from the strong technical and administrative supporting groups and from the research vessels and their crews. The RV Pelagia is in perfect condition due to an extended period in the docks, whereas the RV Navicula was enlarged by 4 meters and brought up-to-date by a major overhaul. Since March 1st we have a new captain, Hans Groot, and per September 1st a new first mate, John Ellen, was appointed.

From a financial/economic point of view 1998 was a turbulent year. As the years before, it was clear after setting the budget for 1998 that once again major efforts were required to obtain substantial additional funding to realize the budget. Thanks to the creativity and willingness of many of us much additional funding was obtained indeed, although the research to be performed to obtain this funding was not always associated with the core of our research. Another part of the budget was realized through renting of the Pelagia. On top of that a reshuffling of earmarked funds was necessary to end 1998 without a deficit.

According to schedule, a detailed draft plan for renovation and new building requiring 16.6 Mf (i.e. 7.6 million Euro) has been submitted to NWO in November. After a positive decision at the end of January 1999 by NWO the building and renovation will start in the second half of 1999.

Hence, we are entering the last year of the millennium very dynamically, not only scientifically, but also otherwise, the more so because in 1999 a panel of 5 experienced scientists will review our science and management of the last 5 years. The outcome of that review is of major importance to the scientific future of our institute in the first 6 years of the next millennium.

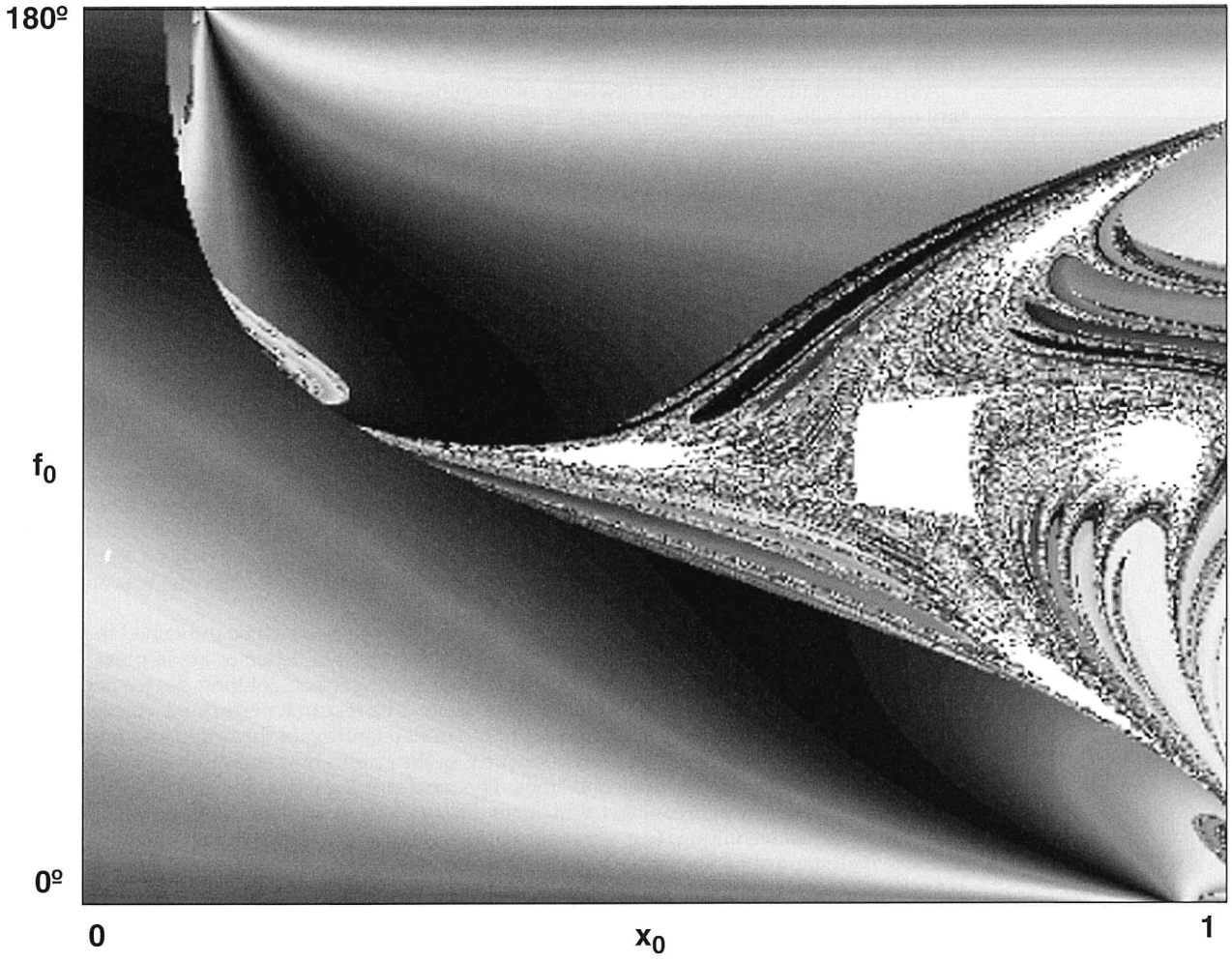
Jan W. De Leeuw
Director



Ray-tracing of internal gravity wave energy in a uniformly-stratified paraboloidal basin.

Rays always make the same angle with respect to the vertical, but, when obliquely incident upon a sloping bottom, are subject to instantaneous refraction towards or away from the direction of the bottom gradient, when approaching shallower or deeper water respectively (see sketch of geometry). Depending upon initial radial location, X_o, ($0<X_o<1$) along any radial line, and initial (horizontal) direction, f_0, measured with respect to that line ($0<f_0<180$ degrees), rays either get focused to a particular vertical plane through the central axis of the basin of particular orientation f_∞ (focusing waves), or circle around the basin perimeter, being engaged in an evercontinuing play of refraction away and subsequent refraction towards the bottom gradient direction (edge waves). The picture shows that the 'fate' of the rays, represented by blue tones, giving f_∞, is strongly dependent on initial location X_0 and direction f_0. For the edge waves such a 'final direction' is never attained, which corresponds with white regions.

1. Scientific Activity



PIONIER

MOLECULAR PALAEONTOLOGY OF MARINE SEDIMENTS

Contributors: *Jaap S. Sinninghe Damsté, Stefan Schouten, Jürgen Köster, Kliti Grice, Fabien Kenig, Francois Gelin, David Clifford, Sarah Sephton, Martin P. Koopmans, Heidy M.E. van Kaam-Peters, Marika D. Kok, Ingeborg Höld, Marcel J.L. Hoefs, Joe Werne, Marianne Baas, W. Irene C. Rijpstra, Marlèn Dekker, Wim Pool, Jan W. de Leeuw*

Reconstruction of ancient environments is a major goal in earth sciences and intends to improve our insight into the history of the Earth. Results from studies addressing this subject are important from a point of view of fundamental science (e.g. palaeoceanography) but are also applicable to recognise and predict natural climatic variations and to predict oil source rock quality to name just a few. Many different approaches are used to decode the geological record. Although it was realised early on that sedimentary organic compounds are probably the most important information carriers with respect to the environment of deposition, diagenetic processes and evolutionary pathways, decoding of that information (molecular palaeontology) started only several decades ago due to the limited analytical tools to separate complex mixtures of organic compounds and to identify their structures on a molecular level.

Sedimentary organic components are derived from biochemicals of primary producers and organisms processing primary produced carbon. On a molecular level three different features of biochemicals can be discriminated: (i) the carbon skeleton, (ii) functional group(s), (iii) stable carbon isotopic composition. If these three types of information are fully preserved in sedimentary biomarker counterparts the most accurate palaeodepositional reconstruction can be obtained using biomarkers. However, a wide range of microbial and (physico)chemical processes during settling of the detritus to the sediment and during subsequent burial of the sediment affect functional group properties of biochemicals. Furthermore, until recently, the carbon isotopic compositions of individual compounds were impossible to measure. Due to these limitations past research has concentrated mainly on the first type of information of biochemicals i.e. the carbon skeleton.

A significant increase of our knowledge of the genesis and diagenetic behaviour of sedimentary organic sulfur compounds strongly indicates that the retrieval of the second type of information present in biochemicals [i.e. functional group location(s)] has become accessible by new methodologies. Furthermore, recent advances in the instrumentation used in isotope geochemistry make it possible to continuously analyse the effluent of a gas chromatograph isotopically, enabling the determination of the carbon isotopic compositions of individual sedimentary organic compounds. Preliminary results indicated that the combination of these two novel approaches in molecular palaeontology significantly alter our perception of the use of biological markers and have the potential to proceed biological marker research with unprecedented specificity. The Netherlands Organisation for Scientific Research (BOA-NWO) provided a PIONIER grant of almost two million guilders for the period 1993-1998 to Dr. ir. Jaap S. Sinninghe Damsté to explore these new possibilities in molecular palaeontology at the Department of Marine Biogeochemistry and Toxicology at the Netherlands Institute of Sea Research (NIOZ) and the Faculty of Earth Sciences of Utrecht University.

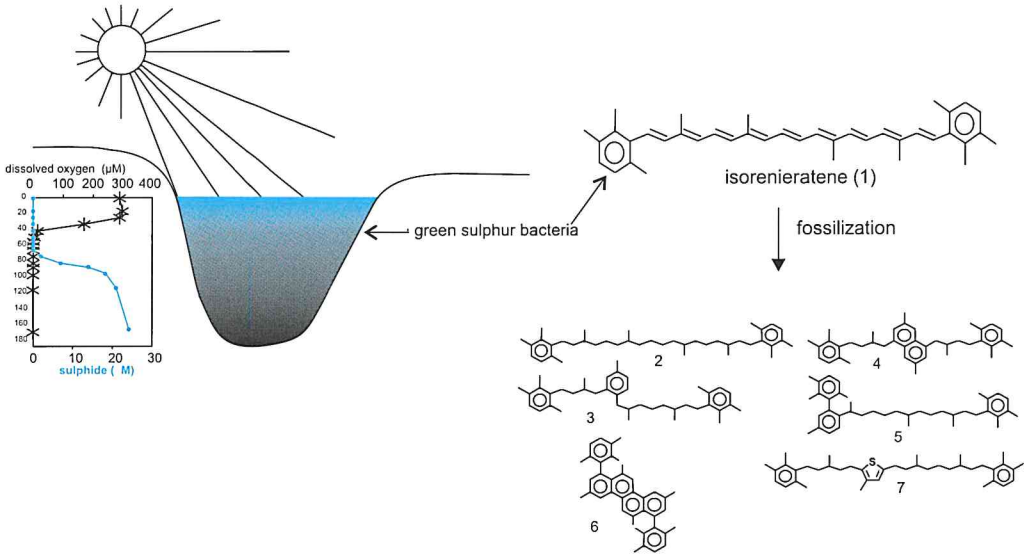
The research in this project focussed on the application of the newly developed combined approach to address four major aspects in molecular palaeontology: (i) multiple sources of biomarkers, (ii) unknown origins of biomarkers, (iii) diagenetic fate of functionalised biomarkers and (iv) biomarkers in the assessment of the sources of sedimentary organic matter. To this end a diverse suite of marine sediment samples from different regimes (e.g. upwelling region, deep sea, continental shelf, restricted marine, hypersaline, and euxinic environments) was analysed with the combined approach.

The scientific results obtained during the project have been and will be published in peer-reviewed journals and books. So far ca. 120 papers have been published or are in press. During the project 4 PhD students, who were directly related to the project, got their degree and 3 others are expected to finish their thesis in the near future. The research performed during the PIONIER project has led to significant advances in the understanding of the origin and fate of biochemicals in marine sediments and, consequently, in the application of biomarkers in the assessment of past environmental conditions. The most striking examples in this respect are biomarkers derived from organisms, which are difficult to trace in the marine geological record with conventional techniques (e.g. green and purple sulfur bacteria, pelagic and methanogenic archaea, methanotrophic bacteria, cyanobacteria, ciliates, insects, C_4 terrestrial plants). Often the recognition of remains of these organisms provides a key to the assessment of important processes in the depositional environment (e.g. stratification, photic zone anoxia, methanogenesis, grazing, C_3/C_4 shift). Natural sulfurisation, occurring within the upper part of the sedi-

ment, often plays a key role in preserving this information. During subsequent release of the sulfurised skeletons through early thermal maturation, this information is partially retained. The ^{13}C contents of biomarkers has shown to be a powerful tool in the assessment of possible origins of biomarkers, in deciphering palaeofood web relationships (e.g. in the assessment of palaeofood sources of ciliates and insects) and also in the unravelling of the often complicated diagenetic reactions of biochemicals which become entrapped in sediments. Biosynthetic and diagenetic effects complicate this issue but can be taken into account. Selective oxidation of biolipids may result in a significant bias of palaeoenvironmental reconstructions based on biomarkers and the interpretation of biomarker data in oxidised sediments should be performed with caution. Important sources of sedimentary organic matter in marine sediments are marine algaenans, sulfurised lipids and carbohydrates. At present, it is not clear whether bacterial biomass is an important contributor to sedimentary organic matter in marine sediments, in contrast to the widespread belief that it is. Analysis of a wide variety of black shale deposits has revealed new information with respect to their formation. 'Black Sea' conditions [overlap of the photic and euxinic (i.e. sulfidic) zone] have been much more important than thought previously. Such conditions thrived during the formation of, for example, Pliocene sapropel formation in the Eastern Mediterranean, black shale deposition during the C/T OAE in the southern North Atlantic Ocean and the Toarcian OAE (oceanic anoxic events) in Europe.

HIGHLIGHTS:

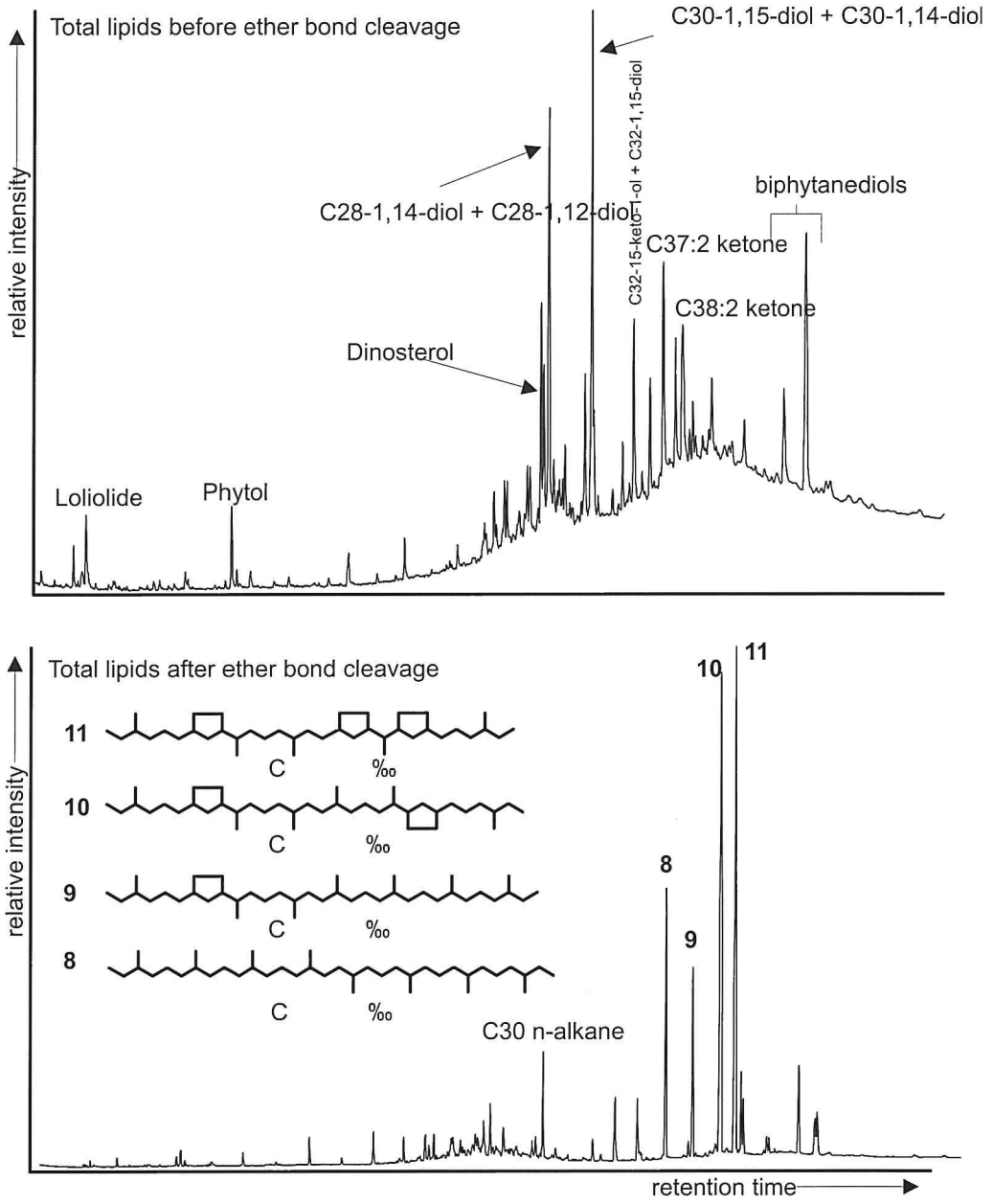
1
Isorenieratene-derivatives



Anoxia of (a part of) the water column is thought to be important for the effective preservation of organic material and the formation of petroleum source. Therefore, it is of great importance to be able to recognise ancient anoxic basins. Photosynthetic green sulfur bacteria (Chlorobiaceae) are photoautotrophic organisms that are strictly anaerobic and require hydrogen sulfide. Their presence points to an euxinc water layer that reaches into the photic zone. Chlorobiaceae produce a characteristic pigment, the diaromatic carotenoid isorenieratene (**1**), which can be used to trace such conditions. For example, in the recent Black Sea, isorenieratene has been isolated from water samples at 80 m from the surface, indicating the coexistence of light and hydrogen sulfide at this depth. The presence of nine double bonds in isorenieratene makes it, however, highly susceptible to early diagenetic reactions in sediments, which severely complicates its recognition in the sedimentary record. Analyses of a large suite of samples from various depositional settings and of different geological ages in the PIONIER project has revealed the presence of a wide array of novel diagenetic and catagenetic products of isorenieratene (e.g. **2-7**). Most of these components have only been characterised by mass spectrometry but, in specific cases, key structures have been isolated from sediment extracts and fully characterised by two dimensional ^{1}H and ^{13}C NMR techniques. Additional evidence for the fact that these products are derived from isorenieratene comes from their stable carbon isotopic composition, which is typically 15‰ enriched relative to lipids derived from algae throughout the Phanerozoic. The anomalously high ^{13}C content finds its origin in the reverse tricarboxylic acid cycle by which CO_2 fixation occurs in green sulfur bacteria. The structures of these diagenetic products strongly suggest that they have been formed by a sequence of cyclisation, aromatisation and hydrogenation reactions occurring with the polyene system of isorenieratene. Initial

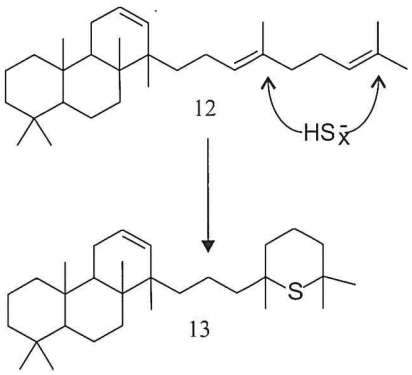
cyclisation seems to occur mainly after appropriate *trans-cis* isomerisation at two specific sites, which favours a Diels-Alder reaction. Structures containing up to four additional aromatic rings have been identified. In addition to cyclisation, aromatisation and hydrogenation, various other reactions may also occur with isorenieratene in sediments: (i) Expulsion of xylene and toluene resulting in formation of C_{32} and C_{33} 'carotenoids'; (ii) natural sulfurisation leading to formation of sulfur compounds; (iii) sequestration into macromolecular organic matter; (iv) C-C bond cleavage during catagenesis. All these diagenetic and catagenetic reactions may occur in concert leading to complicated mixtures of transformation products. Since isorenieratene derivatives indicate the overlap of the photic and euxinc zones, their presence in a wide variety of organic matter-rich sediments ('black shales') indicates that euxinic conditions (i.e. free H_2S in the water column) often have been important for the formation of marine petroleum source rocks.

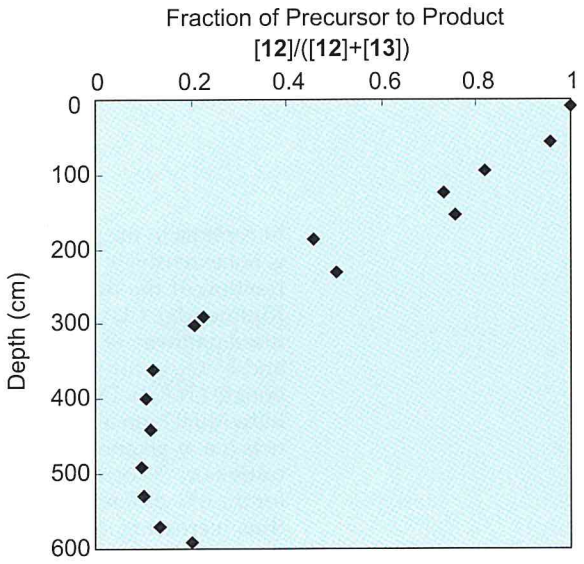
2
pelagic archaea



Organic compounds present in sediments can originate from all three domains of life, i.e. eukaryotes, prokaryotes and archaea. A number of biolipids are biosynthesised by only one domain. For instance, steroids are almost exclusively biosynthesised by eukaryotes, whilst hopanoids are exclusively biosynthesised by prokaryotes. Specific biomarkers for archaea include extended isoprenoids such as the C_{25} regular and irregular acyclic isoprenoids and acyclic and cyclic biphytanes. We have discovered head-to-head C_{40} isoprenoid carbon skeletons containing 0-3 cyclopentane rings (**8-11**) in the marine water column and in marine and lacustrine sediments. With the exception of a tricyclic biphytane, the structures have been identified using authentic standards obtained from ether lipids of the thermophilic archaeon *Sulfolobus solfataricus*. The tricyclic biphytane (**11**), which is structurally different from that biosynthesised by *Sulfolobus*, was tentatively identified based on mass spectral data. These acyclic and cyclic biphytanes occur ether-bound at the a and w-positions and as free and ester-bound a,w-diols. Since the biphytanes derived from the membrane ether lipids of archaea were also found in oxic water column particulate matter, it was proposed that these components derive from pelagic archaea. This is consistent with recent rRNA analyses of marine bacterioplankton, which indicate that archaea comprise up to 34% of the prokaryotic biomass. In surface sediments from the Arabian Sea acyclic and cyclic biphytanes are the most abundant lipids in sediments compared to those biosynthesised by eukaryotes and prokaryotes, indicating that pelagic archaea can be a much more important source of sedimentary lipids than previously thought.

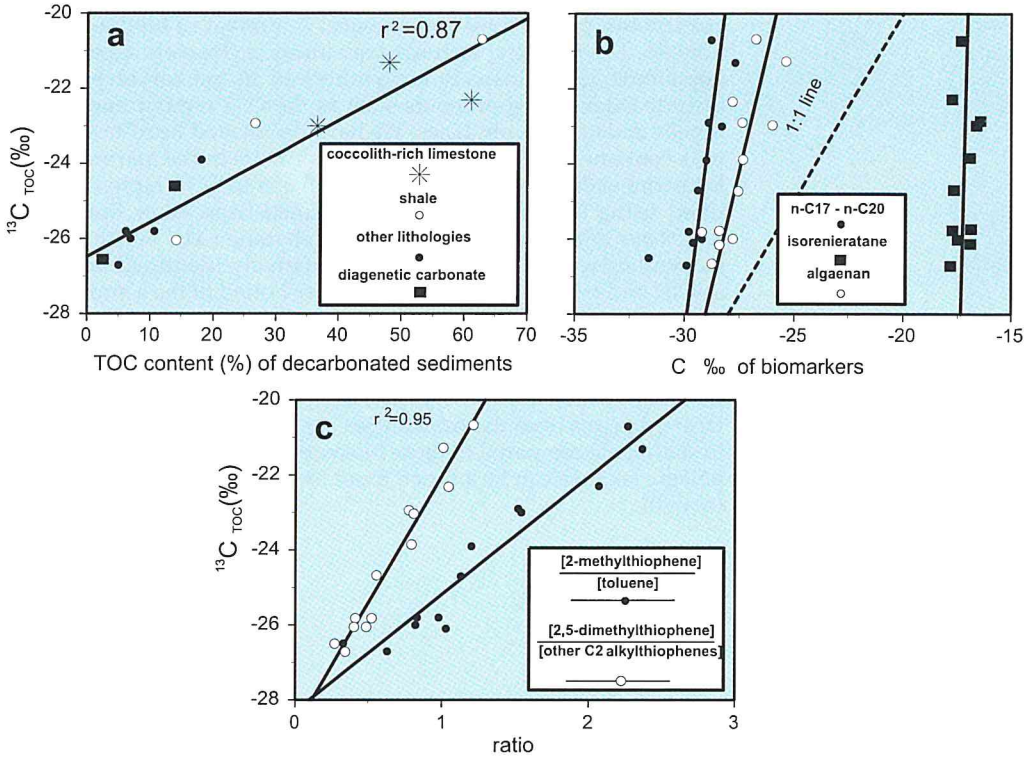
3
Sulfurisation of organic matter





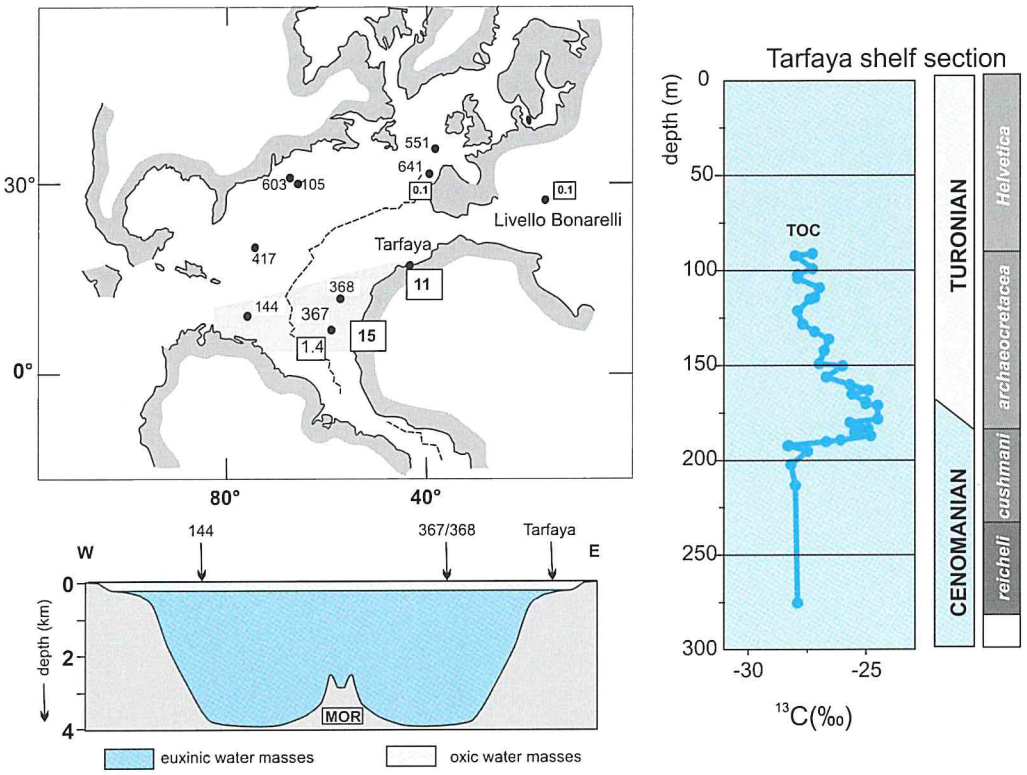
Reaction of reduced inorganic sulfur species with functionalised lipids plays an important role in the preservation of molecular palaeontological information. However, detailed knowledge about the timing and mechanism(s) of the natural sulfurisation reactions was lacking. Such information can be obtained by detailed molecular studies of recent sediments where these reactions actually take place. Analysis of organic matter in the Holocene and latest Pleistocene sediments of the euxinic Cariaco Basin recovered during ODP Leg 165 indicated an almost quantitative conversion of a triunsaturated tricyclic triterpenoid (**12**) to a monounsaturated triterpenoid thiane (**13**) through incorporation of reduced inorganic sulfur species into the isoprenoid side chain within the upper 6 m of sediments. Time control provided by AMS ^{14}C dates was used in conjunction with measured relative abundances of the two compounds to calculate the reaction rate for the sulfurisation of this triterpenoid, and empirically determine the first order rate constant (2×10^{-4} yr^{-1}) for the reaction. This is the first time that such a precursor-product relationship has been positively identified in sediments. These results are in agreement with a study of surface sediments of Ace Lake, a permanently stratified, euxinic saline lake in Antarctica, receiving only a minimal input of iron leading to reaction of reduced inorganic sulfur species with organic matter. With increasing depth in Ace Lake sediments the concentration of specific (poly)sulfide steroidal di- and oligomers significantly increases, whereas the concentration of their precursor sterols drops. At 35 cm ca. 75% of the cholestane skeleton is sulfurised. This indicates that sulfurisation of steroids takes place at very early stages of diagenesis and at low temperatures (<2°C). In both Cariaco Basin and Ace Lake sediments specific precursors are completely sulfurised within less than 10 ka.

4 Sulfurisation of carbohydrates



In contrast to the general belief that carbohydrate carbon (C_{CHO}) is preferentially degraded and is not extensively preserved in the sedimentary record, we have shown that C_{CHO} forms a large fraction of the organic matter (OM) of the total organic carbon (TOC) -rich upper Jurassic Kimmeridge Clay Formation as a result of early diagenetic sulfurisation, a previously unrecognised pathway of OM preservation. For this section there is a positive correlation between TOC and $\delta^{13}C_{TOC}$ for samples from all lithologies (*e.g.* limestones) if we correct for dilution by carbonate (TOC*). Despite the wide range of $\delta^{13}C_{TOC}$ values (-26.7 to -20.7‰), the $\delta^{13}C$ values of individual biomarkers of algal and green sulfur bacterial origin and of kerogen pyrolysis products (i.e. *n*-alkanes) show only small changes (<2‰). This indicates that changes in the concentration or ^{13}C content of dissolved inorganic carbon in the palaeowater column cannot account for the 6‰ difference in $\delta^{13}C_{TOC}$. Kerogen pyrolysates indicated that with increasing TOC*, and thus increasing $\delta^{13}C_{TOC}$, C_1-C_3 alkylated thiophenes with a linear carbon skeleton become increasingly abundant; in the case of the Blackstone Band kerogen (TOC* = 63%) they dominate the pyrolysate. Compound-specific carbon isotope determination of these thiophenes in off-line pyrolysates indicated that they are relatively enriched in ^{13}C. These thiophenes are probably derived from sulfur-bound carbohydrates in the kerogen. Algal carbohydrates are typically 5-10‰ heavier than algal lipids and differences in preservation of labile C_{CHO} through sulfurisation may thus explain the range in $\delta^{13}C_{TOC}$ values without the need to invoke any change in water column conditions. Experiments simulating the natural sulfurisation of the C_{CHO}-rich alga *Phaeocystis* sp., collected from a spring bloom in the North Sea, demonstrated that sulfurisation can indeed lead to a substantial preservation of C_{CHO}. The flash pyrolysate of the insoluble residue (after removal of hydrolysable lipids, proteins and carbohydrates) of the sulfurised cells contains abundant C_5-C_7 alkylthiophenes with a distribution similar to those observed in the Blackstone oil shale kerogen and many other recent and ancient sulfur-rich marine kerogens. These thiophenes were only trace components in the control sample, to which sulfur had not been added. Also, the amount of hydrolysable sugars decreased significantly (i.e. from 35 wt % in the initial biomass to 12 wt % in the sulfurised biomass) upon sulfurisation, indicating that carbohydrates are the probable precursor of the alkylthiophenes. These results can be explained as follows: during sulfurisation carbohydrate skeletons (i.e. predominantly C_5-C_7 linear alkanes) react through their functional groups with reduced inorganic sulfur species, generating a sulfur cross-linked insoluble macromolecular network of carbohydrate skeletons. Upon pyrolysis thermodynamically stable products (i.e. alkylthiophenes) with C_5-C_7 skeletons are formed. These results imply that preservation of C_{CHO} can exert a fundamental control on $\delta^{13}C_{TOC}$ in OM-rich sediments, complicating the interpretation of $\delta^{13}C_{TOC}$ records with regard to estimating terrestrial versus aquatic OM fractions, reconstruction of past atmospheric CO_2 levels and global carbon budget models.

5
A euxinic southern
North Atlantic Ocean



During mid-Cretaceous times large amounts of organic carbon became sequestered in "black shales", possibly due to oceanic anoxic events (OAE) characterised by the development of an extended oxygen minimum zone (OMZ). Black shale deposition occurred worldwide but was mainly concentrated in the North Atlantic Ocean. We have provided the first direct evidence for an open ocean OMZ in the Cenomanian/Turonian (C/T) southern North Atlantic Ocean and in fact showed that the base of the photic zone was euxinic as revealed by molecular fossils from photosynthetic green sulfur bacteria in C/T black shales. This, together with evidence for bottom water anoxia and accumulation of redox-sensitive trace metals and hydrogen-rich organic matter, indicates a continuously euxinic water column. Concurrent with the high organic carbon accumulation rates, which were 15-150 times greater in the southern than in the northern North Atlantic, and the low to moderate biological productivity, this suggests that preservation controlled the accumulation of organic matter in C/T black shales. The estimated low to moderate biological productivity in the C/T southern North Atlantic makes the reason for formation of the euxinic conditions enigmatic. This area can hardly be considered as a stagnant basin like the Black Sea, where euxinic conditions were established through density stratification even with a low biological productivity. The restricted connection with the South Atlantic may have promoted the development of a euxinic water column in the C/T southern North Atlantic. Furthermore, the climate was warm and equable. In absence of cold polar water the oceanic circulation was completely different from today and probably driven by the formation of warm, saline bottom water in low latitudes, which may have reduced the oxygen content of ocean waters. However, these factors certainly do not explain the formation of a continuously euxinic water column and, given the estimated low biological productivity, an external trigger seems to be required. The seawater strontium isotope record has indicated an increase in sea-floor spreading, submarine volcanism and hydrothermal activity during the C/T OAE and a recent high resolution record indicates a correlation with the C/T carbon isotope excursion. Perhaps this also substantially increased the flux of sulfide, formed by thermogenic reduction through contact with hot basalts, from the mid-Atlantic ridge to the ocean and formed a source of sulfide independent from primary production. This would indicate an upward expansion of euxinic conditions from the bottom hydrothermal centers. Such a scenario is supported by several factors. Firstly, the second largest Cretaceous extinction event coincided with the C/T OAE. This

extinction event was most significant for marine invertebrates and intermediate-water planktonic and benthic foraminifera. The sequential extinction of first benthic and subsequently intermediate-water foraminifera appears to record the gradual upward expansion of harmful, oxygen-depleted waters. Secondly, one of the major problems of the intensified OMZ model is that in sections where detailed chemo- and biostratigraphic data are available, the upward slope of the isotopic excursion of biogenic carbonate and organic carbon often predates the *Whiteinella archaeocretacea* foraminiferal zone. This zone is the major time interval where anoxic deposition of organic matter-rich sediments commenced. Since all these sections were deposited in relatively shallow waters, this must indicate that the main phase of organic carbon burial [thought to have caused draw down of atmospheric CO_2 resulting in the ^{13}C anomaly] must have taken place in deeper water sediments during or at the end of the *Rotalipora cushmani* foraminiferal zone. Indeed, at the abyssal DSDP Sites 367 and 368 accumulation of black shales seems to predate the carbon isotopic excursion.

DEPARTMENT OF PHYSICAL OCEANOGRAPHY

The department continued to work under the following main themes:
1. water circulation and hydrography of the North Atlantic
2. dynamics of (non)linear marine processes
3. physical aspects of marine ecosystems

As a part of theme 1) the last cruise of the TripleB (Bay of Biscay Boundary) programme was carried out with a 4 weeks hydrographic survey with RV Pelagia in the Bay of Biscay. This programme (funded by NWO since 1995) has contributed to the WOCE Hydrographic Programme (WHP) and the hydrographic data obtained have been submitted to the WHP Data Assembly Centre. Below a short summary of the results obtained thus far is presented.

Within theme 2) projects concerning the study of the thermohaline circulation, chaotic mixing and internal wave focussing were continued. In addition to the theoretical studies on the curious properties of internal waves, laboratory experiments on the associated class of inertial waves were carried out in the Coriolis laboratory in Grenoble.

Multidisciplinary projects in which the department was involved under theme 3) were the study of the behaviour of cohesive sediments in the Dollard, the INP-mooring project in the central North Sea, the Deep Chlorophyll Maximum (DCM) project and the application of marine optics. Some results of the detailed data analyses of the INP-mooring project are discussed below.

In spring of this year continuous observations from the TESO (Texels Eigen Stoomboot Onderneming) ferry 'Schulpengat' were started. The ferry covers the transect den Helder-Texel every 30 minutes, daily between 06.00 and 22.00 hrs. Measurements include current velocity, salinity, temperature and fluorescence. This project also serves to inform the general public on oceanographic research. It was started in the framework of the International Year of the Ocean. The measurements are presented directly on a screen in the passenger's room. Some of the first results are discussed below.

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

OBSERVATIONS FROM THE TESO FERRY 'SCHULPENGAT' IN THE MARSDIEP TIDAL INLET

Contributors: *H. Ridderinkhof, J.J.M. van Haren, F.Eijgenraam, T. Hillebrand*

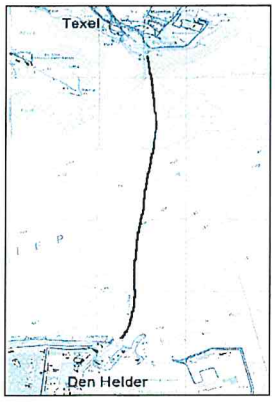
In a co-operation between NIOZ and TESO (Texels Eigen Stoomboot Onderneming) continuous observations from the ferry 'Schulpengat' are carried out, which started early 1998. The measurements include surface temperature, salinity and fluorescence as obtained from a through-flow system as well as vertical velocity and echo-intensity profiles, obtained with an Acoustic Doppler Current Profiler (ADCP). The ferry crosses the Marsdiep inlet between the North Sea and the Dutch Wadden Sea twice per hour, daily between 06.00 a.m. and 22.00 p.m. Especially the frequency and duration of the observations make that a unique data set will be obtained on (variability in) oceanographic conditions in a tidal inlet. The scientific aim of these observations is to obtain more qualitative and quantitative insight in the transport and exchange of materials between the North Sea and the Wadden Sea. This topic has a long tradition at NIOZ, a.o. through studies performed by Postma, Zimmerman and Ridderinkhof which were based on a relatively small data set from the Wadden Sea in the early seventies. This project allows more detailed studies on transport processes in the tidal inlet itself in which the focus will be on the transport of suspended sediments.

Another aim is to increase the interest of the general public for oceanographic research. Therefore observations on salinity, temperature and the current field are presented directly on a screen in the passengers room of the ferry.

The data from the through flow system show a strong variability on different spatial and temporal scales. Sharp gradients in sea surface conditions are often observed in the inlet, indicating the presence of different water masses. The sharp boundary between these water masses is visible also from the many foam lines that are often present in the inlet. The presence of these frontal zones seems to depend strongly on the phase of the tide.

A 1.5 MHz ADCP is attached near the keel of the ferry at some 4.3 m below sea surface. It records current speed and direction and echo-intensity in 0.5 m vertical bins every 4 sec. Each trip of the ferry across the inlet results in some 200 vertical profiles of each parameter.

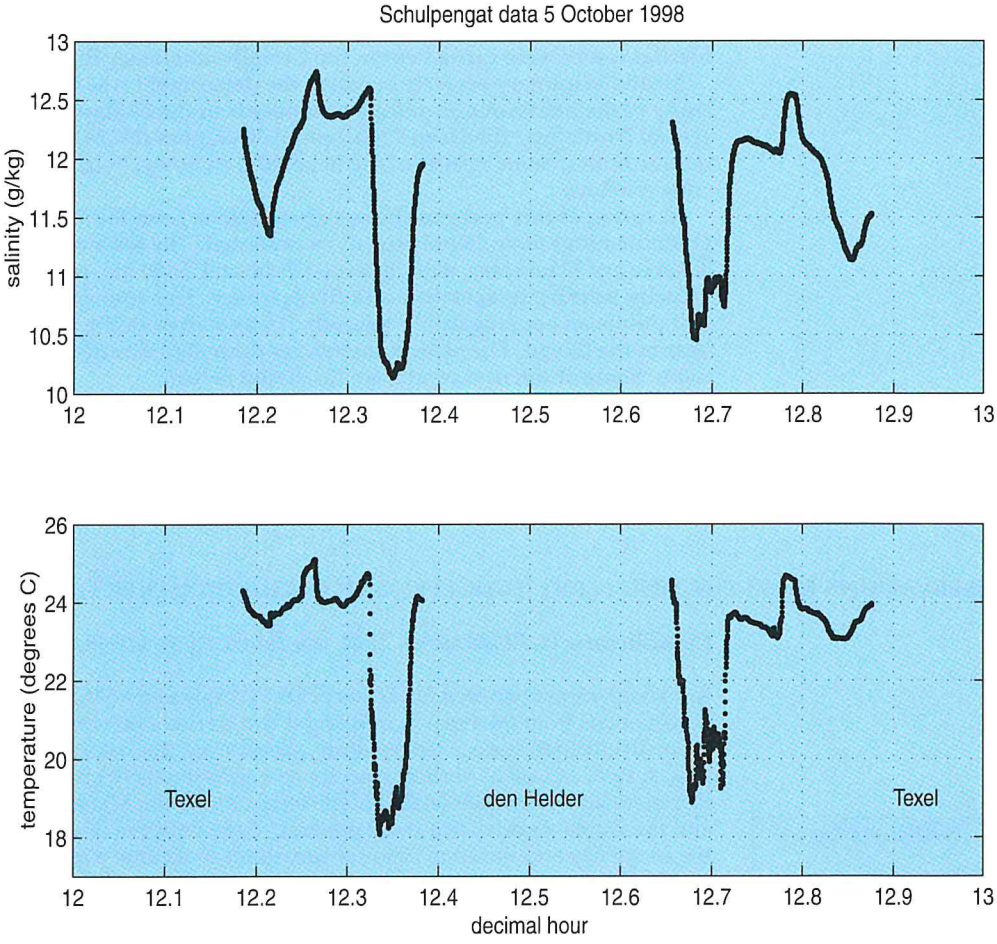
First analysis has been carried out by integrating the ADCP data over the inlet cross-section for each ferry trip resulting in a time series for the integrated water volume transport and the



Track of the TESO ferry Schulpengat between den Helder and Texel on a typical day. The ferry crosses the Marsdiep inlet each 30 min., daily between 06.00 and 22.00.

cross-section averaged echo-intensity. Harmonic analysis of this data set shows that the volume transport is dominantly tidally driven with M2, S2 and their higher harmonics (M4, MS4) being the most important tidal constituents. The analysis also shows the presence of a net flow through the inlet from the Wadden Sea towards the North Sea. This confirms previous (model) predictions on the presence of a south-ward tidally driven residual flow between the largest tidal basins in the Dutch Wadden Sea (the Vlie basin and the Marsdiep basin).

Variations in the cross-section averaged echo intensity, which is a measure for the amount of sediment particles in the water column, are strongly related to variations in the current speed. For instance, there is a strong spring-neap variability in the echo intensity. Also, the echo-intensity is significantly larger during flood than during ebb, resulting in a tidally driven net import of sediments towards the Wadden Sea. However, the observations obtained thus far suggest also that storms may cause a net export of sediments.



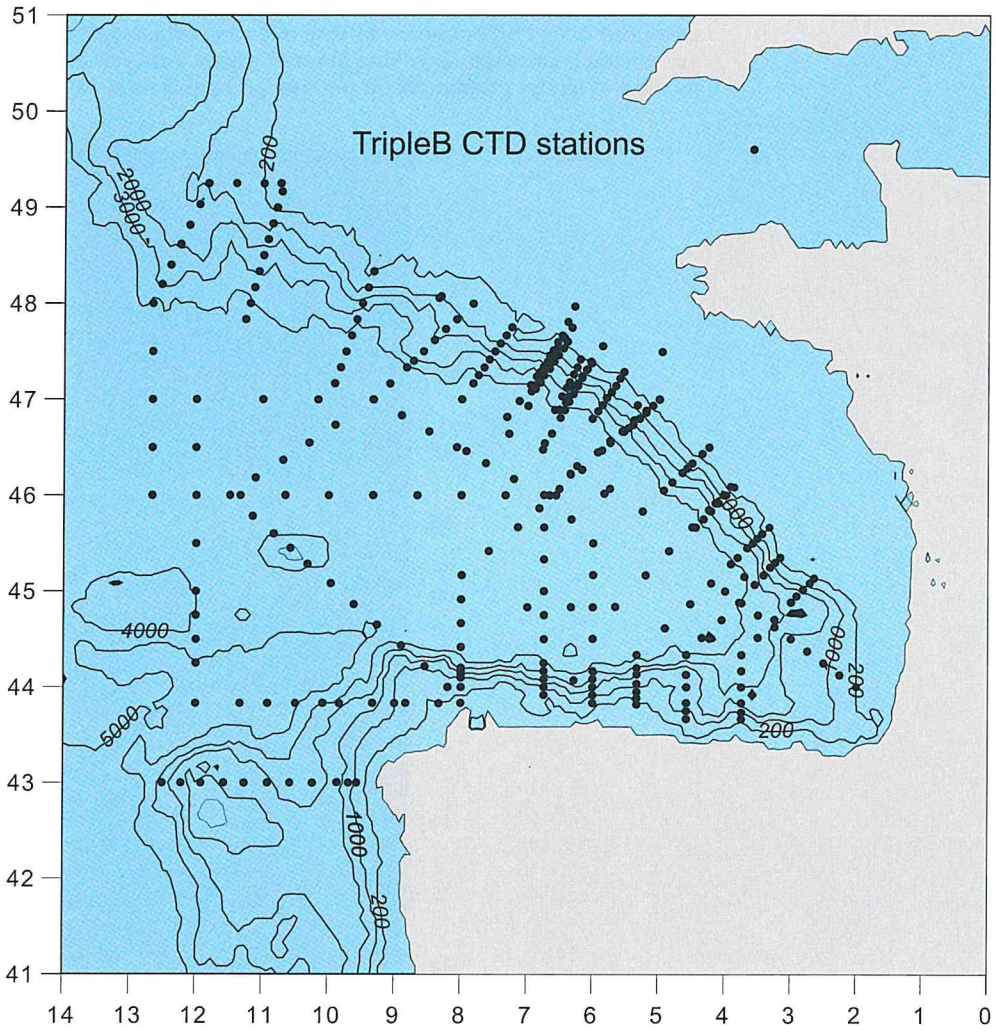
Surface salinity and temperature observed with the through flow system on 5 October 1998 between 12.00 and 13.00, covering two ferry trips. Strong spatial gradients associated with the passage of frontal zones can be observed.

Bay of Biscay Boundary Project (Triple B)

Contributor: *H.M. van Aken*

In 1992 the department of physical oceanography started research in the Bay of Biscay. Since 1995 this research was funded by NWO under the name Bay of Biscay Boundary project or TripleB. In 1998 the last research cruise in this programme was carried out. Subjects of TripleB are the kinematics and dynamics of the boundary current along the continental slope in the Bay of Biscay as well as the assessment of the importance of the boundary current for the large scale hydrography of the eastern North Atlantic and for the meridional heat and mass transports. The programme has also contributed to the WOCE Hydrographic Programme (WHP), since the research area covered part of the WHP repeat area AR12.

During the summers of 1995 to 1998 research cruises have been carried out with R/V Pelagia These covered a total of 82 ship days in the Bay of Biscay. During the TripleB project 340 CTD stations were occupied. On most CTD stations water samples have been collected for the determination of the concentrations of dissolved oxygen and nutrients. Data processing went

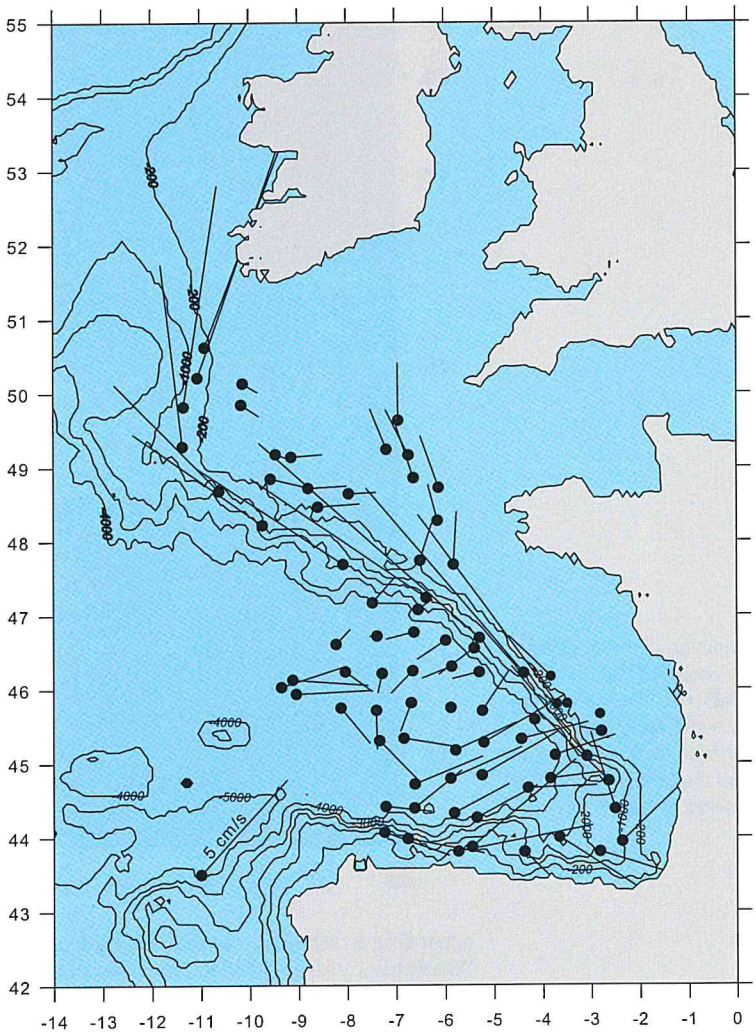


Distribution of the CTD stations occupied during the TripleB project. On most stations water samples were taken also for the determination of the concentrations of dissolved oxygen and nutrients.

according to schedule, so that the hydrographic data could be submitted to the WHP Data Assembly Centre within six months after the end of each cruise. A total of 24 current meter moorings have been deployed for one year, mainly over the continental slope. For the determination of the surface currents in the Bay of Biscay 25 ARGOS surface drifters have been deployed. These drifters were set up to relay their position daily for one year. Additionally low frequency turbulence and very high frequency internal waves were recorded in 1995 and 1996 over the continental slope with a special benthic lander. This in house developed instrument is fitted with upward and downward looking ADCPs and a fast thermistor string. Parameters to be derived from this instrument are momentum and buoyancy fluxes in a 50 m boundary layer over the continental slope. In 1998 turbulence in the upper 1000 m was measured with a free falling probe.

The data analysis for TripleB is still in a preliminary stage and most of it has to be performed in the next few years. The preliminary analysis till now has shown that the mean surface flow derived from the ARGOS drifters shows a clear seasonal variation. A pole-ward slope current can be observed only in winter. In this season it brings relatively warm and saline water towards the southern Rockall Channel near Porcupine Bank. The sub-surface flow has in general a maximum pole-ward velocity at a depth of about 1000 m, the level where the saline core of Mediterranean Sea Water is observed to spread northwards. The character of the high frequency (~tidal) velocity variations varies strongly with position and depth. At certain locations there is evidence for near-inertial waves with an amplitude of the order of the tidal current variations. Strong vertical current shears have been observed in the high frequency range. Isopycnal analysis of the distribution of dissolved oxygen and nutrients suggests a deficit of oxygen, and an excess of nutrients at depth below 2500 m in the eastern Bay of Biscay compared to the Atlantic Ocean. This may be caused by either a relatively stagnant deep circulation or by a relatively strong flux of organic matter from the surface layers. The deep isopycnal salinity distribution shows a salinity maximum along the continental slope at all levels below

the saline Mediterranean Sea Water. This salinity maximum is assumed to reflect enhanced diapycnal boundary mixing over the continental slope. Probably this boundary mixing is caused by breaking internal waves. Analysis of the turbulence measurements and lander measurements is expected to give more information on this subject.



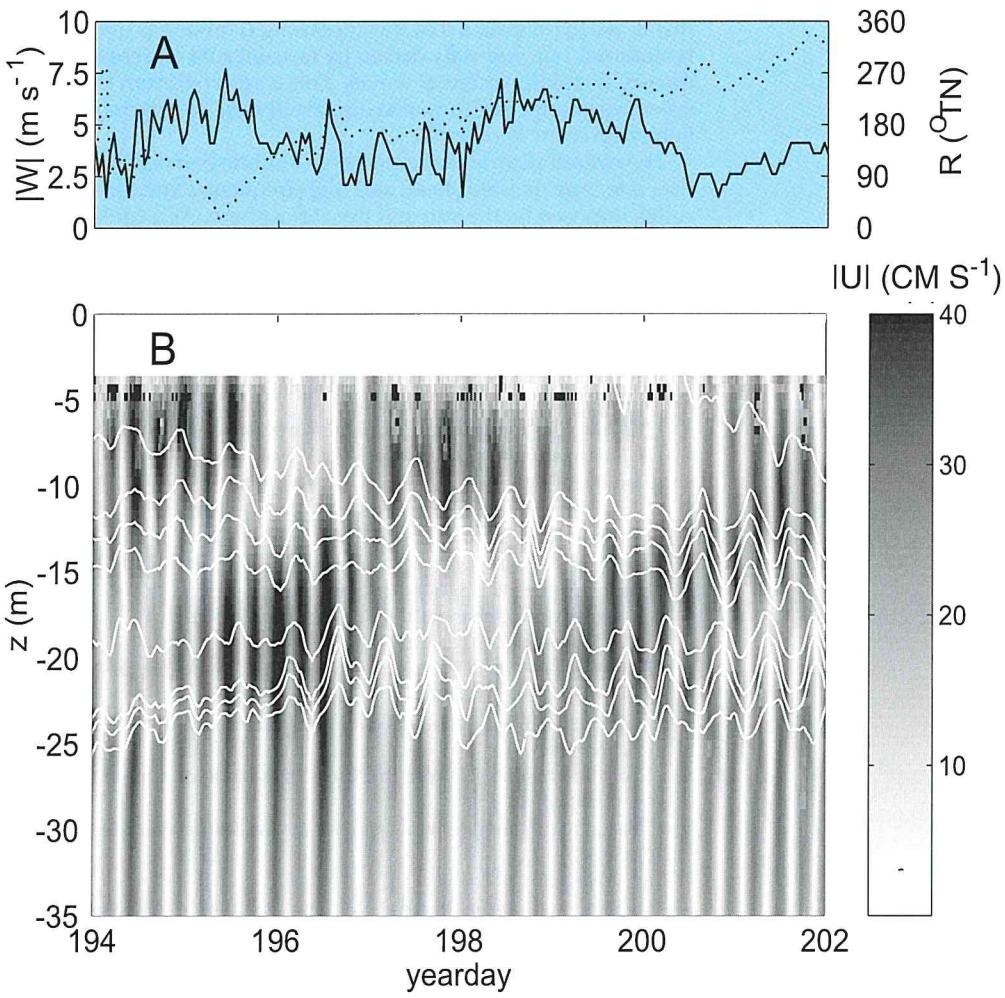
Distribution of the mean surface vectors in winter. These results have been derived from the ARGOS surface drifter data from 1995 and 1996.

STRONG INERTIAL CURRENTS AND MARGINAL STABILITY IN THE CENTRAL NORTH SEA

Contributors: *J.J.M. van Haren, L.R.M. Maas, J.T.F. Zimmerman, H. Ridderinkhof*

In summer, the heating of the sea by the sun results in a water column which becomes stably stratified in density as temperature decreases with depth, warm water being less dense than cold water. In shelf seas, wind and tidal mixing concentrate the initially gradual temperature decrease into a thin layer, the thermocline. The general view is that, by its increased stability, the thermocline impedes vertical turbulent exchange. However, once present the two stably stacked mixed layers allow for the development of slab-like motion of either of the layers, yielding vertical current differences (shear), which tend to *enhance* vertical mixing across the thermocline. This is due to their destabilizing effect on short internal waves which may grow until breaking.

During the Integrated North Sea Programme (INP) current and temperature observations were obtained which clearly showed the equilibrium resulting from this paradox of stabilizing heating allowing trapping of strong vertical current shear around the thermocline. In summer, the observed currents differ substantially from those observed in winter, as the typical semi-diurnal tidal current dominance is found only *below* the stratification. Above the bottom mixed layer, the tidal currents are superposed on motions of about equal magnitude, having a period of 14.7 hours, which corresponds to the local inertial frequency.



Observations from the central North Sea at 54° 25' N and 04° 02' E where the water depth is about 45 m. The water temperature has been monitored from surface to bottom using thermistor strings. Current measurements at 0.5 m vertical increments have been obtained from a bottom-mounted, upward-looking 600 kHz acoustic Doppler current profiler (ADCP).

a. Wind speed (W, solid line) and direction (R, dotted line), which were observed at a platform located 150 km to the south-west of the mooring.

b. Summer stratification (as presented by solid isotherms drawn every 1 °C, between 10-17 °C) and total current amplitude |U|. Above 25 m depth the amplitude varies regularly with depth and time between almost zero and about 45 cm s^{-1}, or about a doubling of the tidal current amplitude (of 20-30 cm s^{-1}). The period of variation in time is about 3.3 days, the M_2-f beat period, and maxima and minima alternate in depth between the near surface well-mixed layer and the layer between the two major thermoclines. (The bad current observations above 5-8 m depth are due to side-lobe interference).

These (near-)inertial motions accompany the adjustment towards equilibrium on a rotating earth, as generated by a variety of disturbances such as a sudden shift of direction of a moderate wind on day 195. As a result, naval current predictions charts are least reliable in summer, due to the modification of the (predictable) tidal currents by equally strong and unpredictable inertial motions. However, most conspicuous is the vertical variation of these motions, with a 180° current reversal across both major thermoclines.

The associated vertical current shear is thus much larger in summer than in winter, predominantly occurring at the inertial frequency and closely related to the varying stratification rate. Using the data shown it was found that the highest shear is found where stratification is largest, to such extent that the gradient Richardson number (Ri), a ratio of stabilization over destabilization by shear, is about constant in time, Ri $\approx$ 0.25-1. These values indicate that the flow is marginally stable, and subject to occasional bursts of mixing, despite the strong stratification, which appare2222ntly attracts equally strong current shear.

It is noted that we observed the distribution of $0.25 < Ri < 1$ during a prolonged period of calm weather *across* the stratification rather than in the weakly stratified layers in between. As a result, we hypothesize that this (occasional) mixing is not driven by stress at the external boundaries but *internally* driven by near-inertial current shear, in interaction with high frequency (breaking) internal waves. This is inferred from the distribution of high frequency internal wave energy, which is also organized near the thermoclines and, hence, near the regions of enhanced shear and low Ri.

The overall picture that emerges is a subtle balance between the (rapidly varying) stratification rate, near-inertial shear, and high-frequency internal waves, down to a well organized criticality, imposed by the sun and the atmosphere. As a consequence, the vertical transport of heat, nutrients and suspended matter, may be different than hitherto assumed, so that, for example, (observed) summer phytoplankton blooms may be triggered by increased levels of nutrients originating from the bottom during periods of calm weather.

EXTERNAL PROJECTS OF THE DEPARTMENT OF PHYSICAL OCEANOGRAPHY

- The morpho-dynamic and bio-dynamic behaviour of mud in tidal areas (NWO-BOA)
  H. Ridderinkhof, R. Van De Ham, J.T.F. Zimmerman
- Non-linear dynamics in physical oceanography (NWO-GOA)
  J.T.F. Zimmerman, G.Schramkowski, G. Van Der Schrier, L.R.M. Maas, H.Ridderinkhof
- The Bay of Biscay Boundary (TripleB; NWO-ALW)
  H.M. Van Aken, J. Ligtenberg, C. Veth, J.J.M. Van Haren, K.M.J. Bakker, M.A. Hiehle, M.T.J. Hillebrand, R.X. De Koster, M.W. Manuels, S. Ober
- Ocean Margin Exchanges II (OMEX II; EC-MAST)
  H.M. Van Aken, M.A. Hiehle, R.X. De Koster
- Processes of Vertical Exchange in Shelf Seas (PROVESS, EC-MAST)
  J.J.M. Van Haren, H.Ridderinkhof, M.T.J.Hillebrand
- Concertations on European Validation Experiments for coastal/shelf water remote sensing(CEVEx; EC)
  M. Wernand
- Coastal Surveillance Through Observation of Ocean Colour (COASTLOOC; EC)
  M. Wernand
- Coastal region long-term measurements for colour remote sensing development and validation (COLORS; EC)
  M. Wernand
- Dynamics of Internal Waves in Moving and Rotating Fluids (INTAS; EC)
  L.R.M. Maas
- Internal wave band fluxes and frontal passages above a sloping bottom in the Bay of Biscay. (EC-TMR)
  J.J.M. van Haren, J.R.Gemmrich
- Inertial Wave Attractors, use of Large-Scale Facility in Coriolis Lab Grenoble (EC)
  L.R.M. Maas

DEPARTMENT OF MARINE CHEMISTRY AND GEOLOGY

Within the department of Marine Chemistry and Geology (MCG) scientific efforts are organized within four research themes:

1. Carbon and trace metals in the oceanic water column
2. Sedimentation and sediment transport processes
3. Biogeochemistry of carbon, phosphorus, silica, and sulfur in marine systems
4. Palaeoceanography

Within each of these research themes several projects, for an important part financed by national (NWO) and international (EU) agencies are carried out. Especially for themes 1 and 4 the cooperation with marine institutes in the Bremen region (AWI and University Bremen) within the NEBROC context (started this year) has large influence for the near future. Five postdoc and PhD student positions became available for palaeoceanographic studies in the Northern and Southern Atlantic Ocean, and for studies on the inorganic carbon system in the water column of the southern- and northern Atlantic Ocean as well as in the North Sea. Also the project on cycling/preservation of biogenic Si in marine sediments , originally started as a NIOZ PhD project, is continued within the NEBROC context.

Within the framework of EU-MAST and NWO several projects, e.g. on the oceanic carbon cycle and the role of trace elements (EU-MERLIM, EU-CARUSO), on sedimentation and associated hydrodynamic conditions on the NW European continental margin (EU- ENAM; NWO-PROCS) and on early diagenesis on the Iberian margin (EU-OMEX) were continued.

CYCLING OF SILICA AND ALUMINIUM IN THE SOUTHERN OCEAN

Contributor: *A.J. van Bennekom*

The aim of the project was to study the distribution of dissolved aluminium and silicic acid in the Southern Ocean, as well as their mutual interaction via diatoms. The project started in 1981, since 1985 it was part of the Dutch Antarctic Programs (NWO Committee for Antarctic Research) and it was terminated in 1998.

Recently, it has been established that the importance of the Southern Ocean for the accumulation of biogenic silica in the sediments is significantly less than thought, because previously the effects of sediment focussing were not taken into account. In a qualitative sense, this was suspected already more than 10 years ago from the presence of unsupported ^{210}Pb down to 10-25 cm depth in the sediments below the Polar Front. Massive redistribution of loosely packed sediments caused that calculated accumulation rates for areas with submarine relief were over-estimated. Nevertheless the contribution of the accumulation in the Southern Ocean to the global silica budget, remains much larger than proportional to its area.

However, the low concentrations of Al in the frustules of 'Antarctic' diatoms result in high solubility and high dissolution rates of their biogenic silica. Rapid settling through the water column is needed to explain this paradoxical situation.

Data were collected near the Weddell-Scotia Confluence with the German RV's Meteor (SIBEX) and Polarstern (EPOS leg 2, cooperation with A.G.J. Buma and R.F. Nolting), as well as during ANT IV/4 in the entire Weddell Sea, and by J.E.E. van Beusekom with RV Marion Dufresne in 1993 (ANTARES 1). Through courtesy of A. Sandee (NIOO-CEMO) and H.J. Lindeboom additional results on the absence of 'Glacial weathering' were obtained during the Dutch expedition to Arctowski station on King George Island in the austral summer of 1990/1991.

Dissolved Al

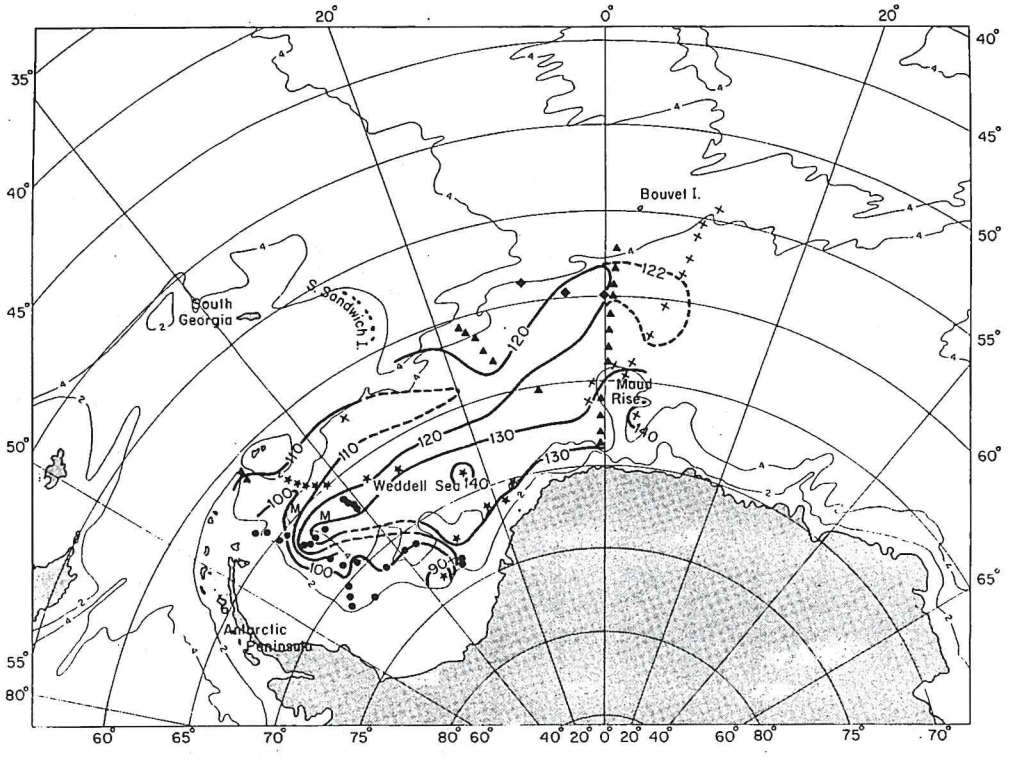
With the fluorimetric lumogallion method for the determination of dissolved Al, adapted for routine use and sufficient sensitivity at the low levels in the Southern Ocean, we measured concentrations up to to 3.1 nM in regions with melting ice, and up to 200 nM in snow samples, collected from the surface of ice floes. Dissolved Al concentrations were 1.5 nM in ice-free surface waters and about 2.7 nM in bottom waters of the Scotia and the NW Weddell Sea. Even lower concentrations were measured in the Indian sector of the Southern Ocean, 0.3-0.4 nM in near-surface waters and 1-1.5 nM in deep waters south of the Polar Front. In this region concentrations of dissolved Al in the interstitial waters of sediments were measured also. They were higher than in bottom water, 20-40 nM at depths exceeding 10 cm. Similar values were found at shallower depths in diatom-rich sediments south of the polar front, while more northerly, where terrigenous or volcanic components are present, a pronounced (up to 160 nM) subsurface maximum was observed.

Near-absence of aerosols and other products of weathering is the primary cause for the low dissolved Al concentrations in the Southern Ocean, but also absorption and scavenging by diatoms must be taken into account.

Silicic acid

The distribution pattern of silicic acid substantiated earlier observations on its use for easy detection of the Weddell Scotia Confluence in surface waters. Southward increase of nutrient concentrations in surface waters of the Southern Ocean proceeds in steps: At the Subantarctic Front, phosphate and nitrate increase stepwise, while silicic acid remains approximately constant; at the Weddell Scotia Confluence silicic acid increases stepwise, while phosphate and nitrate do not change much.

New Antarctic Bottom Water is formed below the ice shelf in the southwestern Weddell Sea. Its relatively low concentration of silicic acid is seen as a tongue of bottom water along the northern edge of the Weddell-Enderby Basin. Towards the east, silicic acid concentrations in bottom waters increase; at 52°S, 62°E a maximum of 156 µM was found. The contribution of silica recycling in surface sediments to these concentrations is extremely variable: low in the western Weddell Sea, high beneath the Polar Front and in the eastern part of the Enderby Basin.



Map of Weddell-Enderby Basin with 2000 and 4000 m depth contours and location of boxcores (+), stations with both boxcores and water column sampling (filled circles) as well as water column stations of this study (open circles) and from the literature (other symbols).

Diatom production

During EPOS Leg 2 the productivity of diatoms was studied using radioactive ^{32}Si, a novel method at that time, suitable for shipboard measurements, developed by Lindner and Tréguer. Large production of short duration was found in the Marginal Ice Zone and smaller production but of much longer duration in frontal regions. The observed Si/C ratio of up to 0.8 in 'Antarctic' diatom populations was larger than the average of 0.13 found in other regions of the world.

Aluminium in diatoms; effects on solubility and dissolution rates

Natural samples of sea water with diatoms were incubated for 10-20 days with addition of 50-100 nM Al and without addition of Al. These experiments produced diatom samples of the same species composition but with different Al content. Uptake of Al markedly decreased their rate of dissolution as well as their solubility. This effect of Al was also found for diatom species from temperate regions, and therefore it is physico-chemical. The higher dissolution rate and

solubility of 'Antarctic' diatom frustules, compared to other regions, are due to the low concentrations of Al in the Southern Ocean water.

Empty diatom frustules in sediments take up more Al than those of living diatoms. The amounts depend on the presence of minerals with a high release rate of dissolved Al (e.g. gibbsite or kaolinite). For determination of the low Al concentrations in diatom frustules from Southern Ocean sediments, the EDAX facility at NIOZ has insufficient sensitivity. Extensive use was made of the microprobe facilities, coupled to crystal spectrometers at the Free University (Amsterdam) and the Agricultural University (Wageningen).

The inverse relationship between the apparent solubility of biogenic silica and its Al-content explains most of the variation in interstitial silicic acid concentrations in opal-rich sediments.

Before the NWO Committee for Antarctic Research was established, projects in the Southern Ocean were stimulated by many persons and organisations; two should be mentioned: the late Prof. J.J. Zijlstra and the (Dutch) Committee for Antarctic Research of the International Union for the Conservation of Nature and Natural Resources (IUCN).

INTEGRATED MONITORING OF TOTAL PARTICULATE MATTER IN THE DUTCH COASTAL ZONE (RESTWAQ 2)

Contributor: *W. van Raaphorst*

Total Particulate Matter (TPM) in the water column is an important variable to monitor in coastal waters since it determines light penetration, acts as a vehicle to transporting pollutants, organic matter and nutrients, and because it relates suspended sediment transport to coastal development as well as dumping-dredging activities. To model TPM transports adequately in the coastal zone reliable synoptic distributions are a prerequisite for calibration, if possible for different seasonal and wind conditions. Such data sets can be collected by conventional seagoing expeditions with extreme efforts only. Remotely sensed data collected by satellites provide an alternative, if these data can be calibrated properly against field data and if the calibration parameters do not vary in time and/or space too much. Until present, the application of remotely sensed data for the Dutch coastal zone has been rather limited due to problems with converting these data into particulate matter concentrations. In RESTWAQ 2 we tested a novel approach in which we directly integrated data from simple physical transport modelling, in situ data of particulate matter and remotely sensed reflectance data to estimate weekly and monthly distribution patterns of particulate matter in the Dutch coastal zone. The project was funded by the Netherlands Remote Sensing Board (BCRS) within the framework of the National Remote Sensing Programme (NRSP-2), with contributions from Delft Hydraulics (leading institute), the Royal Dutch Meteorological Institute, the Institute for Environmental studies of the Amsterdam Free University, and NIOZ.

Within RESTWAQ 2, NIOZ was responsible for interpolating *in situ* observations of TPM in the coastal zone, using remotely sensed reflectance of the sea surface to optimize the interpolation algorithm. In a first attempt we tried to calculate distributions for single-week periods of 1995, combining data from the Rijkswaterstaat monitoring data base with data measured by the NOAA/AVHRR satellites (weekly composites). This attempt failed, however, due to either an

TPM distribution in Dutch Coastal zone (October 1995). Left: baed on interpolation algorithm development of NIOZ. Right: based on algorithm developed at Delft Hydrolics.

insufficient number of in situ data, or an uneven distribution of data points in the coastal zone, or poor quality reflectance images in many weeks. Therefore, we merged the *in situ* data into monthly means and used monthly reflectance composites to estimate particulate matter distributions for 8 months in 1995. Results complied well with long-term average distributions determined in earlier studies. The features dominating the particulate matter distribution in the Dutch coastal zone seem to be the input along the coast from the south and the local physical hydrography causing that particles are transported northwards while being pushed close to the coast. Local turbidity inputs, e.g. from the Rhine, seem of lesser importance.

Our results were compared with outcomes of a particulate matter transport model developed at Delft Hydraulics and with remotely sensed reflectance images which were converted to particulate matter distributions on the basis of this model by using a non-linear calibration algorithm. It was concluded that our interpolation procedure gave results which were closest to the directly measured particulate matter concentrations. However, at least some 20 *in situ* data points, uniformly spread over the area, were required to perform this procedure successfully. Even without such *in situ* data points the approach of Delft Hydraulics in which reflectance data and the transport model were combined resulted in reliable patterns of particulate matter in the Dutch coastal zone. Absolute concentrations at given positions were, however, predicted with relatively large uncertainties. Therefore an additional algorithm was developed to merge the outcomes of both our interpolation model and the Delft Hydraulics scheme. Although this procedure may introduce some redundancy (e.g. the same reflectance images are used in both approaches), it probably provides the best possible estimate of the monthly TPM concentrations at high spatial resolution (1x1 km grid) in the Dutch coastal zone.

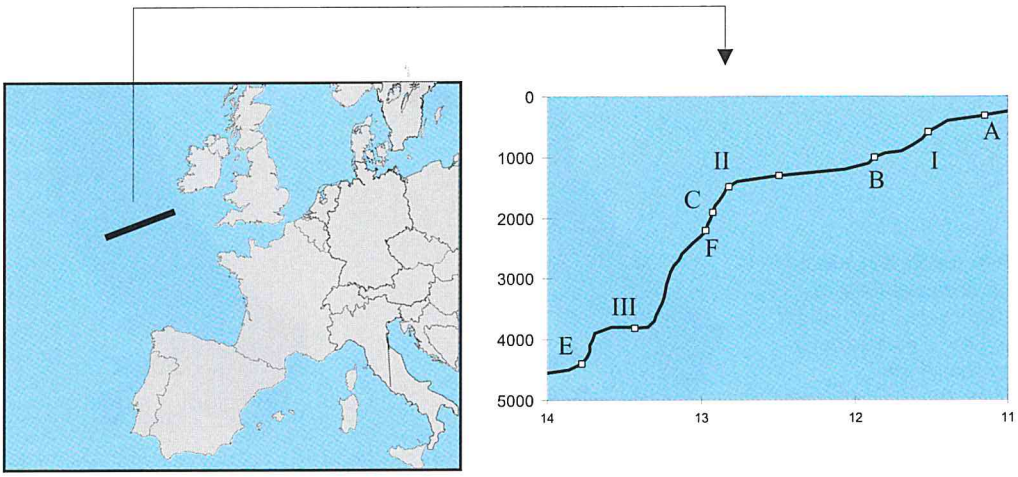
OMEX I (GEOCHEMISTRY)

Recycling of organic matter along a shelf-slope transect across the N.W. European Continental Margin (Goban Spur)

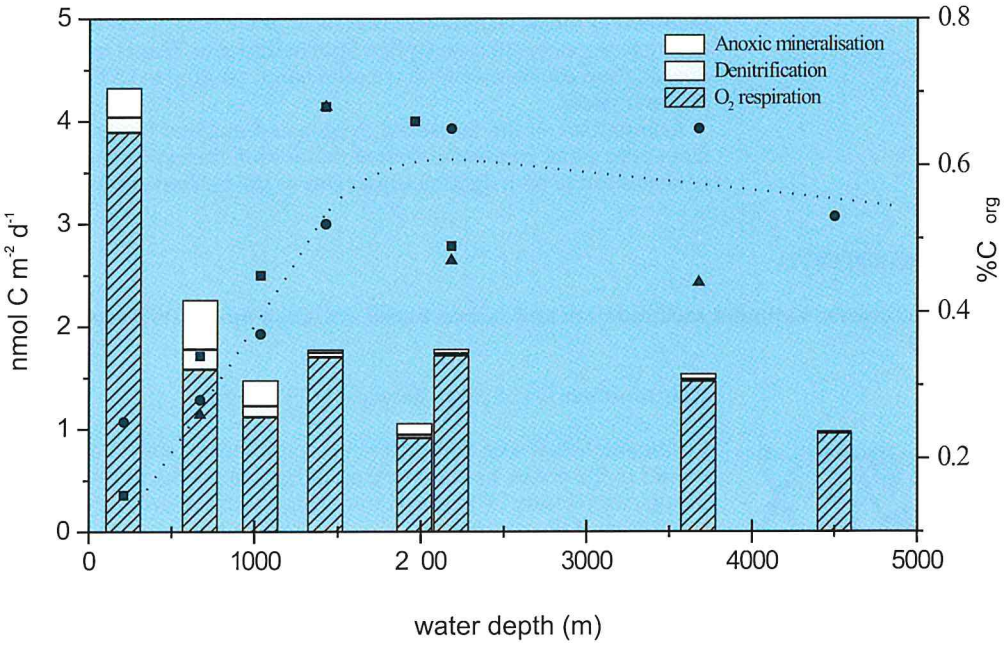
Contributors: *L. Lohse, W. Helder, E. H. G. Epping*

OMEX
Ocean Margin EXchange

High rates of particle deposition along the continental margins lead to intensified biogeochemical processes in the underlying sediments. Although continental margin sediments comprise only 11 % of the surface area of the world ocean, more than 80 % of the global benthic mineralisation takes place here. Their contribution in global biogeochemical cycles is undisputed, though considerable debate exists about the spatial variation of benthic mineralisation and preservation processes. Several studies indicate that enhanced rates of carbon mineralisation and burial occur on the upper continental slope compared to the continental shelf. This argument has been rationalised by invoking hydrodynamic forces which would allow only for temporal deposition of particulate organic matter on the shelf. As a consequence, a significant fraction of organic matter produced on the shelf should be exported towards the continental slope, where more suitable hydrodynamic conditions allow for deposition, and so-called depo-centers may be formed. Whether these depo-centers are present along the north-west European continental margin represented a primary goal within the multidisciplinary Ocean Margin EXchange programme (OMEX), sponsored by the European Community (MAST II). Our investigations concentrated on the Goban Spur transect, a shelf-slope transition in the north-eastern Atlantic, located about 250 km to the south-east of Ireland. Seven sampling stations along this transect were visited during three cruises in October 1993, May/June 1994 and September 1995.

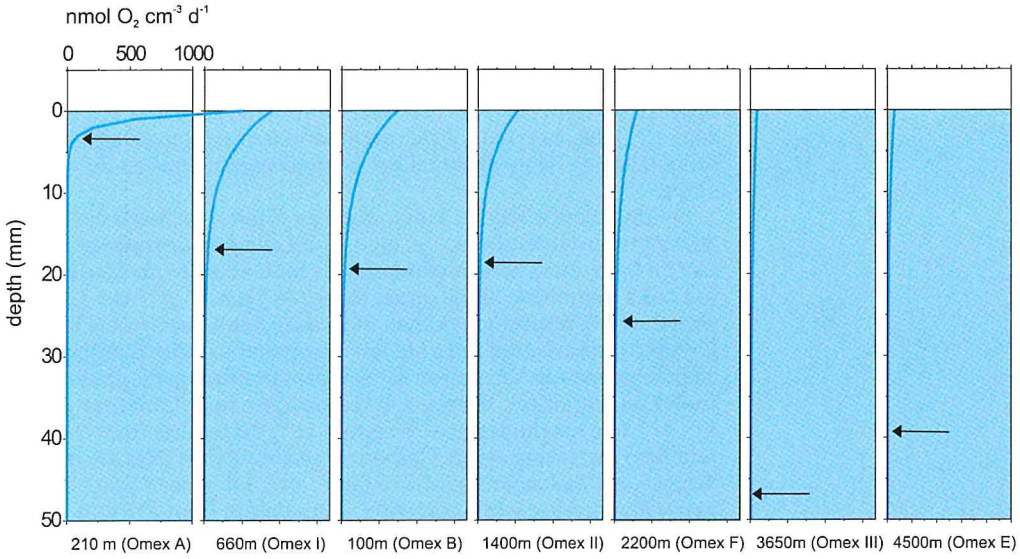


Sampling locations of the OMEX I benthic programme and cross section of the Goban Spur transect.



Depth-integrated carbon mineralisation rates specified for aerobic respiration, denitrification, and anoxic mineralisation along the Goban Spur transect. Symbols indicate the concentrations of organic carbon at the sediment-water interface. The dotted line indicates the trend of interfacial carbon concentrations with water depth.

Carbon oxidation rates were determined from the pore water distributions of oxygen, nitrate, ammonium, dissolved manganese and dissolved iron and from fluxes of these solutes across the sediment-water interface. Pore water profiles of oxygen were measured *in-situ* with a benthic lander and on-deck in sediment cores retrieved by multi-coring. With water depths increasing from 200 to 1500 m benthic carbon oxidation rates decreased from 4.3 to 1.5 mmol C m^{-2} d^{-1}, while the interfacial organic carbon concentrations increased from 0.2 to 0.7%. At stations deeper than 1500 m, no further trends with depth were found. Carbon burial efficiencies in this low-sedimentation continental margin were not related to water depth and ranged from 0.8 - 2.3%. We conclude from these data that there is no distinct carbon depocentre at the Goban Spur continental slope, this in contrast to the slope at the western North Atlantic. Integrated carbon mineralisation rates indicated that oxic respiration accounts for more than 70% of the total carbon oxidation at all stations. Substantial anoxic mineralisation was identified on the upper slope only, while the contribution of denitrification never exceeded 10% along the entire transect. Benthic oxygen fluxes showed no direct response to pulses of organic material settling on the sea floor, as appearing in sediment traps, suggesting that the organic material deposited is dominated by refractory compounds. This finding was supported by steady-state modelling of pore water oxygen profiles which showed that the organic matter mineralised is dominated by a fraction which decreases exponentially in the sediment. With increasing water depth, this



Depth-independent (R_1, dashed line) and exponentially decreasing volumetric respiration rate (R_2, solid line) profiles as calculated from modelled oxygen profiles. Arrows indicate depth at which the R_2-fraction has decreased to 95% of its value measured at the sediment-water interface. Please, note that the interfacial value for R_2 at Omex A (1403 nmol cm^{-3} d^{-1}) exceeds the y-scale.

fraction penetrates deeper into the sediment. The concomitant decreasing value at the sediment-water interface indicates that most of the organic material has lost its reactivity already before being deposited on Goban Spur sediments. This is in line with the low organic matter degradation constants which we calculated, ranging from 0.9 yr^{-1} at 600 m to 0.002 yr^{-1} at 4500 m water depth.

Comparison of the measured oxygen and nutrient fluxes with the diffusive fluxes calculated from pore water profiles indicated that within the experimental errors there was no significant contribution of bioirrigating organisms to the sediment-water exchange fluxes.

OMEX I (GEOLOGY)

Recent sediments, sediment accumulation and carbon burial at Goban Spur, NW European Continental Margin (47-50°N).

Contributors: *Tj.C.E. van Weering, H.C. de Stigter*

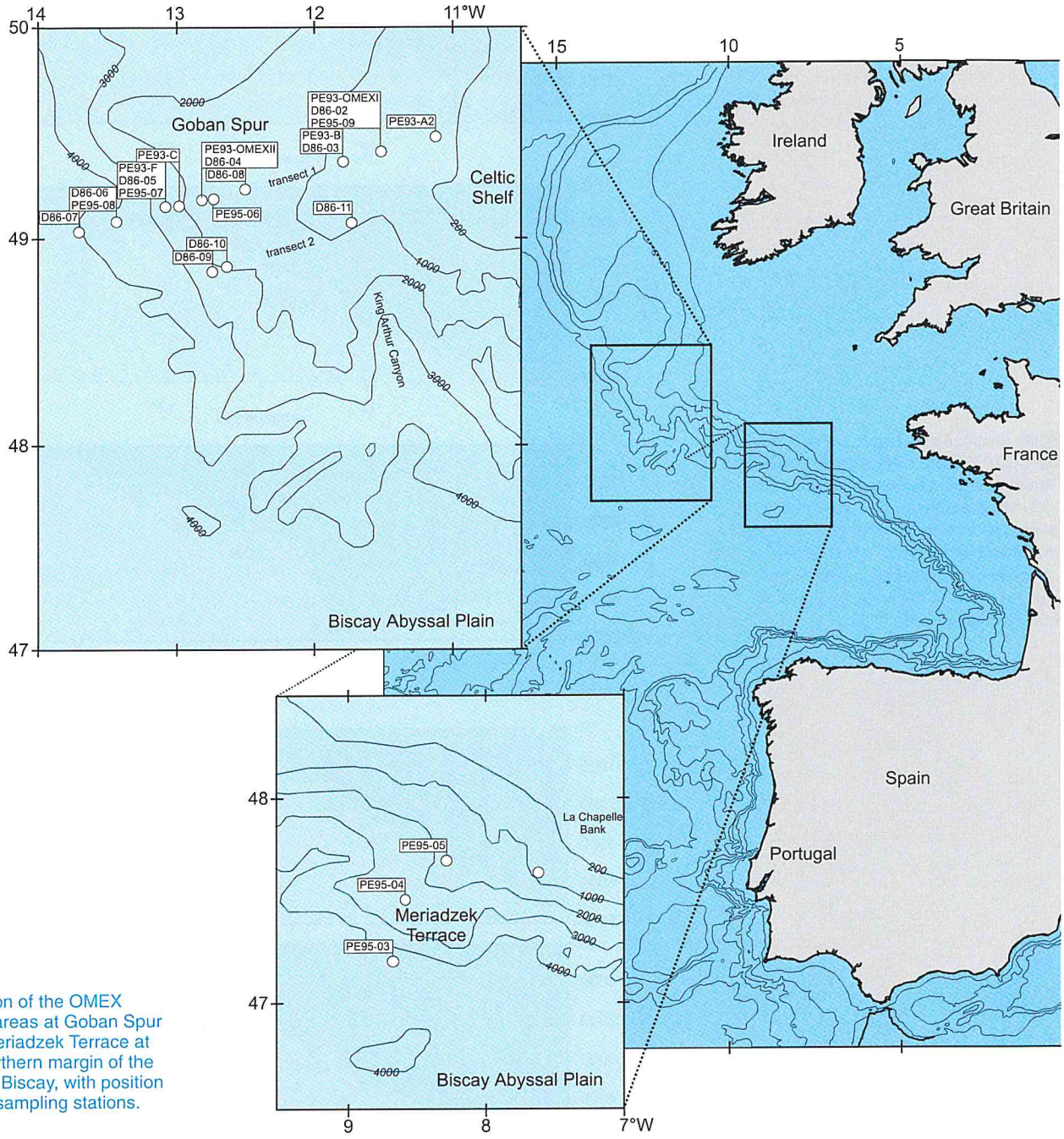
Continental shelf seas are considered an important source of dissolved and particulate organic matter to the ocean, because of their enhanced productivity and strong influence of continental inputs. Conversely, cross-slope transfer of nutrient-rich deep ocean water and local upwelling conditions at the continental slope and shelf edge may help to sustain the high productivity of shelf seas. It has been suggested that the export of particulate organic matter from the shelf leads to enhanced deposition of organic matter on the adjacent continental slope, producing so-called organic carbon depocentres. Apart from the general objective to quantify the exchange of dissolved and particulate matter across the NW European continental margin, one of the particular aims of the EU-funded Ocean Margin Exchange (OMEX I) programme was to test this 'depocentre hypothesis'.

It was our contribution to the OMEX I programme to study particulate matter distribution in the water column, benthic boundary layer hydrodynamics, and sediment characteristics on the Goban Spur and Meriadzek Terrace continental margin. Our focus on sedimentary processes was inspired by the close correlation that is generally found between mass sediment accumulation and organic carbon burial. Three transects at Goban Spur and Meriadzek Terrace were extensively studied by repeated sampling of the water column and bottom sediments. Benthic boundary layer hydrodynamics on the upper slope were recorded over a period of more than two years with the BOBO I benthic lander.

The recent sediment distribution and characteristics appear to be directly related to the near-bed hydrodynamic regime at the margin. From the shelf to the abyssal plain the surface sediments at Goban Spur grade from mixed lithoclastic-bioclastic silty sand into hemipelagic clayey carbonate ooze, with the median grainsize decreasing from about 100 µm to 10 µm. The presence of winnowed foraminiferal sand on the slope break at Goban Spur is consistent with relatively high current velocities (>20 cm s^{-1}) measured in the area, resulting in periodical off-slope (SW-W) and along-slope transport of particles, and in entrainment of particles in a bottom nepheloid layer.

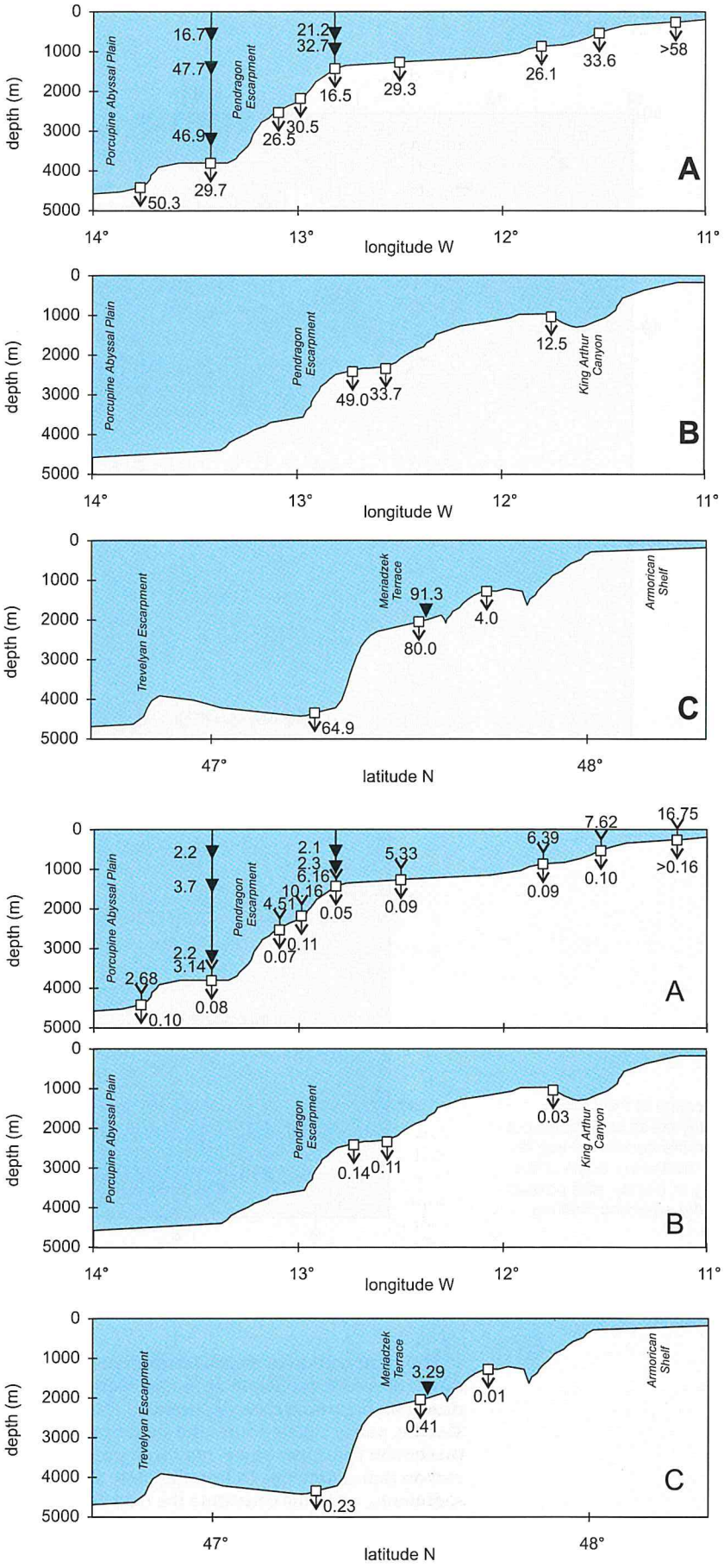
^{210}Pb activity decreases exponentially downcore, reaching a stable background value at about 10 cm (shallower stations) to 5 cm (deeper stations) sediment depth. As sedimentation rates in the area are consistently below 0.1 mm yr^{-1}, the presence of excess ^{210}Pb (halflife 22.3 yr) down to several centimetres depth must by attributed to biological mixing of the sediment. ^{210}Pb profiles of repeatedly sampled stations show negligible annual variability. ^{210}Pb flux to the sediment decreases with increasing water depth. Below 2000 m the flux of ^{210}Pb is of the order of 0.3 dpm cm^{-2} yr^{-1}, about a third of the shelf and upper slope values. Sediment mixing rates (D_b) decrease with water depth down the slope, along with decreasing macro- and meiofaunal density. They likely reflect reduced organic carbon fluxes at the deeper part of the slope.

Sediment mass accumulation rates are highest on Meriadzek Terrace, with a maximum of 80.0 g m^{-2} yr^{-1}, about twice as high as at Goban Spur stations of comparable water depth. On Goban Spur, mass accumulation rate is highest at the shelf edge (>58 g m^{-2} yr^{-1}), decreasing toward a minimum on the upper slope (16.5 g m^{-2} yr^{-1} and 12.5 g m^{-2} yr^{-1} in Goban Spur transects 1 and 2, respectively), then increasing again toward the foot of the continental slope. Organic carbon burial rates are low compared to other margins, and appear closely coupled to sediment mass accumulation rates. A maximum organic carbon burial rate of 0.41 g m^{-2} yr^{-1} is found on Meriadzek Terrace. On Goban Spur, burial rates range between a minimum of 0.03 g m^{-2} yr^{-1} to a maximum of >0.16 g.m^{-2}.yr^{-1}, decreasing from the shelf toward the upper slope, and then increasing again. Carbonate accumulation rates are once again highest on Meriadzek Terrace, with a maximum of 44.5 g m^{-2} yr^{-1}. On Goban Spur, carbonate accumulation rates generally increase with increasing water depth, from >13 g m^{-2} yr^{-1} at the shelf edge to 30.7 g m^{-2} yr^{-1} at the foot of the slope.



Location of the OMEX study areas at Goban Spur and Meriadzek Terrace at the northern margin of the Bay of Biscay, with position of the sampling stations.

The combination of organic-carbon poor sediments and only moderate sediment mass fluxes observed on Goban Spur and Meriadzek Terrace is clearly unfavourable for the formation of an organic carbon depocentre. The protruding geometry of Goban Spur and Meriadzek Terrace, partly isolated from the shelf by submarine canyons, and relatively strong currents present on the upper slope, may well prevent substantial deposition of shelf-derived organic-carbon rich sediments. In fact, the more sheltered canyons may act as traps for shelf-derived sediments, and thus constitute the true depocentre for organic carbon on the NW European margin.



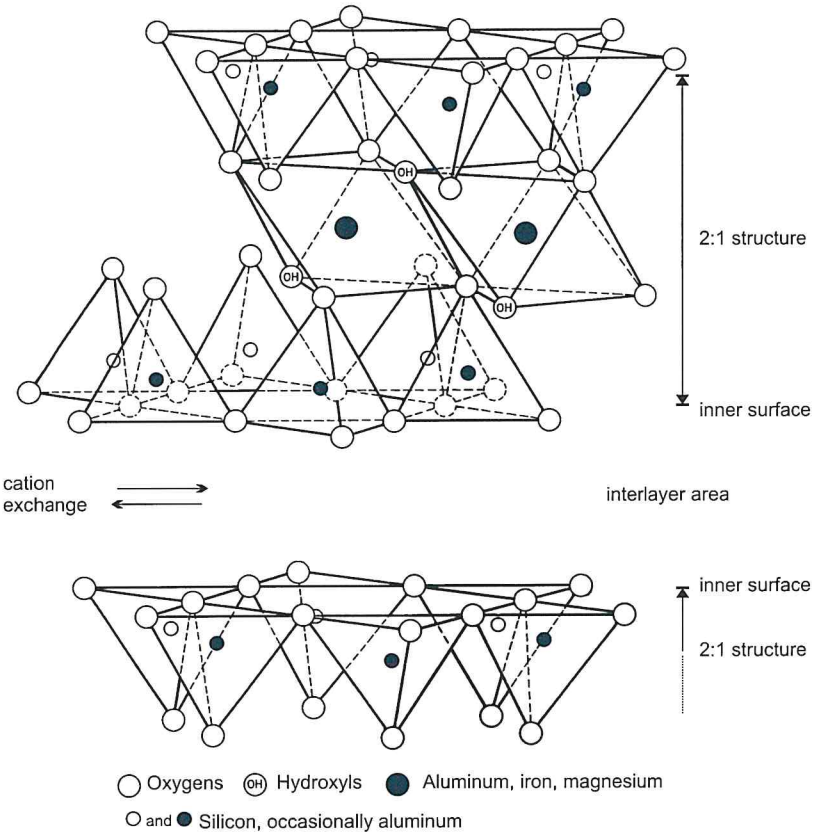
Mass accumulation rates along Goban Spur transects 1 and 2 and along the Meriadzek Terrace transect (values below bottom profile). Mean annual mass fluxes measured in sediment traps by Antia et al. (Goban Spur) and Vangriesheim et al. (Meriadzek Terrace) are shown for comparison (values next to solid triangles in the water column). All fluxes are expressed in g m^{-2} yr^{-1}.

C_{org} burial fluxes (values below bottom profile) along Goban Spur transects 1 and 2 and along the Meriadzek Terrace transect. Values shown above the bottom profile represent benthic C_{org} mineralisation rates measured by Lohse, Helder and Epping, and values in the water column are mean annual C_{org} fluxes through the water column measured in sediment traps by Antia et al. (Goban Spur) and Vangriesheim et al. (Meriadzek Terrace). All fluxes are expressed in g m^{-2} yr^{-1}

UNRAVELING THE STRUCTURE OF INTERLAYER COMPLEXES OF CLAY MINERALS

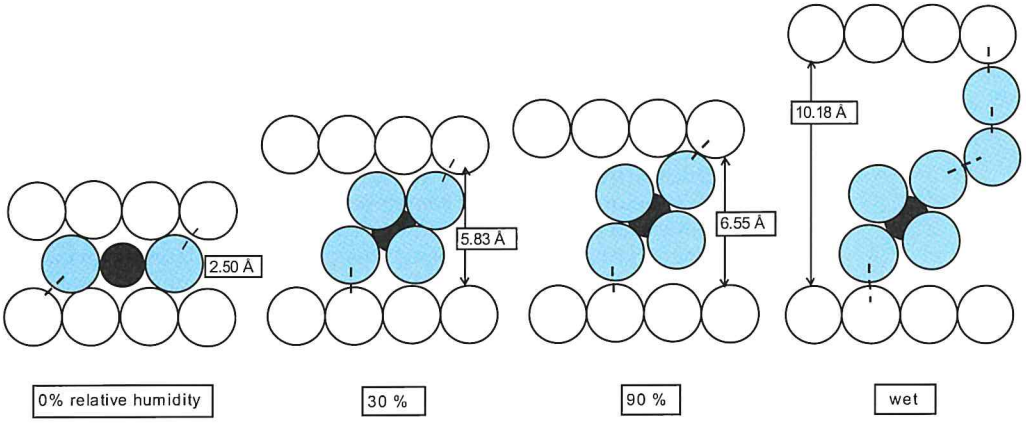
Contributor: *S.J. Van der Gaast*

Clay minerals play an important role in preservation and transformation of organic compounds and in the absorbtion of inorganic ions (e.g. NH_4^+). This is related to their charged layered structure by which they are able to bind charged and also uncharged compounds. Unraveling the structure of interlayer complexes is important to understand (early) diagenesis of organic matter and element cycling in marine sediments. Smectite is one of the most interesting clay mineral groups, it displays large charged surfaces, larger than most other clay mineral types due to its interlayer spaces. Moreover, smectite is a ubiquitous constituent of soils, but also of marine sediments. Knowledge of the structure and layer morphology of smectites is important to understand their binding capacity.



Structure of montmorillonite. Clay minerals contain two-dimensional tetrahedral sheets in which individual tetrahedra are linked with neighbouring tetrahedra by sharing three corners each to form a hexagonal mesh pattern. The fourth tetrahedral corner forms part of an adjacent octahedral sheet in which individual octahedra are linked by sharing octahedral edges. An octahedral sheet is sandwiched between two tetrahedral sheets, of which one is inverted, thus forming a so-called 2:1 layer. Montmorillonite particles consist of a number of these layers which are laterally stacked.

During several years formation of smectite from a range of rock-forming materials was studied at the NIOZ. Layer morphology of smectite is strongly determined by the water content and its structure in the smectite interlayer. To study this, Ca-exchanged montmorillonite (Wyoming, USA), which is a member of the smectite clay mineral group with the chemical composition $M_{0.75}[Si_{7.75}Al_{0.25}](Al_{3.5}Mg_{0.5})O_{20}(OH)_4$ (M= monovalent metal), was measured at varying relative humidities. The Ca^{2+} ion was used because bivalent cations tend to give a better defined hydration complex than that of monovalent cations and because Ca-montmorillonite displays the hydration transition-zones best. The largest volume of the interlayer of smectites is occupied with water molecules. These water molecules interact with each other, with the surface oxygens of the clay inner surface, and with the charge-compensating exchangeable cations. Depending on the cation and the relative humidity, a variable amount of water can be taken up in the interlayer spaces. The water absorbed by smectites consists of the water solvating the exchangeable cations in the interlayer spaces, and the water in external regions (for example, external surfaces and micropores). To study the water organization of smectite spectroscopic techniques have been used frequently. Then, however, the sum of the two types of water is measured. To measure the water organization of the interlayer spaces only we used X-ray powder diffraction. With this technique the dimension of the interlayer space perpendicular to the layers (the basal spacing) was measured, from which the organization of the water molecules in the interlayer was inferred.



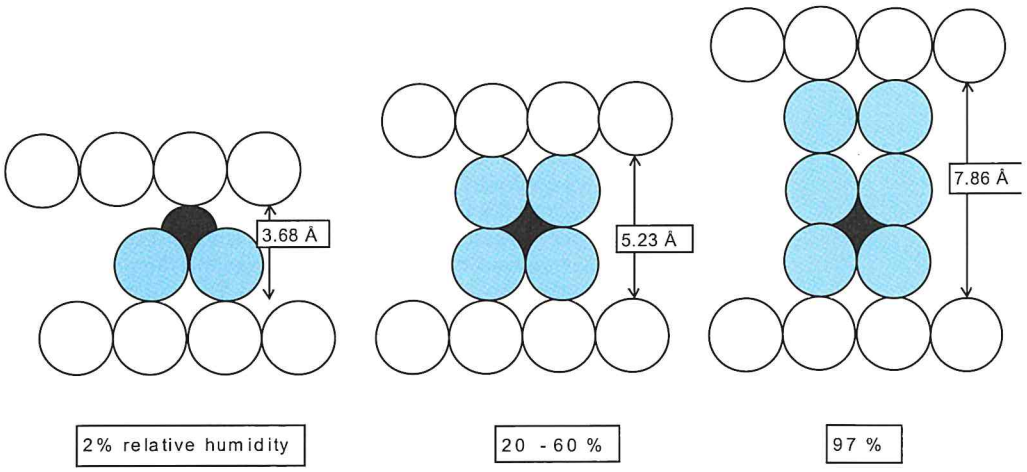
2-dimensional view of the octahedral hydration complex, $[Ca^{2+}(H_2O)_6]$, in the interlayer of montmorillonite at different relative humidities. Open circles: oxygens of the clay layers; circles filled with wave pattern: water molecules; black circles: Ca^{2+} ion; broken line: hydrogen bond.

For Ca-montmorillonite two different structures of water in the interlayer could be distinguished. One of these was described in literature earlier. Due to charges in the tetrahedral sheets of the montmorillonite some water molecules of the octahedral hydration complex $[Ca^{2+}(H_2O)_6]$ are hydrogen bonded to oxygens of the clay inner surface. Upon increasing the relative humidity from 30 to 90% the montmorillonite gradually expands its interlayer space from 5.83 to 6.55 Å, which is caused by non-coordinated water molecules entering the interlayer spaces with increasing numbers.

We concluded that the hydration complex is able to tilt and thereby keeping the clay layers together. At wet conditions the interlayer spacing expands further to 10.18 Å; some water molecules are then joining the hinging points of the hydration complex. The number of water molecules and their O-H angles thus determine the maximum interlayer spacing.

We detected another water structure that kept the interlayer spacings stable at a somewhat smaller distance of 5.23 Å between 30 to 60% relative humidity. At 97% relative humidity the spacings expanded towards 7.86 Å. Our data showed that the interlayer spacings changed stepwise with increments of the size of an O^{2-} ion (2.63 Å) upon increasing relative humidity. However, due to the hydrogen bonds, the distance of water molecules in water normally is 2.76 Å. This suggests that hydrogen bonds were absent between the water molecules of the hydration complex and the oxygens of the clay layers. The hydration complex may now be situated opposite to the charges in the octahedral sheets, thus excluding the possibility for hydrogen bonding to oxygens of the clay inner surface. From calculations it was concluded that the water molecules in this case were coordinated in a cubic modification $[(Ca^{2+}(H_2O)_8]$. Such a coordination for Ca was predicted some 40 years ago by L. Pauling. Difference in opinion in the literature concerning absorption processes on Ca-smectites could originate from the presence of these two types of water structures in the interlayers.

This work was done in cooperation with R.A.Kühnel from ITC in Delft, R.L.Frost from Technical University of Brisbane, and J.Vasterink from Philips in Almelo.



2-dimensional view of the cubic modification of the hydration complex, $[(Ca^{2+}(H_2O)_8]$, in the interlayer of montmorillonite at different relative humidities. Note the absence of the hydrogen bonds.

EXTERNAL PROJECTS OF THE DEPARTMENT OF MARINE CHEMISTRY AND GEOLOGY

- Air-sea carbon-dioxide fluxes (NWO-NOP II)
  H.J.W. de Baar, M.H.C. Stoll
- Teluk Banten: Coastal marine sediments and sedimentation (NWO)
  T.C.E. Van Weering, G. Van De Berg, W. Boer
- Trace elements-Phytoplankton interactions (NWO-NAAP)
  H.J.W. de Baar, J.T.M. De Jong, R.F, Nolting
- Cycling of silicate (NWO)
  A.J. van Bennekom, E. Koning, G.-J.A. Brummer, J. Van Iperen
- Biological availability of trace elements
  H.J.W. De Baar, K.R. Timmermans
- Neogene history of the Benguela Current
  J.H.F. Jansen
- Sedimentary manganese and iron cycles (SMILE; NWO-GOA)
  W. Van Raaphorst, C. Van Der Zee, W. Helder, J.F.P. Malschaert
- European North Atlantic Margins (ENAM; EC-MAST)
  T.C.E. Van Weering, H.J. De Stigter, H. De Haas, W. Boer
- Remote sensing of water quality (RESTWAQ; BCRS)
  W. Van Raaphorst
- Air-sea gas exchange of MAGE (ASGAMAGE; EC-MAST)
  H.J.W. De Baar, M.H.C.Stoll
- Marine ecosystem regulation: Trace metals and carbon dioxide regulation (MERLIM; EC-MAST)
  H.J.W. De Baar, K.R. Timmermans, R.F. Nolting, J.T.M. De Jong
- Mass transfer and ecosystem response (MATER; EC-MAST)
  W. Helder, E. Koning, H.T. Kloosterhuis
- Autonomous lander instrument packages for oceanographic research (ALIPOR, EC-MAST)
  W. Helder, T.C.E. Van Weering, L. Lohse, H. Franken, B. Koster, E.H.G. Epping
- Biogases in European estuaries (BIOGEST; EC-MAST)
  W. Helder, H.P.J. De Wilde
- Ocean margin exchanges (OMEX; EC-MAST)
  W. Helder, T.C.E. Van Weering,, W. Van Raaphorst, W. Boer, J.C. Van Ooyen, K. M.J. Bakker, H.T. Kloosterhuis, L. Lohse, H.J. De Stigter, H. De Haas, E.H.G. Epping
- Combined action to study the oceans thermal skin (CASOTS, EC-MAST)
  H.J.W. De Baar, M.H.C. Stoll
- Entangled sulfur and carbon cycles in phaeocystis dominated ecosystems (ESCAPE; EC-MAST)
  M.H.C. Stoll, H.J.W. De Baar
- Carbon dioxide uptake by the Southrn Ocean (CARUSO; EC-MAST)
  H.J.W. De Baar
- Atlantic data base for exchange processes at the deepsea floor (ADEPD; EC-MAST)
  W. Helder

DEPARTMENT OF MARINE BIOGEOCHEMISTRY AND TOXICOLOGY

The field of research that MBT addresses, involves the basic disciplines of chemistry, geology and biology. Within this field, the basic questions of MBT are:

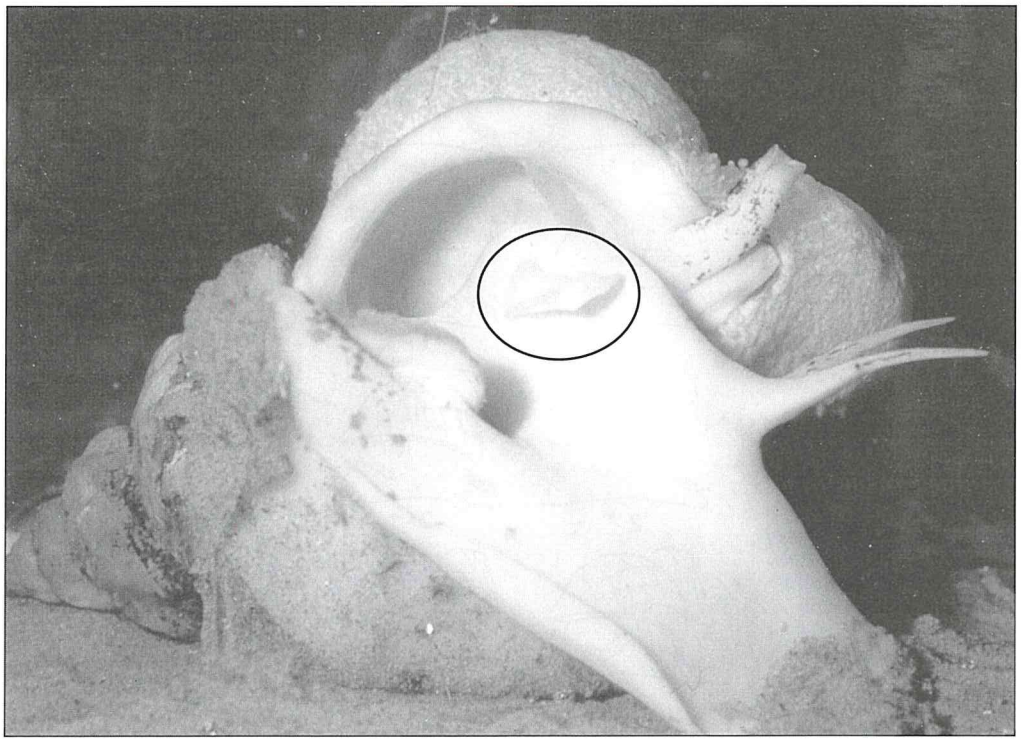
- **Which organic compounds (of natural or anthropogenic origin) are present in the different compartments of the marine environment?**
- **What are the reaction pathways involved in their biosynthesis, biotransformation and diagenesis?**
- **Can the reaction rates be determined and how are these affected by environmental conditions?**
- **In the case of biogeochemistry an additional important question is: when did the reactions take place (geological component)?**
- **In the case of toxicology an additional important question is: what are the biological effects of the observed concentrations of the parent compounds or their reaction products?**

Research is divided into two departmental themes; Biogeochemistry and Environmental Chemistry & Ecotoxicology. Both are intimately related to the NIOZ prioritised research area ' transfer of energy and matter in 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'.

IMPOSEX FORMATION IN THE COMMON WHELK, *BUCCINUM UNDATUM*, BY TRIBUTYLTIN FROM ANTI-FOULING PAINTS ON SHIP HULLS.

Contributor: *B.P. Mensink*

Tributyltin (TBT) is the active biocide in anti-fouling paints which are applied to prevent the attachment of biota to the ship hull. A smooth hull optimizes operational speed and minimizes fuel consumption. However, TBT also shows environmental effects on non-target species. An effect occurring at low environmental concentrations is the occurrence of imposex in mainly coastal snail species. Imposex is the development of male sexual characteristics (a penis and a sperm duct) in female animals. In 1991, imposex was first shown to occur in the open sea in common whelks (*Buccinum undatum*) from the Central and Southern North Sea. The imposex frequency was positively correlated to shipping traffic intensities in that area. This illustrated that the occurrence of imposex was not restricted to areas in the vicinity of harbours and marinas, which was the axioma for TBT policy at that time.



Female whelk with penis homologue (encircled). Photo: Hans Kralt.

This project was initiated to study the mechanism of imposex and the sensitivity of *Buccinum undatum* towards TBT, particularly to:

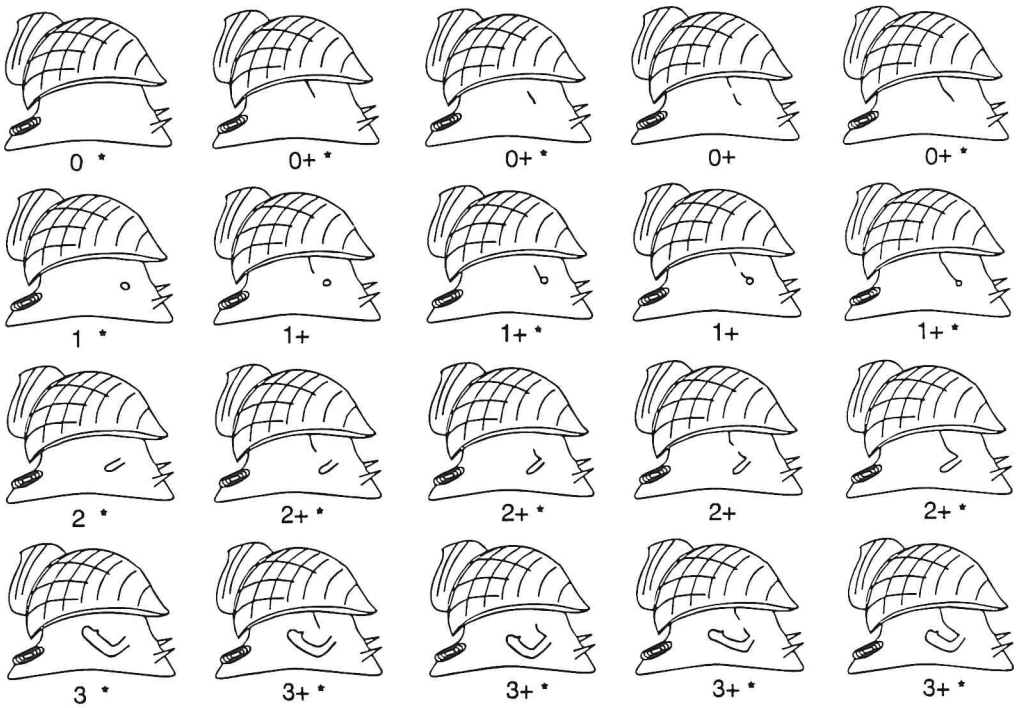
1. assess the dose-effect relationship of TBT for imposex in *B. undatum*;
2. determine the consequences of this masculinisation process for *B. undatum* with respect to growth and reproduction;
3. identify other important factors that may influence population developments of *B. undatum*.

In two laboratory experiments, whelks of different ages were chronically exposed to different levels of dissolved TBT. The masculine development as affected by TBT differed between life stages. A dose dependent masculinisation (first penis and later sperm duct development) of whelks exposed from the egg phase was observed at TBT concentrations ≥17 ng TBT l^{-1} during the first months of their development. Two-years old presumed females showed primarily sperm duct development as a first characteristic of exposure to TBT. In contrast, adult females did not show any masculinisation despite an 11 month exposure period to concentrations up to 1 µg TBT l^{-1}. Transplantation of eggs from a heavily (TBT) contaminated environment to 'clean' Wadden Sea water showed that only exposure after emergence from the egg is affecting sexual development. After 5 years in the experimental set-up, only the two largest females of the non-exposed reference group produced eggs. This did not result in off-spring, since the males had not fully matured.

Histological examination of two years old whelks showed they had not yet developed their gonads, which made it impossible to discriminate between the sexes. The complete formation of a sperm duct and a penis in the absence of a gonad suggests that the formation of these organs is not controlled by the gonads, but is a neuro-endocrine process. Because no other sexual organ was observed in the histological studies than those already visible with the eye, our method for the imposex determination of whelks on board is a reliable, gentle and non-invasive method, which has therefore been proposed as a biomonitoring method for TBT contamination in open seas in the SIME (Substances in the Marine Environment) working group of the Oslo and Paris Commission (OSPARCOM).

In vitro assays with whelk microsomes showed the presence of a cytochrome P450 enzyme system, which could be dose-dependently inactivated by exposure to TBT. This might be important because the cytochrome P450 system is also involved in the regulation of steroid hormones, which regulate the reproduction process in vertebrates.

Field studies on imposex in *B. undatum* were carried out in the Eastern Scheldt and the North Sea. These studies resulted in an overview of all kinds of possible variations in stages of imposex development. Of the whelks caught in the Eastern Scheldt, more than 90% of the females showed imposex, of which more than 50% showed the most advanced stages, characterised by the formation of a considerable curved penis and a sperm duct (stage 3). The sperm duct

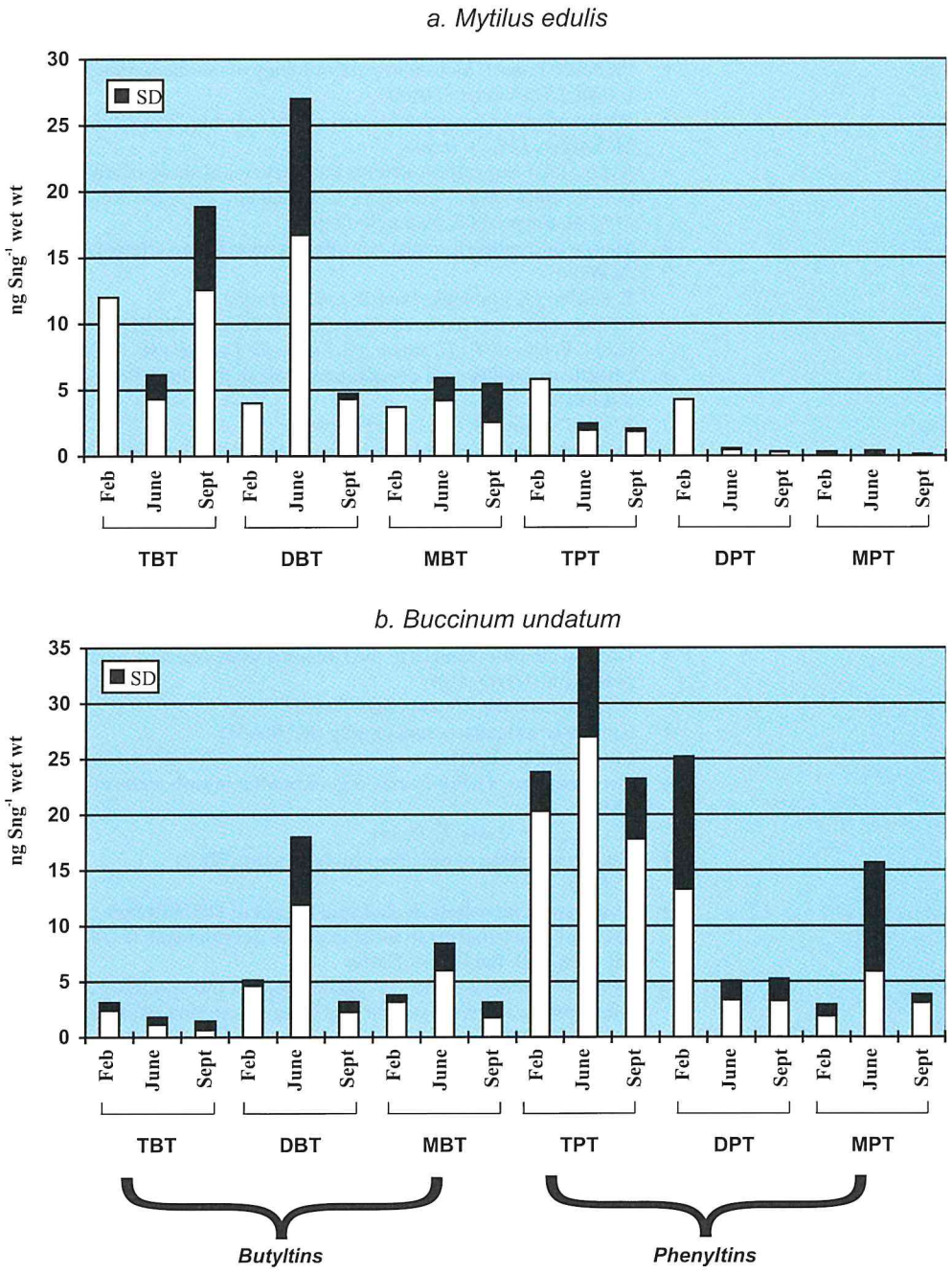


Assumed possible stages of imposex in Buccinum undatum. The stages that have been observed in field (North Sea, Eastern Scheldt) and laboratory studies are indicated with an asterisk.

started in the mid-ventral section of the egg-capsule gland without disturbing the cell organisation. Despite these high imposex rates, occlusion of the genital pore as observed in the most advanced stages of imposex in the dogwhelk (*Nucella lapillus*) was never observed. These females developed normal oocytes which were apparently fertilised, since sperm cells were observed in the sperm-ingesting gland.

Imposex females from the North Sea showed only stages 1 and 2 (without the development of a sperm duct). In view of the observations in the Eastern Scheldt, it is unlikely that reproduction has stopped in these lightly affected animals, but smaller effects cannot be excluded.

Beam trawl fishery seems to affect whelk populations adversely, since in a laboratory survival experiment the damage inflicted by the heavy tickler chains caused increased mortality compared to whelks caught with baited traps. In the field, whelks with shell damage may also be more vulnerable to predator attack when they can no longer withdraw their soft parts fully into the broken shell.



Levels of organotins in whelks and mussels (main food) from the Eastern Scheldt. Besides butyltins, also phenyltins were found. Triphenyltin (TPT) is mainly used in agriculture as a fungicide in potato growth, but it is also added to some formulations of anti-fouling paints. Levels of TPT were clearly biomagnified from mussel to whelk, but TBT was not, because it is apparently dealkylated more rapidly in the whelk than TPT.

In summary, beam trawl fishery can be considered as a major source for direct mortality, whereas exposure to TBT can impair development, resulting in maturing at a higher age. Although it is clear that whelk populations have been declining in parts of the North Sea and the Wadden Sea, the relative contribution of both sources of anthropogenic influence is presently unknown.

This research has contributed to the decision of the Marine Environmental Protection Committee of the International Maritime Organisation (IMO) to ban new applications of TBT on large ships world-wide by the year 2003 and the presence of TBT-based anti-fouling paints in the top layer of paints by the year 2008.

EXTERNAL PROJECTS OF THE DEPARTMENT OF MARINE BIOGEOCHEMISTRY AND TOXICOLOGY

- PIONIER project 'Molecular palaeontology of marine sediments' (NWO-BOA)
  I. Höld, J.S. Sinninghe Damsté
- Environmental changes at the time of the Permian/Triassic biotic crisis (NWO-ALW)
  M. Sephton, J.W. De Leeuw
- A molecular and carbon isotopic biogeochemical study of environmental conditions leading to deposition of "black shales" during the Cenomanian/Turonian oceanic anoxic event (NWO-ALW)
  M.M.M. Kuypers, J.S. Sinninghe Damsté
- Marine microalgae as major contributors to marine sedimentary organic matter and crude oils (NWO-ALW)
  P. Blokker, J.S. Sinninghe Damsté, J.W. De Leeuw
- 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
- Climate variability on a decadal time scale in the North Sea as revealed by biomarker analysis (NEBROC)
  B. Van Dongen, J.S. Sinninghe Damsté
- Molecular and geochemical analysis of hot spring cyanobacterial and Chloroflexus mats as stromatolite analogs (NASA)
  M. Van Der Meer, J.W. De Leeuw
- Neogene history of the Benguela Current and climate in southeastern Africa: a high resolution study of biomarkers and plantonic Foraminifera (NWO-ALW)
  E. Schefuss, G.J.M. Versteegh, F.J.H. Jansen, J.S. Sinninghe Damsté
- Coccolithophorid evolutionary biodiversity and ecology network (EC-TMR)
  H. Kinkel, G.J.M. Versteegh, 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
- Sapropels and palaeoceanography (EC-MAST)
  J.S. Sinninghe Damsté
- Geochemistry of sulphur-rich organic matter in carbonate/evaporite depositional environments (EC-TMR)
  K. Grice, J.S. Sinninghe Damsté
- Passive sampling of dissolved contaminants (RIKZ)
  K. Booij
- Action to demonstrate the harmful impact of TBT. Effective communication strategies between scientists and policy makers to assist in policy development (EU-LIFE).
  J.P. Boon, C.C. Ten Hallers-Tjabbes
- In vitro biotransformation of organohalogens and specific cytochrome P450 isozyme activities in microsomal preparations of harbour seal (Pieterburen Seal rehabilitation and Research Centre)
  R.J. Letcher, J.P. Boon
- Changes in sexual development and reproduction success of the common whelk (*Buccinum undatum*) after exposure to organotin compounds (TBT and TPT)
  B.P. Mensink, J.P. Boon

DEPARTMENT OF BIOLOGICAL OCEANOGRAPHY

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

1. **Phytoplankton competition for nutrients and flowcytometry as a tool to determine pico-phytoplankton species composition and growth**
2. **Experimental studies on zooplankton**
3. **Deep chlorophyll maximum layer of the tropical Atlantic Ocean**
4. **Bacterial production and consumption of exopolymers**
5. **Bacterioplankton response to physically and chemically changing environments**
6. **Ecosystem modelling**

In theme 1 competition experiments for inorganic nutrients with selected phytoplankton species and grazing experiments with microzooplankton were performed and the phasing of cell division of picophytoplankton was studied.

In theme 2, the role of food quality on the limitation of zooplankton growth was investigated. Focus was put on the rate of growth and development of copepods in relation to their food.

Theme 3 dealt with the Deep Chlorophyll Maximum (DCM) in the tropical Atlantic. A multidisciplinary cruise in 1996, focused on the effect of physical processes on the ecosystem stability in the DCM. Analysis of the data and preparations of manuscripts have been performed.

In theme 4 the role of diatom-mucus for stabilzing the sediment and the interaction between benthic bacteria and diatoms was studied in the Ems-Dollard Estuary. Moreover, the role of bacterioplankton in the production of exopolymer particles was investigated.

Within theme 5, the bioavailability of dissolved organic matter exposed to solar radiation for bacterioplankton was studied. The bacterioplankton species composition was studied in different depth strata of the Eastern Mediterranean Sea and the role of ultraviolet radiation on the bacterioplankton species composition.

Theme 6 focused on the development and application of the European Regional Seas Ecosystem Model (ERSEM) which has been developed in 2 successive EU-MAST projects. The ERSEM model was coupled to a 1D hydrodynamical model and has been applied to the Baltic and the Adriatic Sea.

THE QUALITY OF ALGAE AS FOOD FOR COPEPODS

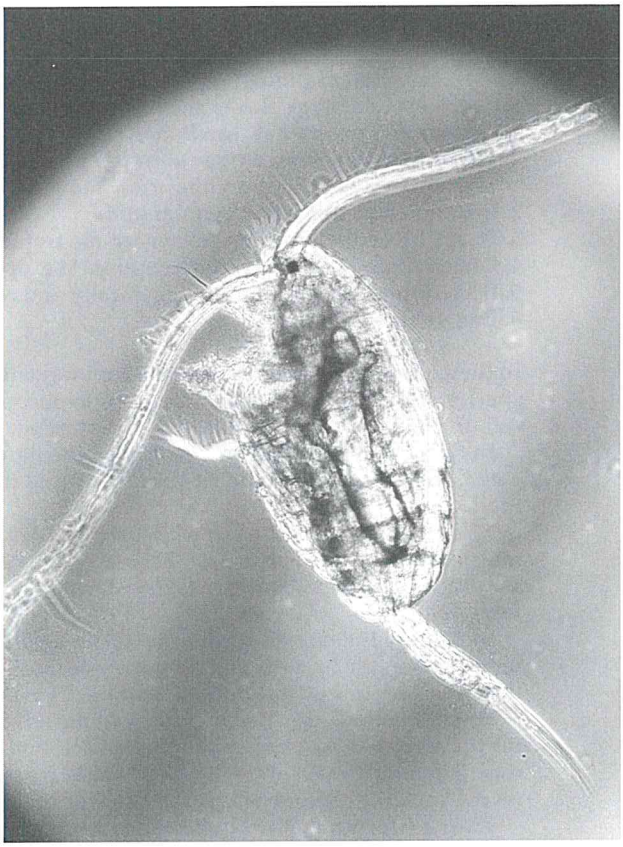
Contributors: *W.C.M. Klein Breteler, M. Koski*

Herbivorous zooplankton in the sea are exposed to food changing daily, both in abundance and quality. The importance of food quality for the development and growth of copepods was studied in the laboratory, using continuously cultured phytoplankton as food to the copepod *Pseudocalanus elongatus*. This copepod species is cultivated permanently at the NIOZ, which guarantees a continuous availability of animals at constant conditions. The study concentrated on biochemical and physiological differences of the food algae. Seven different species of algae were grown under different nutrient conditions. Species of about similar size and shape were selected to exclude effects of cell size and morphology on grazing behaviour. Edibility of the algae was checked by measuring the grazing rate of the copepod. Possible toxicity was studied by offering the different algae species in a mixture with *Rhodomonas* sp., which is regarded as a reference species of known, good food quality.

Copepods were incubated in bottles and kept in suspension together with the respective foods using a rolling device. Starting with young nauplius larvae, the development of the copepods was monitored until they reached the adult stage. In separate experiments the grazing rates of nauplii, copepodites and adults were measured, as well as the egg production of the adults.

Most algal species were consumed at rates similar to that of *Rhodomonas* sp. Also, N-limited algae were consumed at a rate similar to N-repleted algae. The diatom *Thalassiosira weissflogii* was ingested at a rate twice as high as most of the other algal species, while *Chrysochromulina polylepis* was not ingested by the copepods at all. No evidence of toxicity of any of the algal species was observed.

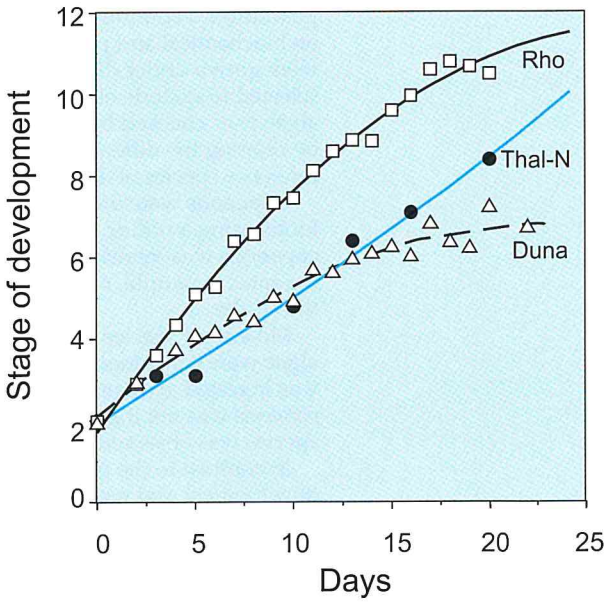
In contrast to the general similarity in food uptake, there were large differences in copepod development and growth with the different kinds of food. Irrespective of the high consumption of *T. weissflogii*, the copepods developed at a rate similar to that obtained with *Rhodomonas* sp. as a food source. Species of moderate quality were *Gymnodinium simplex* and *Tetraselmis suecica*; feeding on these algal species led to only moderate survival and egg production. Species of



Copepodite stage IV, female of *Pseudocalanus elongatus*. Large sac with lipid reserves visible along the central axis of the body.
Photo: W.C.M. Klein Breteler

poor food quality were *Amphidinium* sp., *Dunaliella* sp. and the uningested *C. polylepis*. These species caused low rates of development and growth, low survival and almost no egg production. Using N-repleted and N-depleted *Rhodomonas* sp. as food source, no differences in copepod growth was detectable. However, N-limited *T. weissflogii* caused a significant decrease in copepod growth rate.

The different responses of copepod development with different but well-consumed food species, points to differences in assimilation rates, such as observed for *T. weissflogii*, and to differences in biochemical composition of the other edible algae. Currently, the lipid composition of these algae is determined. The first measurements give evidence that the presence or absence of highly unsaturated fatty acids and sterols might explain at least part of the observed differences in the nutritive value of algal species.



Mean stage of development of *Pseudocalanus elongatus* fed with different species of algae. Stages 0 (egg), 1-6 (nauplii), 7-11 (copepodites) and 12 (adult). With *Rhodomonas* sp. (Rho) as food, development is fast and most animals reach maturity in about 25 days. With N-limited *Thalassiosira weissflogii* (Thal-N) and *Dunaliella* sp. (Duna), development of copepods is much slower and stops before or when reaching the young copepodite stages.

EFFECTS OF UV RADIATION ON DNA DAMAGE AND PRODUCTION IN BACTERIOPLANKTON IN THE COASTAL CARIBBEAN SEA

Contributors: *P.M.Visser, A.J. Kop, F.C. van Duyl*

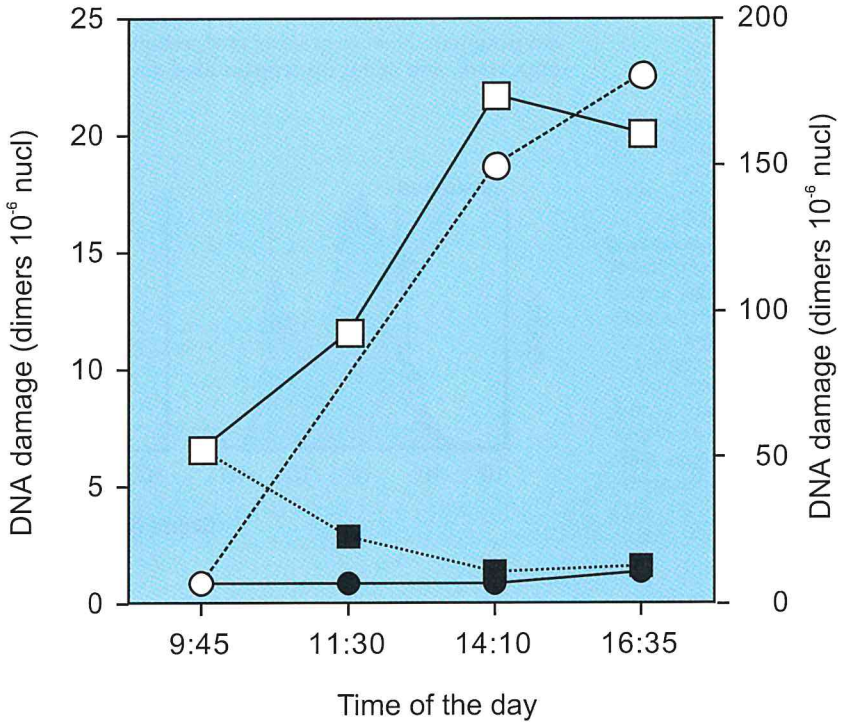
Ultraviolet radiation (UVR) penetrating the water column is one of the physical variables influencing all aquatic marine ecosystems. Only little attention has been paid to the effects of UVR on bacterioplankton, although it is now well-documented that heterotrophic bacteria are a large and productive component of the planktonic microbial food web. UVR can affect bacterioplankton directly by inhibition of protein and DNA synthesis, or indirectly by photolysis of dissolved organic carbon (DOC) which may increase the available substances for bacteria or by inhibiting the activity of bacterivorous grazers. All these different effects of UV radiation will have consequences for the functioning of the microbial food web. The aim of the study was to quantify effects of UVR on coral reef bacterioplankton. This project was funded by WOTRO-NWO.

The effect of different ranges of the solar radiation spectrum on the leucine and thymidine incorporation and on the induction of DNA damage in natural bacterial populations was investigated in the coastal Caribbean Sea off Curaçao.

The UVR was found to penetrate deeply into the water column. UVB with wavelength 305 nm was still 5% of the surface irradiance at 15 m depth, while the 5% level for UVA (380 nm wavelength) was at a depth of 55 m.

DNA damage in microorganisms and biodosimeters (pure DNA in quartz tubes) was quantified by the number of cyclobutane dimers (thymine dimers) formed. Increasing cyclobutane dimer formation during the day was found when incubated in full surface solar radiation. When UVBR was excluded no dimer formation was observed, indicating that DNA damage was induced by UVB radiation only. The amount of thymine dimers in the >0.8 µm fraction (considered to be mainly phytoplankton) was only one third of the amount of induced thymine dimers in the <0.8 µm fraction (mainly bacteria) suggesting that phytoplankton is less sensitive for UV induced DNA damage than bacterioplankton.

Protein (measured by leucine incorporation) and DNA (measured by thymidine incorporation) synthesis was inhibited to about 30% of the dark control during the day when exposed to surface solar radiation. For both, protein and DNA synthesis a trend was found with the highest inhibition under full solar radiation, lower inhibition when UVBR was shielded off and the lowest inhibition when also UVA (<375 nm) was excluded. Inhibition of protein and DNA synthesis was found in the bags incubated in the upper 15 meters of the water column. Recovery of protein and DNA synthesis following UV inhibition was favoured by long wavelength UVA and PAR light. But also in the dark recovery occurred.



Diurnal course in DNA damage (thymine dimers per 10^6 nucleotides) in the < 0.8 µm fraction of seawater incubated in bags translucent to UVR (open squares: under full solar radiation; filled squares: in the dark; left Y-axis) and in biodosimeters (open triangles: under full solar radiation; filled triangles: in the dark; right Y-axis) at April 3 1997.

The intracellular carbohydrate content of the phytoplankton incubated under full solar radiation was not significantly higher than the dark, while the intracellular carbohydrate content without UVBR was significantly higher. There was a tendency of increased carbohydrate storage with increasing depth probably indicating the inhibiting effects of UVR or high PAR intensities on carbohydrate storage in phytoplankton.

PHYTOPLANKTON IN THE OCEAN: ARE THEY ALL ALIVE ?

Contributors: *M.J.W. Veldhuis, G.W. Kraay & K.R. Timmermans*

Bulk measurement of chlorophyll and accessory pigment analysis of the oceanic phytoplankton community usually reveal the presence of healthy populations. Additionally, flow cytometric signatures show distinct clusters in terms of size and chlorophyll fluorescence.

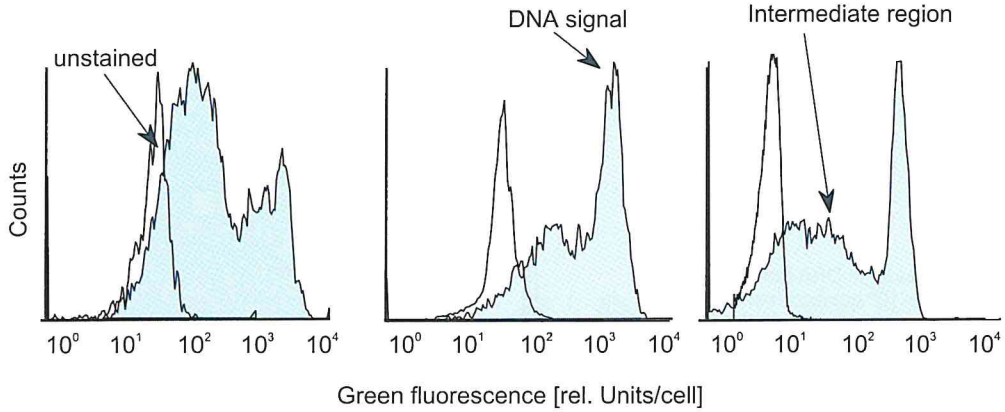
However, both cultures and field populations show considerable variation in the viability of the phytoplankton species. Examining the viability, by using a membrane impermeable DNA-specific dye, indicated that a large number of cells had lost their membrane integrity. The test separated each clusters in viable (unstained), positive (cells with fully stained DNA) subgroups, as well as a variety of intermediate stages indicating a partly reduction in membrane integrity.

Cultures of actively growing phytoplankton cells were not stained by the dye. In contrast, senescent cells showed a distinct DNA signal, thus allowing a clear separation between the healthy and less viable fraction of the population. The relative abundance and the degree of staining varied among the different cultures examined. The fraction of non-viable (positively stained) cells increased in particular when cells were kept in the dark for a longer period.

Field samples of phytoplankton collected during spring in the North Atlantic Ocean (40 °N, 23°W, MERLIM project) showed also considerable variation in the viability of the different algal groups examined. The highest fraction of unstained (healthy) cells was observed in *Synechococcus* (> 90%). This percentage declined to 60 - 40% in some of the small eukaryotic phytoplankton groups. Incubation experiments revealed an increase in the fraction of viable cells up to 90%, during the time course of the incubation (several days). The first 24 hours were crucial in this process. Since nutrients were not really depleted, the low fraction of viable cells in the ocean is surprisingly high.

The reduction in membrane integrity might be related to viral infection or autolysis due to Programmed Cell Death (PCD, or better known as apoptosis). PCD is a gradual process of autocatalyzed cell mortality.

It might be that the damaged cell membranes represent the initial phase of autolysis of phytoplankton cells. The occurrence of a large number of damaged cells has far reaching consequences for productivity, growth rate and the recycling of carbon and nutrients in the marine environment. Next to grazing and sedimentation autocatalyzed cell death could be a third important, and so far underestimated, factor responsible for a loss in phytoplankton biomass.



Frequency histograms of DNA staining properties of three phytoplankton species showing the different stages in viability. Healthy cells show staining properties matching that of the unstained cells; fully stained cells (with compromised cell membrane) show maximum staining corresponding with the DNA signal of the cell and different stages of intermediate staining in cells with partly damaged cell membrane.

EXTERNAL PROJECTS OF THE DEPARTMENT OF BIOLOGICAL OCEANOGRAPHY

- The role of ultraviolet B radiation in the functioning of heterotrophic bacteria in coral reefs and adjacent tropical ocean waters off Curaçao, Netherlands Antilles (WOTRO).
  F.C. Van Duyl, P.M. Visser
- *Emiliania huxleyi* project (NWO-NOPII)
  R. Riegman
- Mass transfer and ecosystem response (MATER, EC-MAST)
  P. Ruardij
- Baltic Sea System Study (BASYS, EC-MAST)
  P. Ruardij, G.J. Herndl
- Canary Islands Azores Gibraltar Observations (CANIGO, EC-MAST)
  G.J. Herndl
- The chemical composition and reactivity of bacterially derived dissolved organic carbon (DOC) and its contribution to the bulk oceanic DOC pool (SLW-NWO project)
  G.J. Herndl
- Bacterioplankton exopolymer production, exopolymer reactivity and contribution to the oceanic dissolved organic carbon pool (TMR-Environment and Climate)
  G.J. Herndl
- Role of ultraviolet radiation on the interaction between phytoplankton, dissolved organic matter and bacterioplankton (TMR-EC-MAST)
  G.J. Herndl
- Developing functional probes to deterimine ectoenzymatic actvity in marine bacterioplankton (TMR-EC-MAST)
  G.J. Herndl

DEPARTMENT OF MARINE ECOLOGY

The department of Marine Ecology consists of three theme groups: (1) Intertidal Population Ecology, (2) Shelf Benthic Biology and (3) Long-term Changes.

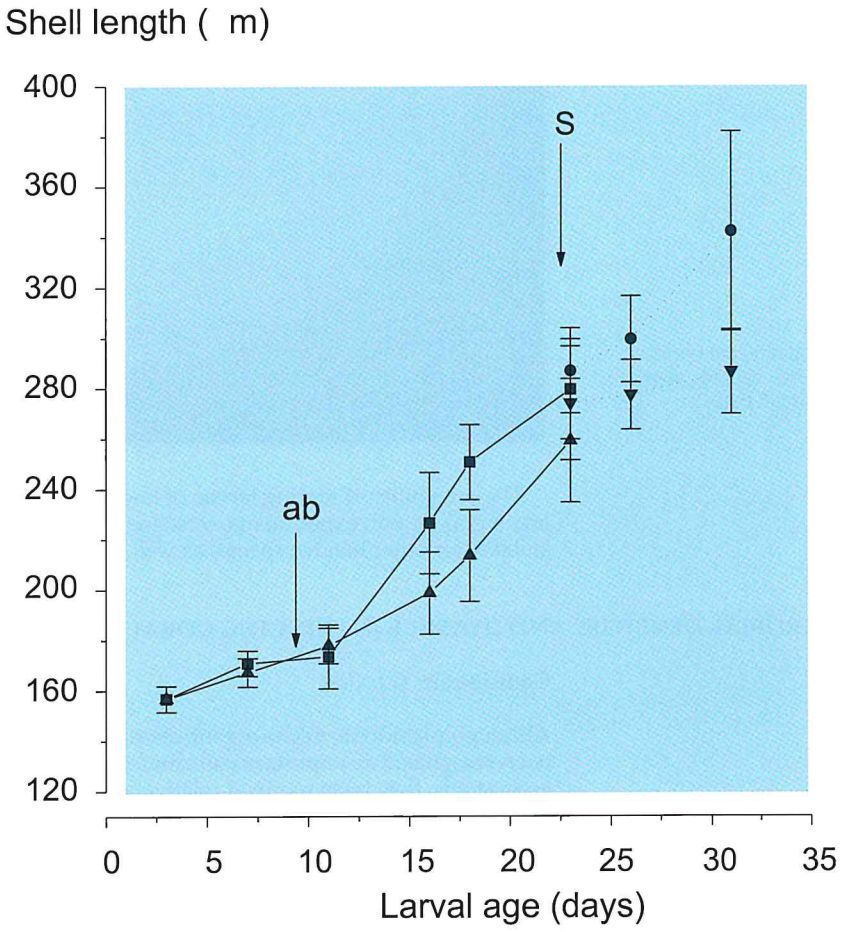
Both the structure and the functioning of marine ecosystems (and especially benthic communities) offer a wealth of interesting, important and urgent scientific questions. Numerous processes of a complex nature, involving biological, physical and (geo)chemical interactions, underlay the continued existence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

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

REARING OF MACOMA BALTHICA IN THE LABORATORY

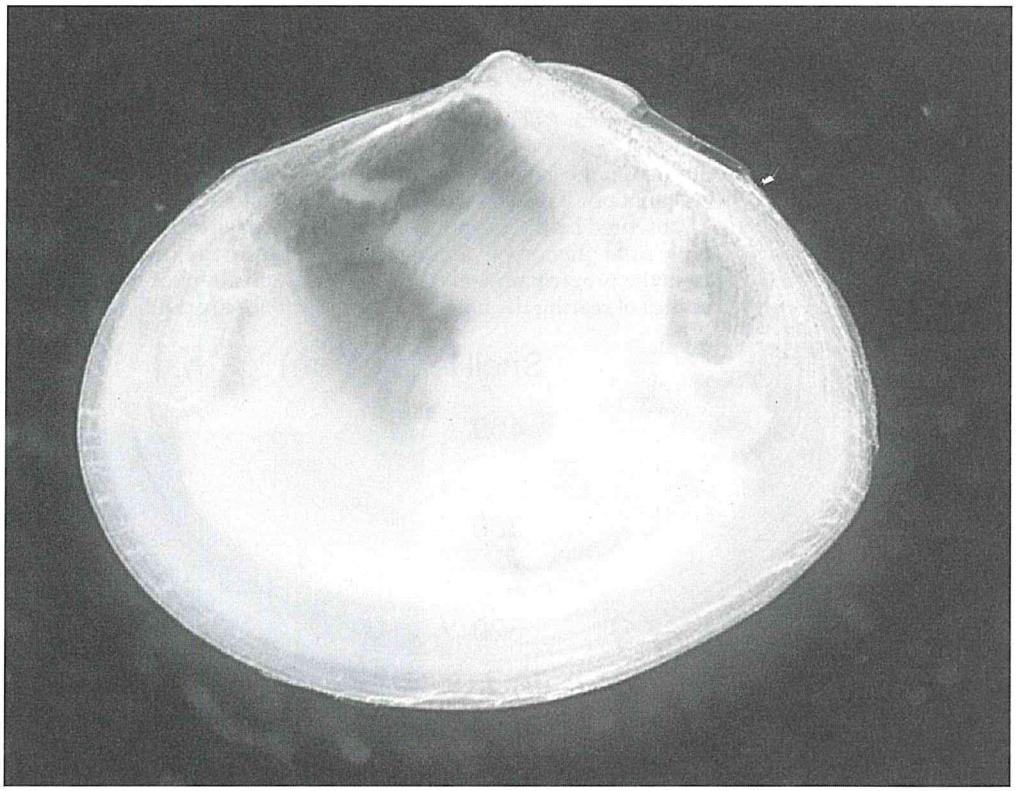
Contributors: *P.J.C. Honkoop, J. Drent, P.C. Luttikhuizen, J. Hegeman*

Studies on the genetic structure of bivalve populations and the relation with fitness of individuals cannot be based on field measurements alone. In the field genotypic differences will always be obscured by the phenotypic response to environmental circumstances. To distinguish genotypic from phenotypic differences it is necessary to perform (cross-)breeding experiments and raise the progeny under controlled conditions. A pilot project was started to explore the possibilities of rearing the bivalve *Macoma balthica* to adulthood from eggs and sperm obtained from



Shell growth (mean±SD) of reared larvae of *Macoma balthica* during the period from fertilisation to an age of 31 days. Antibiotics (ab) were added for the first time at an age of 9 days. S refers to the age at which the larvae were ready to settle and were transferred to a settlement set-up.

adults in the laboratory. Hitherto, rearing of larvae of this species never succeeded for periods longer than one or two weeks. The practical work of this project started at the end of March and since then about 30 batches of larvae (almost each batch contained offspring from a single pair of adults) were reared. Mortality in the first batches was enormous and most of these batches collapsed. Addition of antibiotics decreased the mortality dramatically and the survival during the first three weeks of life was almost 50%. An indirect consequence of adding antibiotics was the higher growth rate (measured as increase in shell length), as shown in the figure. Another critical period is the period of settlement, which in nature occurs at an age of three to four weeks and a shell length of about 280 µm. At this size the animals metamorphose and change from a pelagic to a benthic way of live. Mortality during this period is commonly very high. Sand or silt as settlement-substrate cannot be kept clean, increasing the risk of diseases. Therefore, plankton gauze was used as settle-substrate. Although no substrate was available to bury in, we succeeded in getting the larvae through metamorphosis. After this period mortality was low, even in the absence of antibiotics. Later on, when metamorphosis was completed, part of the larvae was transferred to sandy sediment. Mortality remained low and the growth rate was higher than in larvae which remained on plankton gauze. At the time of writing, the oldest larvae, now called post-settlers or juveniles, have an age of 7 months, a shell length of 5 mm, and the shells start to colouring.



A 4 months old reared *Macoma balthica* shell, length 2.5 mm.

The possibility of rearing larvae of known parents opens a rich field of research (cross-breeding, larval growth experiments, selection experiments etc.). The techniques developed can be suitable for other bivalve species as well.

MICROBIAL DENSITIES AND DYAMICS IN FRINGING CORAL REEF WATERS

Contributor: *G.J. Gast*

Although planktonic micro-organisms such as phytoplankton, bacteria and flagellates have been recognized as important contributors to the transfer of energy and nutrients in pelagic ecosystems, they have received relatively little attention in studies on coral reef ecosystems. Data on micro-organisms and nutrients were collected in fringing coral reef waters, including anthropogenically eutrophied reef water, and the adjacent oceanic water over a full seasonal cycle. The studied system was the coral reef of Curaçao in the southern Caribbean Sea. The adjacent oceanic water has a strong influence on the open fringing reef environment.

Fluctuations in this larger water mass, such as periodically upwelled water, were reflected in the reef water column. Millions of cubic meters of seawater flow over the 50 - 150 m wide shallow reef terrace (0 - 8 m depth) every day and the development of specific coral reef water column characteristics is hampered by this enormous dilution. Yet, specific microbial and chemical characteristics were recognised in the reef water column, which were related to the presence of the coral reef.

Fringing coral reefs at Curaçao have strong influences on microbes in the overlying water column, leading to increases in bacterial production and specific growth rates and concomitant decreases in microbial abundance.

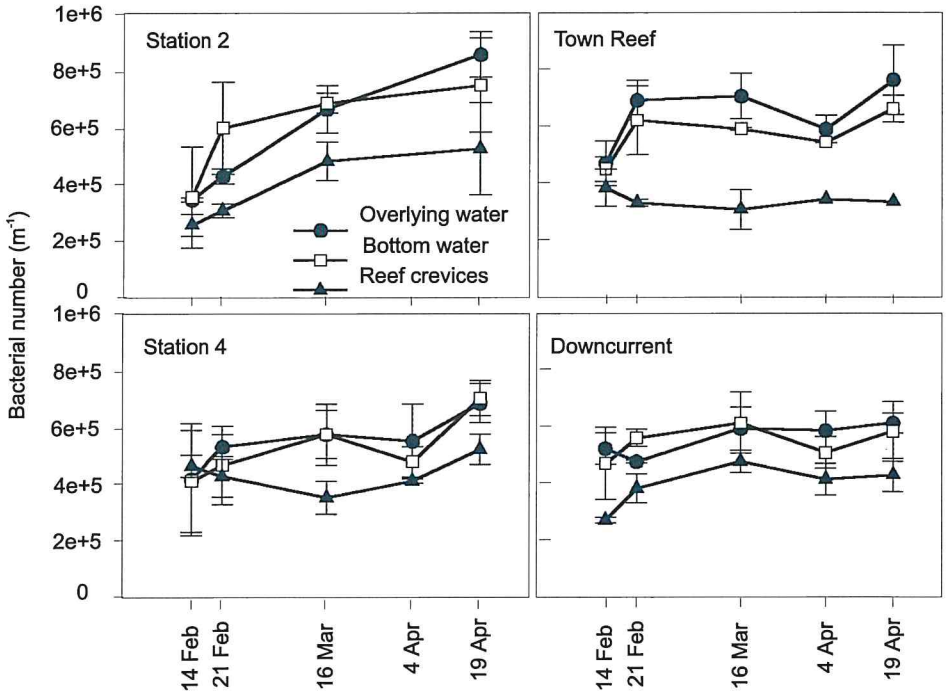
Nutrients

Nitrate concentrations in the reef water column were consistently enhanced compared to the adjacent ocean at all reef sites, but ammonium and phosphate concentrations differed only occasionally and inconsistently. Nutrient concentrations were enhanced in crevices under coral colonies close to the bottom in a N:P ratio of ca. 20. Possible sources are mineralization in the interstitial water or in coral heads, or production by heterotrophic organisms such as boring and other sponges, and resting fish. Apparently, the reef as a whole lost nitrogen, but not phosphate. In coral reef systems, nitrogen fixation is an important input mechanism for nitrogen. Organic N is eventually mineralized into ammonium, which is rapidly oxidized by bacteria via NO_2 to NO_3. The data indicate a considerable flow of nitrogen through this reef ecosystem.

In eutrophied reef water, ammonium and phosphate concentrations were elevated (sewage discharge), but the nitrate concentration was only slightly increased compared to the non-eutrophied reef sites. Strong variation in ammonium and phosphate concentration occurred through time. Nitrate concentrations were not elevated on the same days as ammonium and phosphate. Anoxic conditions in the sewage system probably prevent ammonium oxidation and no nitrate is discharged. Rather, the nitrate concentrations showed a smaller but more consistent increase compared to non-eutrophied reef water, which is most likely caused by groundwater seepage. Groundwater at Curaçao contains high nitrate concentrations under the town where much water from septic tank drains into the ground.

Bacteria

The abundance of bacteria decreased in a gradient from open oceanic water to reef overlying water to reef bottom water to crevices under corals. The strongest reduction occurred in the last step: densities in crevices were often half those in the bottom water. Cryptic filter feeders, such as boring sponges which abound in the crevices, filter bacteria efficiently from the large volumes of water they pump. This indicates that the reef as a whole functions as a filter for bacteria. This pattern was more apparent in well-developed reefs with large corals. Here crevices are



Bacterial numbers in February - April 1995 at coral reef sites along the southern coast of Curaçao, Caribbean. Overlying water: water column at 2 m depth; bottom water: water between coral colonies at 8 m depth; crevices: gaps and hollows between and under coral colonies at 8 m depth. Mean of 2 samples taken 50 m apart (duplicate counts of numbers in each sample).

larger, bottom relief is better developed and a more extensive bottom water boundary layer exists. Mineralization of the removed bacteria could contribute 10% and 20 % of the observed increases in inorganic N and P in crevices, respectively.

A concurring but opposite pattern was found in bacterial production, which tended to increase from oceanic to overlying to bottom water. In the first half of the year, bacterial production was the same in oceanic and reef water, while abundance was reduced over the reef. Thus specific growth rates were higher in the reef water column. In the second half of the year, there was no difference in abundance, but production increased in reef water and growth per cell was still enhanced. The conversion factor to calculate growth in cells from leucine incorporation was the same in oceanic and reef water. This means that the increase in mean specific growth rate of the whole bacterial community must be caused by an increase in the fraction of active cells in reef water. The reef had a stimulating effect on bacterial production in the reef water column, which led to a larger fraction of active cells.

Phytoplankton

Algal biomass and composition were highly variable over time (weeks) and in space (km's) in eutrophied and non-eutrophied fringing coral reef waters and in the adjacent ocean. The ocean and reef showed a changing spectrum of phytoplankton characteristics. Prymnesiophyceae, Bacillariophyceae, Dinophyceae, Chrysophyceae and Chlorophyceae or Prasinophyceae alternated as dominant groups, but without consistent trends indicating mechanisms such as selective removal and stimulation by the reef benthos. However, the cyanobacterium *Synechococcus* was consistently reduced in the reef water column (observed in both zeaxanthin concentration and flow cytometer counts). As happens to heterotrophic bacteria, cyanobacteria were removed, possibly filtered, from the reef water column. How and why bacterial (sized) cells are specifically removed are intriguing questions to be addressed in a folllowing project.

Anthropogenic eutrophication.

Sewage discharge into the fringing reef water column resulted in enhanced inorganic nutrient concentrations, but no stimulation of bacteria or algae was observed. Mixing of discharged water with reef and oceanic water is likely to have diluted the waste input too fast to result in an enhancement of bacterial or algal growth rates. Runoff increased bacterial production in front of the town after heavy rain and high bacterial production was found also in water originating from the harbour.

In the enclosed harbour bay strong effects of eutrophication were found: high nutrient concentrations, high bacterial production, enhanced bacterial and heterotrophic flagellate densities, increased bacterivory by heterotrophic nanoflagellates and elevated algal biomass. The phytoplankton community was dominated by large diatoms and dinoflagellates. The comparatively long residence time allowed micro-organisms to respond to the local eutrophic conditions.

The water coming out of the harbour with each ebbing tide was sometimes found to influence the reef water column, but due to delution effects were no longer visible 4 km from the mouth of the bay. The effects of eutrophication on the microbial ecosystem were of short duration and were limited to the reef waters in front of the town.

BENTHIC-PELAGIC COUPLING IN THE NORTH SEA

Contributor: *A.J. Boon*

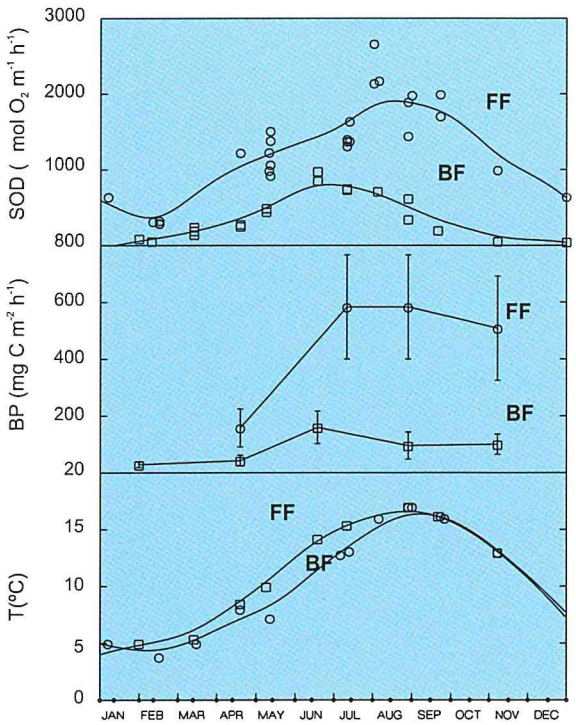
This study focused at the amount, nature and quality of labile organic matter (phytopigments, fatty acids) in near-bottom water and sedimentary environments in relation to the benthic metabolic response (sediment oxygen demand, sediment RNA/DNA content, growth lines in bivalves). The sampling stations, chosen on basis of their differences in hydrographic and sedimentary characteristics, were Broad Fourteens (BF), Frisian Front (FF), Oyster Ground (OG), German Bight (GB) and Skagerrak (SK).

Near-bottom studies, in 1994, 1995 and 1996, consisted of installing a sediment trap at 3.2 m above the bottom and a sediment recorder on the sediment surface. The latter device, developed at the NIOZ, sampled material rolling over the seabed, which is assumed to contain the main source of food for bottom-suspension feeders and epibenthic deposit feeders. These devices were deployed in various seasons and each time sampled 12 consecutive hours in a tidal cycle. These studies showed large spatial and temporal (tides, seasons) variations in the amount and composition of near-bottom organic matter. Near-bottom chlorophyll a and fatty acid concentrations usually were highest in spring, while on average the highest concentrations were found at GB. Here, the influence of the river Elbe was clear, because the fatty acid pattern suggested a terrestrial origin of the organic matter. At BF, the material had a much fresher sig-

nature than at station FF. These differences could explain data from earlier studies showing the common heart urchin, Echinocardium cordatum, to have a higher growth rate at BF than at FF.

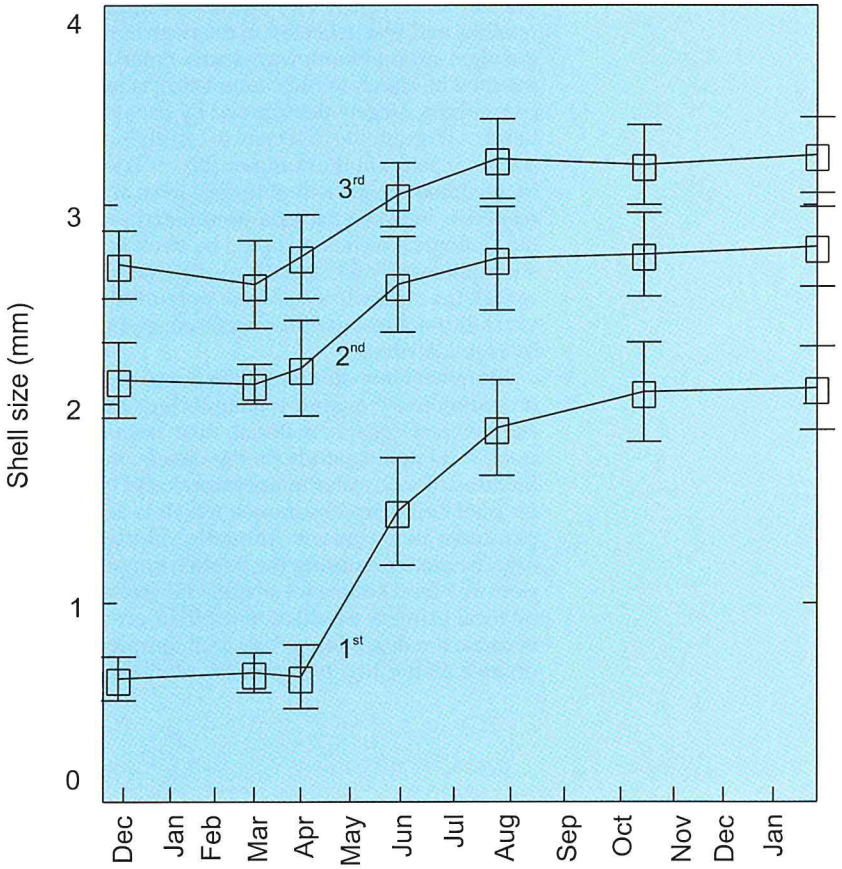
Studies in 1993 and 1994 showed the strong relationships between the year-round algal development in the water column and in the sediment, which is the major drive for the benthic metabolic processes in the southern North Sea (BF, FF, OG). Samples were taken from the surface water, near-bottom water (with a Rosette sampler) and the sediment (with a box corer). They were analysed for phytopigments, and sediment oxygen demand (SOD) was measured by incubating on deck sediment cores. The size was measured and the number of growth (=year) lines were counted of specimens of a small deposit-feeding bivalve (*Mysella bidentata*) from FF. The succession (species, biomass) of algae in the water column at these three stations differed notably, and was reflected in the near-bottom water and the upper sediment layer. The effect of the algal spring bloom was clearly noted in the phytodetrital content in the sediment, reaching maxima in March to May. Interesting is to look at the metabolic reactions of the whole benthic community, largely determined by bacteria, on the one hand and of the bivalves on the other hand. Although the SOD reacts swiftly to the increased amount of algal detritus in the sediments, it peaks in the summer (BF) or late summer (FF) due to increased water temperatures. By contrast, the growth of the bivalves at FF is strongest during spring. This differential response, between bacteria-dominated processes and macrobenthic growth, could be typical for the ecological niches occupied by benthic bacteria and benthic invertebrates. This hypothesis is strengthened by the specific nutritional needs of many invertebrates. Invertebrates are known to lack the ability to synthesise polyunsaturated fatty acids, essential components for their survival (but not essential for bacteria), and thus depend importantly on what is delivered to them by algal detritus.

Moreover, this differential response of the invertebrate and bacterial community has its effect on sedimentary organic matter cycling. Since the benthic bacteria are the main decomposers of sedimentary organic material, their response determines strongly what happens to the detrital pool. A modelling study on the data from stations BF, FF and OG suggests that due to the combination of low water temperatures and high algal detritus input in the spring, an organic matter pool builds up in summer, which is decomposed in late summer/autumn, when water temperatures are increased. Annually, chlorophyll a is a good quantitative indicator for the labile organic matter entering the benthic system. Regarding the function of this labile organic matter pool as a food source for benthic invertebrates, it seems that they dependent more importantly on local primary production for their growth and propagation than on lateral supply. This is because the degradation rate of chlorophyll a is high and this compound is in near-bottom organic matter highly correlated with the, for invertebrates, essential fatty acids.



Overview of sediment oxygen demand (SOD), bacterial production (BP) and temperature (T) at Broad Fourteens (BF) and Frisian Front (FF).

Interestingly, when a whole year is considered, the sedimentary chlorophyll a inventory at SK suggests that much more labile organic matter enters the sediment than is broken down, as infered from SOD. This is in contrast with the other stations, where a much better balance between these parameters was found. An explanation could be that the relatively large fraction clayey particles in the Skagerrak sediments delay degradation of labile organic compounds. Earlier geochemical studies strongly suggest such a phenomenon, which could lead to a larger preservation of organic matter in Skagerrak sediments than at the other studied sites in the North Sea.



Growth curves of the bivalve *Mysella bidentata* from Frisian Front (numbers in figure denote year-classes).

EXTERNAL PROJECTS OF THE DEPARTMENT OF MARINE ECOLOGY

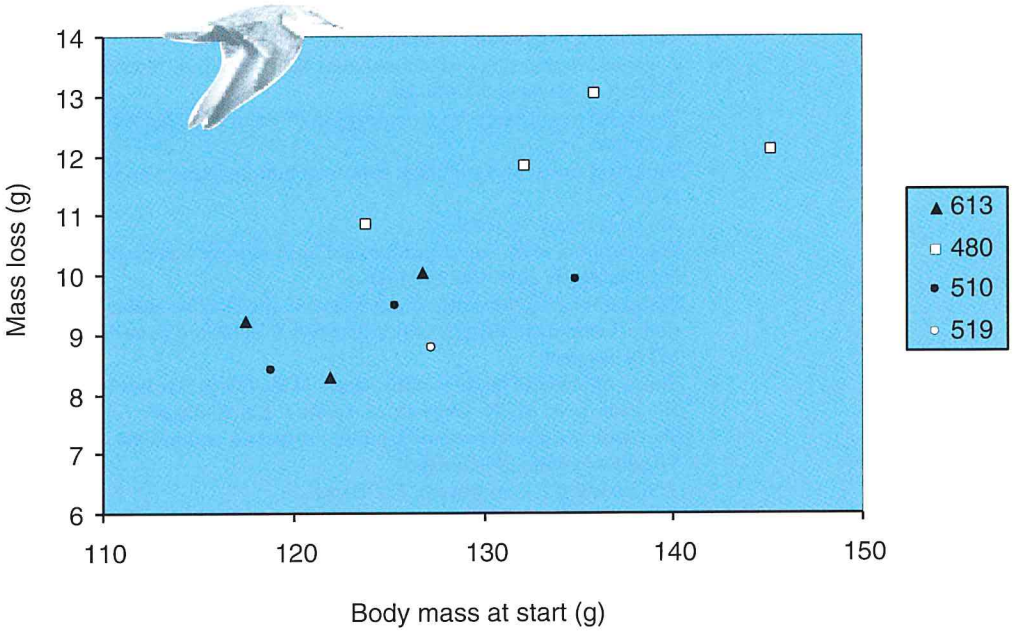
- Evolutionary arms race in intertidal mudflats (NWO-PIONIER)
  T. Piersma
- Monitoring Effects of Oil Based Muds around Drilling Platforms (RWS)
  R. Daan, M. Mulder
- Differentation in Caribbian reef-building coral populations (NWO)
  R.P.M. Bak
- Population dynamics of groupers (Serannidae) at Banten Bay; Coral community dynamics of an Indonesian coral reef under stress; and Population dynamics of some selected bird species, their food requirements and the changing environment - Teluk Banten II (NWO)
  H.J. Lindeboom, R.P.M. Bak, E.H. Meesters, Yus Rusila Noor, Siti Nuraini
- Dynamics through natural and anthropogenic causes of marine organisms: effects of large scale ecological changes on fish and fisheries (dynamo; EU)
  H.J. Lindeboom, C.J.M. Philippart, C. Winter, J.W. De Leeuw, J.J. Beukema, J. Van Der Meer
- Damage of coral reefs by recreational activities: Strategies and the development of novel markers for environmental stress (EU)
  R.P.M. Bak, G. Nieuwland
- Mediterranen targeted project II - Mass transfer and ecosystem respons (EU)
  G.C.A. Duineveld
- Modelling the impact of fisheries on seabirds (EU)
  H.J. Lindeboom, C.J. Camphuysen
- Autonomous lander instrument packages for oceanographic research (ALIPOR; EU)
  G.C.A. Duineveld, P.A.W.J. De Wilde, E. Berghuis, R. Witbaard
- Ocean margin exchange II (OMEX; EU)
  G.C.A. Duineveld, E. Berghuis, A. Kok, J. Van Der Weele, M. Lavaleye, P.A.W.J. De Wilde
- Research on the effects of the drop sea-floor level on macrobenthos (NAM)
  J.J. Beukema
- Monitoring exploration drilling (NAM) *H.J. Lindeboom*
- Biological monitoring programme, part North Sea and "Voordelta"
  R. Daan, S. Holtman, M. Mulder
- Biological monitoring programme, part Wadden Sea, Balgzand and Eems-Dollard (RWS) (RWS)
  R. Dekker
- Sampling and analysis of large species of bottom fauna near dumpingsites in the North Sea 1997 (RIKZ)
  M.J.N. Bergman, R. Daan
- The mapping of habitats/ecotopes in Dutch marine waters (BEON-Habitats, RWS)
  H.J. Lindeboom, H.W. Van Der Veer
- Distribution of (epi)benthic macrofauna on the Dutch continental platforms, in relation to the distribution of beam trawl fisheries since 1993 (BEON-Effecten Visserij, RWS)
  M.J.N. Bergman
- Effects of fisheries on the benthic fauna of the North Sea and Irish Sea - II (EU)
  H.J. Lindeboom, M.J.N. Bergman, M. Fonds, C.J.M. Philippart, J. Van Santbrink, P. Van De Puyl
- Shellfisheries, shorebirds and benthos around Griend in 1988-1996 (Natuurmonumenten & Vogelbescherming-Nederland)
  A. Koolhaas, C.J. Camphuysen, T. Piersma
- Effects of climate change on reproduction of intertidal bivalves (NOP II)
  J.J. Beukema
- Evaluation RWS monitoringsprogrammes (RIKZ)
  J. Van Der Meer
- North Sea Birds, an inventory (Oranjewoud)
  C.J. Camphuysen
- Limiting the ecological effects of beamtrawl gears; (REDUCE; EU)
  M.J.N. Bergman, M. Fonds
- Parameters for Ecosystem Quality in the North Sea (GONZ-II)
  H.J. Lindeboom, C.J.M. Philippart, M. Lavaleye
- The tree of the sea: climate reconstructions on basis of the bivalve Arctica islandica (CLIVARNET)
  H.J. Lindeboom, R. Witbaard
- Essay Aquatic Biomass: possibilities for the future (NRLO)
  H.J. Lindeboom

FLIGHT STUDIES IN THE LUND WIND TUNNEL

Contributors: *Åke Lindström, Theunis Piersma, Henk Visser*

A most prominent feature in the life of knots are their long migratory flights, involving several thousands of kilometres each year. Bird flight is one of the most energetically demanding activities known in the animal kingdom, and the energy spent during the time on the wing therefore forms a prominent part of any bird's energy budget and ecology. However, accurate measurements of flight cost are available for only very few bird species, and none at all for shorebirds.

The prime reason for this ignorance is the extraordinary practical difficulties involved in measuring flight cost in birds. In the Lund wind tunnel, operated since 1994, it is possible for the first time to have birds flying unrestrained for very long periods, mimicking long migratory flights under controlled laboratory conditions. Building on previous co-operation with the Bird Migration Group at Department of Ecology, Lund University, Sweden, a project was started in 1998, aimed at detailed studies of the energy expenditure of flying knots. There are numerous exciting aspects of knot flight to be studied, but since only few birds at the time can be studied we concentrate on three aspects of knot flight. First, we measure the energy expenditure (*flight power*, expressed in Watt) of flying knots at one representative flight speed. Second, we want to see how this cost varies with body mass. For theoretical reasons, flight power must increase with increasing body mass, and given that the body mass of a knot varies more than twofold over the year, this is a crucial variable to measure when understanding the energy turnover levels of knots. Thirdly, we want to evaluate whether knots get dehydrated during flight by measuring the amount of body water before and after flights in the wind tunnel.

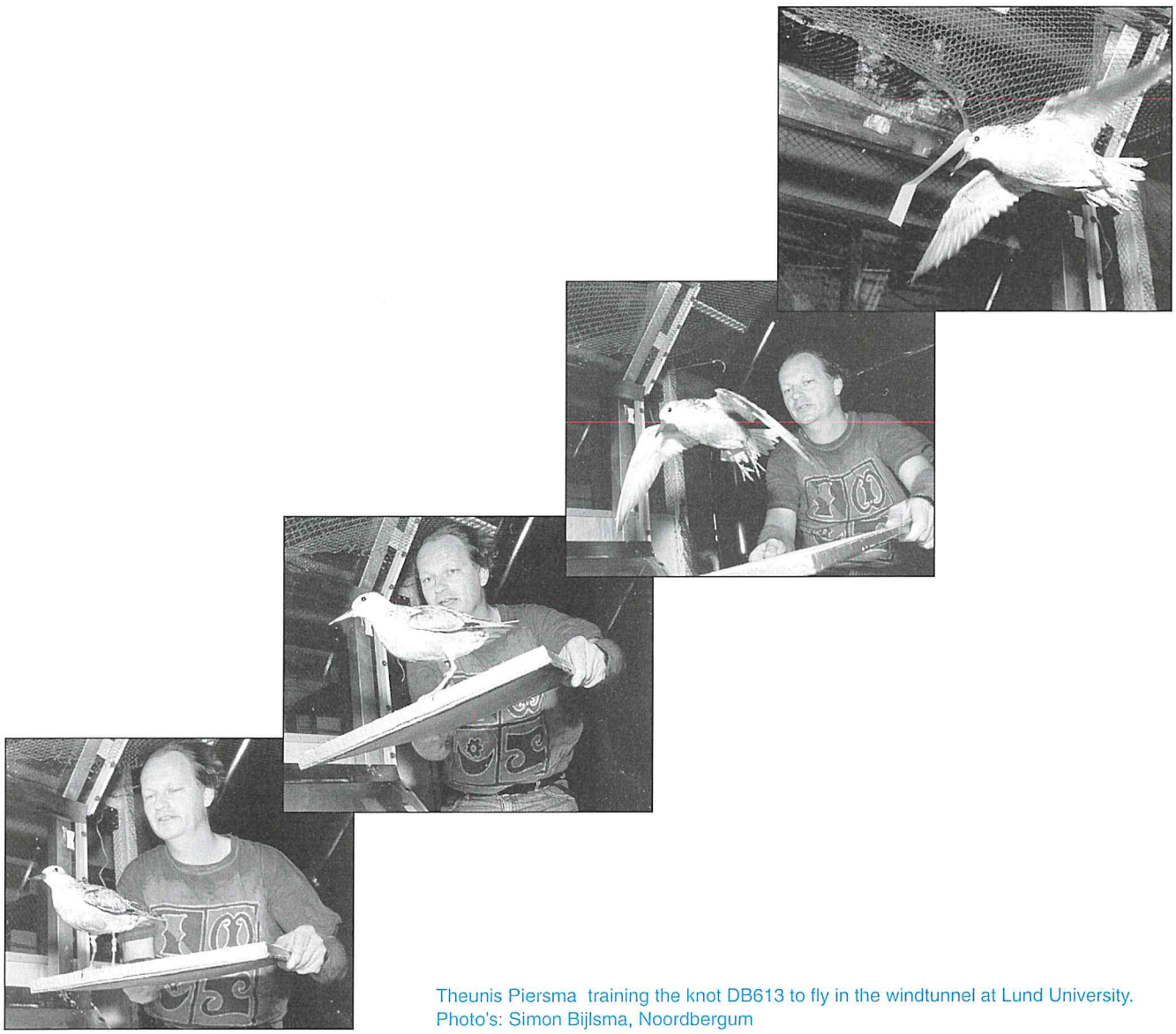


Relationship between mass loss and initial body mass of knots flown for 10 hours in the wind tunnel in Lund, the different symbols indicating different individuals. The mere fact that this relationship is positive suggests that we may be able to quantify the incremental energy costs of departing with high body mass levels on long-distance migratory flights.

In autumn 1998, small groups of knots have been brought from the shorebird facilities at NIOZ, Texel to Lund, southern Sweden. After an initial phase of taming, each bird was tested a few times in the wind tunnel. This means flying in an air current of 55 km/h getting nowhere! Almost all birds would fly to some extent but only few would master the conditions fully. Our aims were high and we only wanted to study birds that flew in a perfectly relaxed manner. The amounts of body water before and after the flights, and the water turnover and energy expenditure during the flights, were measured using the 'doubly-labelled water' method (DLW). A small, exactly known, amount of water labelled with ^{2}H and ^{18}O was injected under the skin. This water mixes with the body fluids and a blood sample was taken before and after flight. From the decrease in stable isotope concentrations in the blood it is possible to estimate flight power as well as water efflux rates. To verify whether the bird had lost water during the flight, another small dose of DLW was administered immediately and a small blood sample taken after another hour of equilibration. In a successful session, a bird is first injected in early morning and then flies for 10 hours. It should be noted that before this study, only two birds had ever flown in a wind-tunnel that long (one thrush nightingale and one knot, both in Lund).

Although a 10 hour flight is short compared to some flights knots make in the wild (some may last 72 hour) it should be long enough to produce highly accurate measures of energy turnover using the DLW technique.

Four individuals have flown successfully for 10 hours, making four and three times long flights each. There was no apparent change in body water during the 10 hour flight, suggesting no dehydration. The level of energy expenditure (12.5 W), being more than 10 times the basal metabolic rate, was rather high. As mass loss will be proportional to the amount of energy spent, the positive correlation between mass loss and body mass at the start of the flight indicates that the flight costs of knots do increase with body mass (see the figure). The variation in body mass is quite small, though, given that some knots may weigh up to 240 g prior to departure in spring. It is our aim to bring back the very same individuals to Lund in late spring and measure their flight costs also at very high body masses.



Theunis Piersma training the knot DB613 to fly in the windtunnel at Lund University.
Photo's: Simon Bijlsma, Noordbergum

Aan ameublement en inventaris en de uitbreiding daarvan werd, zooveel de beperkte middelen het maar toelieten, aandacht en zorg gewijd. In de Bibliotheek werden in de laatste vakken, die daarvoor beschikbaar waren kleine boekenrekken geplaatst; in de kamer van den Directeur werd een nieuw boekenrek en een kastje met laden aangebracht, terwijl voor Mejuffrouw Julie Hoek, die in het Station als adjunct-bibliothecaris werkzaam is, een der vertrekken in den nieuwen vleugel werd ingericht: het kleine vertrek werd behangen, het plafond werd er geverfd. Ook in de werkkamers werden verschillende kleine verbeteringen aangebracht, waarvan de noodzakelijkheid allengs gebleken was.

Bij de vele en zich weinig regelmatig over zijnen beschikbaren tijd verdeelende werkzaamheden, die het beheer van het Station met zich brengt, werd de Directeur wakker geassisteerd door Dr. Redeke, die hem door de regeering in zijne betrekking van Adviseur in Visscherijzaken als assistent is toegevoegd. Vooral tijdens de telkens terugkeerende dienstreizen van den Directeur is de aanwezigheid van den Heer R. voor het Station en voor hen, die er gebruik van maken, van het grootste nut. Voor zijne welwillend verstrekte assistentie komt hem dan ook de dank der Vereeniging toe.

Het aan het Station verbonden personeel ging wakker voort zijn plicht te doen. Is hun taak in de wintermaanden gewoonlijk niet zeer zwaar, 's zomers vraagt het soms wel degelijk veel van hunne toewijding en inspanning, met echt-Hollandschen zin voor de reinheid van het geheel te zorgen en toch altijd klaar te staan, als op hun hulp een beroep wordt gedaan door een der in het Station werkende personen. Het bedienen van den motor en van de pomp voor zeewater behoort mede tot de taak van den oudsten bediende: het komt hem toe, dat hier wordt uitgesproken, dat hij zich met groote nauwgezetheid van die taak kwijt.

Eene vrij ernstige ongesteldheid noodzaakte hem echter reeds na een negental dagen zijn verblijf te Helder te staken; ofschoon hersteld mocht hem nog niet aangeraden worden naar het in een groot deel van het jaar tochtige, in voor- en najaar in den regel gure, Helder terug te keeren.

De jonge Redeke als student op het Zoölogisch Station

Omtrent het overige wetenschappelijke werk, dat in het afgeloopen jaar in het Station plaats vond, of dat door het Station gesteund werd, moge hier nog het volgende vermeld worden.

Door den Directeur werden de hem door de regeering opgedragen, op de Zeeuwsche oesters en de oestercultuur betrekking hebbende onderzoekingen voortgezet en voor zooverre het eerste deel betrof — de quaestie, of het mogelijk was, dat de oesterbanken van de Oosterschelde of de oesterputten van de oevers der Schelde door pathogene bacteriën besmet konden geraken — afgesloten; omtrent de visscherijen op onze benedenrivieren, zalmvisscherijen, visscherij met aalraamsfuiken, ankerkuilvisscherij enz. werden nieuwe waarnemingen gedaan en gegevens verzameld; vooral met betrekking tot den zalm en de elft werden vele aanteekeningen gemaakt. Aan de meeste dezer onderzoekingen nam ook de Heer Redeke, die van af 1 April als assistent van den adviseur in het Station vertoefde, deel. Den tijd, die hem restte, besteedde hij aan het gereed maken van zijn academisch proefschrift, dat in het najaar gereed kwam en waarmede hij op 24 October '98 aan de Amsterdamsche Hoogeschool promoveerde. Het proefschrift, dat geheel in het Zoölogisch Station bewerkt was, had tot titel: Onderzoekingen betreffende het urogenitaalsystem der Selachiers en Holocephalen.

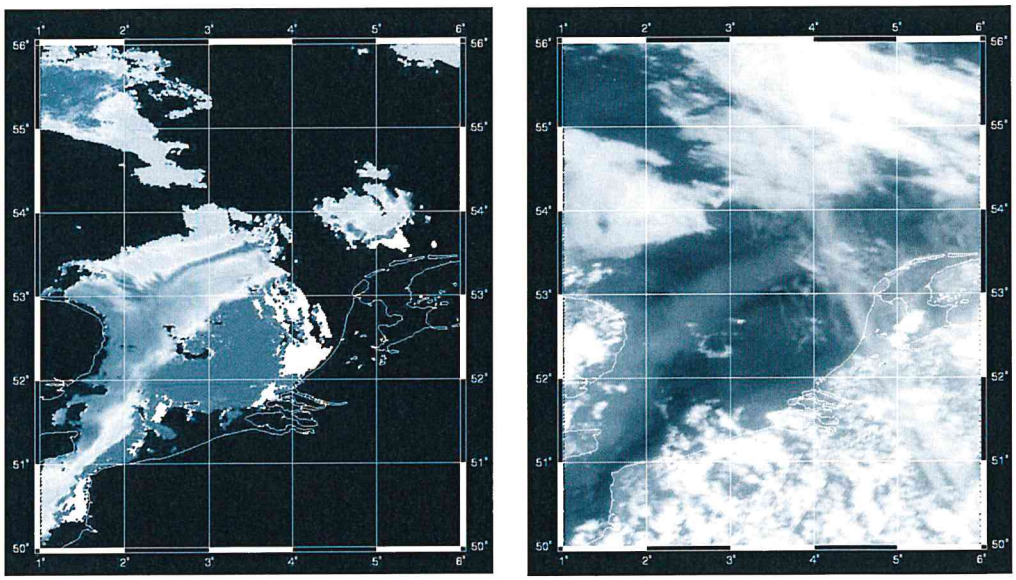
THE NETHERLANDS MARINE RESEARCH FACILITIES (MRF)

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

This year the National Programme consisted of:

1. Triple B, hydrographic observations in the WOCE Hydrographic Programme in the Bay of Biscay. Project manager and chief scientist was Dr. H.M. van Aken (NIOZ). In a 21-days cruise with RV PELAGIA the programme of 1997 was repeated.
2. Entangled Sulphur and Carbon cycles in Phaeocystis dominated ecosystems (ESCAPE), a project which aims at linking the pelagic carbon and sulphur cycles. Both cycles are relevant to climate studies since carbon dioxide is a major greenhouse gas and dimethyl-sulfide is a source of cloud condensation nuclei. During blooms of Phaeocystis an inventory was made of its role in C and S cycling off northern Norway and in the southern bight of the North Sea. Project manager was Dr. W.W.C. Gieskes and expedition leader Dr. J. Stefels, (both RUG Marine Biology). This project formed the Dutch contribution to the MAST III programme ESCAPE. To locate phytoplankton blooms precisely, remote sensing images were used in the ESCAPE. North Sea on 28 April 1998 Left: Chlorophyll; Right: True colour.
3 Multi-disciplinary Study of Mud Volcanism in the Eastern Mediterranean (MEDINAUT); programme manager and chief scientist was Dr. J.M. Woodside (VU-IvA). A French-Dutch team studied processes and products of mud volcanoes and fluid vents in different settings in the eastern Mediterranean Sea during a number of dives with the French Nautile to the sea floor.. The work was done near the crest of the Mediterranean Ridge, in the Olimpi sector where considerable background information exists from research in the past six years, and in the Anaximander Mountains, where recent studies identified gas hydrates from a mud volcano.
4 TEST cruise; cruise leader Dr. B. Kuipers (NIOZ). In a five day cruise on board RV PELAGIA a new system, the Scanfish, was successfully tested. The system is able to measure sea water temperature and conductivity in an undulating profile between 0-400 meter water depth.

Advice to GB-ALW for the National Programme 1999 and 2000:
For the execution of the 1999 programme for HOLOCENE (project manager Dr. J. Sinninghe Damsté, NIOZ), PROCS (project manager Dr. ir. H. Ridderinkhof, NIOZ), and parts of Carbon Uptake (LABEL) (project manager Prof.dr. C. Heip, NIOO-CEMO) MRF advised the use of RV PELAGIA. For the 2000 programme MRF advised GB-ALW on twelve sea-going proposals (ten NIOZ, one UU, and one UU-IMAU).

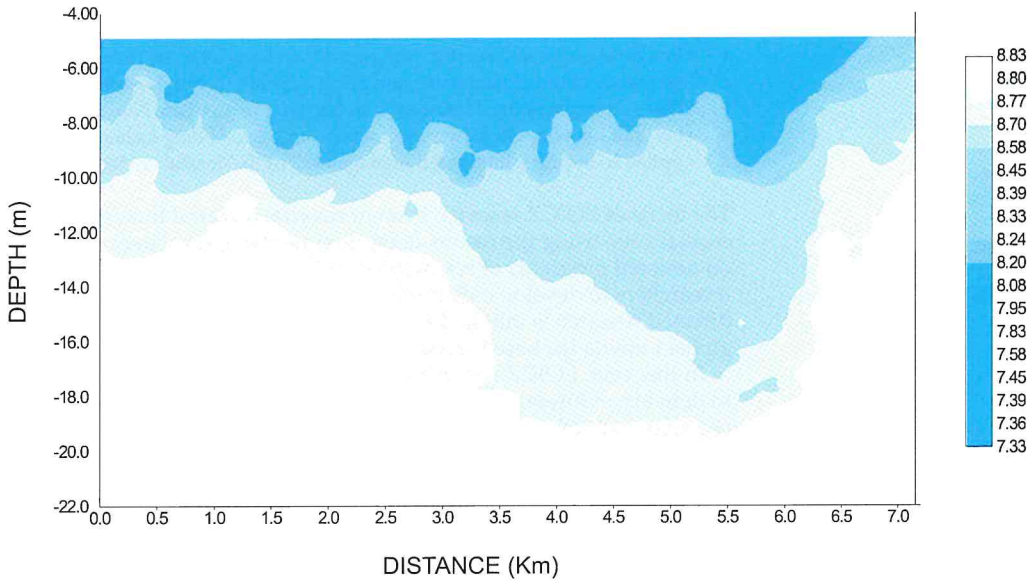


Remote sensing images North Sea on 28 April 1998 used for ESCAPE. Left: Chlorofyll. Right: True colour.

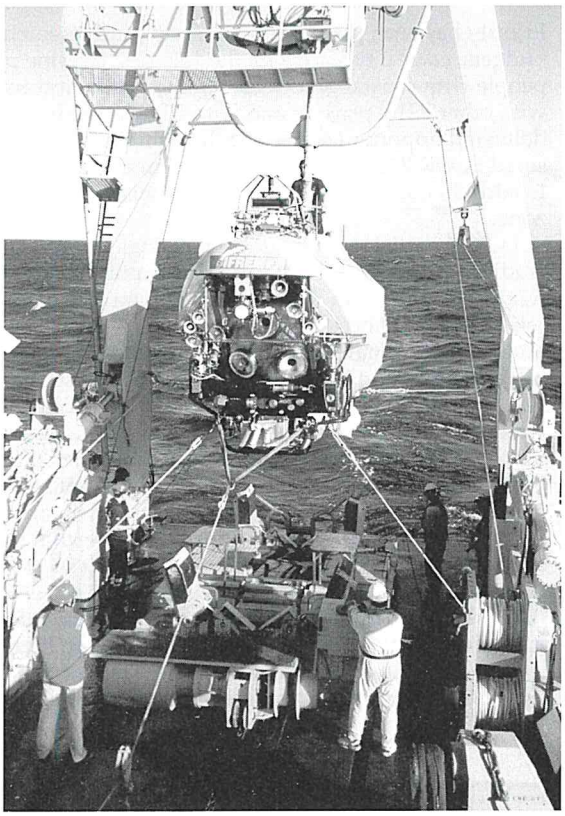
M.J. Rietveld and C.N. van Bergen Henegouw (executive secretary ISOM) took part in the 12th meeting of the International research Ship Operators Meeting (ISOM), at the Scripps Institute of Oceanography in San Diego, USA.

The total effort in terms of ship days and personnel involved in 1998 is given in the table.

Project		ship days	scientists	students	MRF	others
1	Triple B	16	6	4	5	
2	ESCAPE	20	14	0	1	
3	MEDINAUT	34	11	1		
4	TEST	5	2	1	6	6
Total		75	19 + pm	6 + pm	11 + pm	6



SCANFISH TEST cruise
December 1998.
Water temperature °C
'Molengat'.



The French Nautile.during MEDINAUT.
Photo: J.M.Woodside, Amsterdam

6

LAND-OCEAN INTERACTIONS IN THE COASTAL ZONE (LOICZ).

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

The world's coastal zones form a long narrow boundary between land and ocean that is highly valued by human societies. The Land-Ocean Interactions in the Coastal Zone (LOICZ) core project of the International Geosphere-Biosphere Program (IGBP) on Global Change studies this relatively small but highly productive, dynamic and sensitive area. The LOICZ International Project Office (IPO) is hosted by NIOZ and funded by the Netherlands government.

Major questions that LOICZ addresses on a global scale are:

- Is the coastal zone a sink or source of CO_2?
- What are the mass balances of carbon, nitrogen and phosphorus in the coastal zone?
- How are humans altering these mass balances, and what are the consequences?
- How do changes in land use, climate and sea level alter the fluxes and retention of water and particulate matter in the coastal zone, and affect coastal morphodynamics?
- What is the role of the coastal zone in trace gas (e.g., DMS, NO_x) emissions?
- How can knowledge of the processes and impacts of biogeochemical and socio-economic changes be applied to improve integrated management of the coastal environment?

The focus of LOICZ research is on horizontal material fluxes and on scaling of processes in the coastal zone using the results of environmental and socio-economic science. LOICZ depends on national programs of research and individual scientists' contributions, and works with researchers to develop collaborative and multidisciplinary projects to meet the goals. While directed research is initiated to fill gaps in knowledge, LOICZ mainly aims to value-add to the global knowledge base through focussed workshops of experts.

In this year, LOICZ has moved from a dominantly planning and network-building function to delivery of integrated science products that address coastal zone processes and changes at regional and global scales. The target is to provide a first global synthesis and models by end of the year 2002, and to cross-link the coastal zone assessment with the family of IGBP core projects (terrestrial, atmospheric, oceanic).

The IPO provides scientific support and integration, opportunities and planning, administration and communications.

Activities

Priority has been placed on workshops and research that develops regional biogeochemical budgets, coastal typology methodologies, riverine processes and discharges and interaction of people with coastal processes. Stronger links and collaborative activities have been established with other IGBP projects and with SCOR. During 1998, expert workshops in five regions have delivered important science findings in these priority areas for the LOICZ program. A co-sponsored SCOR Working Group on coral reefs has concluded its work and another has been set up to address the significance and mechanisms of submarine groundwater discharge in the coastal zone.

LOICZ participated in global meetings on river deltas, ocean processes and European coastal studies (ELOISE), and expanded the number of LOICZ scientific contributors and research network, particularly in the European region. In many areas of the world the LOICZ program relies upon enhanced skills and networks to better develop an understanding of the existing interplay of coastal processes and their significance for global change. Strong collaborative arrangements and actions have been forged especially with IOC (including GOOS and ICAM programs) and START, and links are being established with IAI and APN regional networks. Additional contributing projects have been gained from most regions of the world, with strong input from Europe (especially ELOISE and the UK LOIS). The Netherland LOICZ Committee is finalising agreements for a major program of research. New projects are being developed for 1999 that focus on the Caribbean, South America, South Asia and Oceania regions.

Internal and external communications are vital to the program which now includes a contact network of more than 2300 people and agencies throughout the world. The application of the science produced by LOICZ is an important issue. A strong liaison has been built with the Netherlands Coastal Zone Management Centre at RIKZ and a clear link has been made with IOC as a crucial mechanism for delivering our science to the global intergovernmental forum.

Two examples of our science activities in 1998 include biogeochemical budget work in San Quintin, Mexico and interim consideration of global calcification processes.

LINKING THE NATURAL SCIENCES WITH THE SOCIAL SCIENCES

Contributors: *Silvia E. Ibarra-Obando* (Center for Scientific Research and Higher Education, Mexico; LOICZ SSC), *Stephen V. Smith* (University of Hawaii, USA; LOICZ SSC), *Robert W. Buddemeier* (University of Kansas, USA; LOICZ SSC) and *Fredrik Wulff* (Stockholm University, Sweden; LOICZ SSC)

We selected the San Quintin system (30°N, on the Baja California peninsula, Mexico) a valley and bay where natural influences are clearly defined and anthropogenic influences are strong. Weak coupling between the land and bay allow study of the two sub-systems independently.

Agriculture occupies about 15,000 hectares, with tomatoes and strawberries being the main crops. This activity provides employment for about 15,000 people, most of them migrants from the Mexican states of Oaxaca, Guerrero, Veracruz and Sinaloa. The agriculture is not sustainable. The Valley and adjacent watershed are desert, with the agriculture supported by extraction of groundwater to such an extent that the water table is declining and saltwater intrusion is occurring. Agricultural production is almost entirely for export to the USA. With this activity, the local population is about 60,000; without it, they would probably number no more than a few thousand.

Along the bay, the main economic activity is oyster aquaculture, occupying only 400 of the 50,000 hectares of the bay. Seasonal coastal upwelling along the Pacific coast of Baja California results in a high productivity of the ocean. Biogeochemical budgeting of the bay demonstrated that there is an import of organic detritus associated with the upwelling. This detrital supply is an important food supply to organisms in the bay, including the cultured organisms. No other food or raw materials are required to support the aquaculture. The aquaculture provides employment for 350 people, and only 30% of the production is exported. This activity is sustainable at its present level, because the oysters are maintained by exchange of water and organic matter with the highly productive coastal water. Intensive mixing of water by wind and tides ensures that the biota have an ample food supply and that the water is well aerated.

During the workshop, we interviewed local government officials, field migrant workers and aquaculture people. After five days of intensive work, a new model linking the biogeochemical fluxes and the implications for mariculture and agriculture was developed. This can now be used as a "blueprint" for similar studies in other coastal areas, to link land and ocean and natural and social sciences, and ultimately to support management decisions at local and global scales.

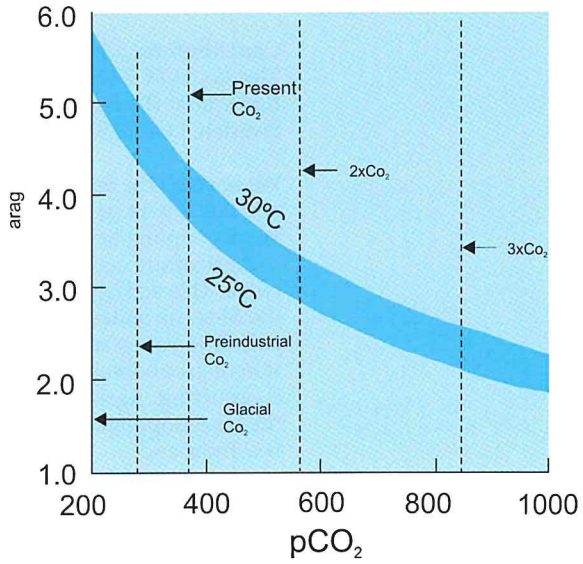
RISING CO_2 AND MARINE CALCIFICATION

Contributors: *Robert W. Buddemeier* (University of Kansas, USA; LOICZ SSC), *Jean-Pierre Gattuso* (Observatoire Océanologique, Villefranche-sur-mer, France), *Joan A. Kleypas* (National Center for Atmospheric Research, USA)

One of the systemic changes in the total earth system that is most representative of global change is the inexorable increase in atmospheric CO_2 concentration. CO_2 has risen from a base of 280 ppmv before the industrial revolution to 370 ppmv at present, and is projected to reach 560 ppmv ($2xCO_2$) by 2065. These anthropogenically-forced changes are superimposed on a high point in the natural CO2 cycle, and the atmospheric CO_2 is probably already higher today than any concentration experienced in the last several million, and possibly tens of millions, of years.

The carbon cycle is a major focus of IGBP, and increasing CO_2 is extensively studied as a contributor to global climate change, as a possible 'fertilizer' of photosynthesis, and in many other ways. One major role, however, has received little attention until recently: the effect of atmospheric CO_2 on marine biogeochemistry and ocean ecosystems. The ocean contains close to 90% of the earth's 'exchangeable carbon' but it mixes only slowly, and the surface layer has an inorganic carbon inventory similar to the atmosphere's and a residence time somewhat longer. Because the ocean is buffered at a pH of about 8, the dominant species of inorganic carbon is the bicarbonate ion, HCO_3^-, with only minor amounts of carbonate ion ($CO_3^=$) and aqueous CO_2 (dissolved CO_2 and H_2CO_3, carbonic acid).

The surface ocean equilibrates rapidly with the atmosphere, however, so each new increment of CO_2 is reflected in a transient increase in surface ocean carbonic acid concentration — transient, because the inorganic carbon system re-equilibrates in a way represented by the equation $H_2CO_3 + CO_3^= \longrightarrow 2HCO_3^-$. Thus, rising atmospheric CO_2 results in an increase in total inorganic carbon (and bicarbonate ion) in the surface ocean, an increase in aqueous CO_2, and a significant decrease in carbonate ion concentration. This in turn affects the calcium carbonate mineral saturation states of the surface ocean; because Ca^{++} concentration is much larger than



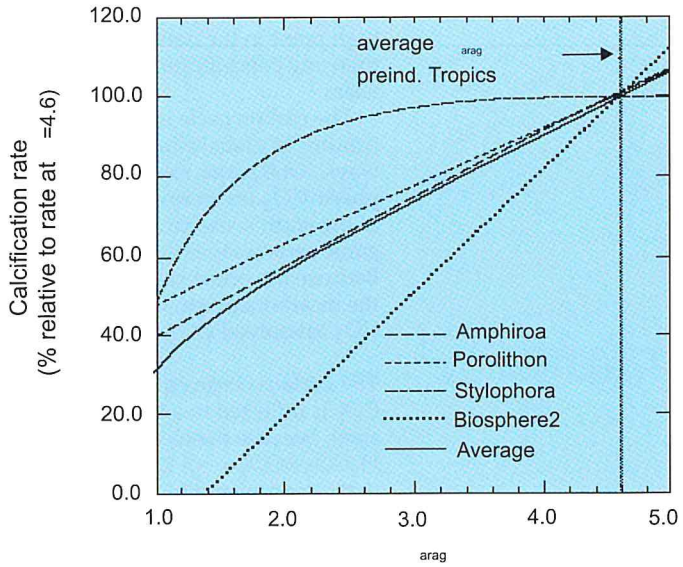
The effect of rising atmospheric CO_2 on the saturation state Ω of aragonite. Changes in Ω-aragonite as a function of pCO_2 and temperature for the range of temperatures most often associated with coral reef development, and the range of probable recent past and future pCO_2 values.

carbonate ion concentration and nearly constant, it is the $CO_3^{=}$ concentration that controls the ion activity (concentration) product $[Ca^{++}]*[CO_3^{=}]$.

If we define Ω as $[Ca^{++}]*[CO_3^{=}]/K_{sp}$, where K_{sp} is the product of concentrations that result in neither precipitation nor dissolution of calcium carbonate, then $\Omega < 1$ reflects an undersaturated (dissolution-promoting) condition; and $\Omega > 1$ represents supersaturation (conducive to precipitation). At present the world's surface oceans are all supersaturated with respect to calcite, the least soluble mineral form of calcium carbonate. Aragonite supersaturation is greatest in the tropics and diminishes toward the poles, and high-magnesium calcite (the most soluble form) is strongly supersaturated only in lower-latitude waters.

Although there is geological evidence for saturation state control of mineral distributions and accumulations and the saturation state dependence on CO_2 is strong, little marine biological research has focused on the effects of CO_2, presumably because Ω is projected to remain > 1 in the foreseeable future, and it is known that all or most calcifying organisms possess active ion transport and concentration mechanisms that enable them to precipitate minerals in an undersaturated environment.

Recent LOICZ-supported investigations into coral reef responses to global change have revealled the importance of saturation state responses in these ecosystems, which produce predominately the more soluble carbonate minerals. Both new research and review of the literature have shown a strong dependence of both organism and community calcification rates on saturation state. Although the data base is limited and the mechanisms are not fully understood, the strength and consistency of the signal suggest that calcification rates of reefs and benthic



Strong dependence of both organism and community calcification rates on saturation state. Summary of experimental results on calcification as a function of saturation state for 2 tropical algae, a coral, and a mesocosm of reef-related species. Average rate relative to the calculated preindustrial rate was used to estimate recent past and probable future calcification changes.

calcifying communities have already decreased by 6-11%, and that a doubling of CO_2 will result in a total decrease of 17 to 35%. This will be reflected in shifts in community composition and metabolism, and at the organism level reduced calcification potential may result in weaker skeletons (with greater vulnerability to bioerosion, physical damage) and/or reduced extension rates (implying reduced ability to compete for benthic resources). Additional support for these predictions comes from a recent statistical analysis of the relationships among environmental variables and coral reef biogeography; the findings indicate that temperature, light, and saturation state all exercise a significant degree of control over reef distribution.

In addition to future shifts in organism and ecosystem dominance or survival, the findings suggest important considerations for research into paleo-environments and the functioning of the carbon cycle. It is common to interpret past variations in organism or mineral abundances in terms of organic productivity and temperature. Recognition that carbonate accumulation rates, indicator fossil abundances, or organic/inorganic burial ratios can be affected directly by the marine chemical consequences for calcification of atmospheric CO_2 concentration changes may help to resolve uncertainties and apparent contradictions, and to develop more useful hypotheses concerning feedbacks in the carbon and carbonate cycles.

This perspective on the saturation-state mediated role of CO_2 change in the ocean opens a variety of new avenues for research and integration. It is the first finding of a direct negative biotic effect of rising CO_2 on a major ecosystem, it provides an altered perspective on the future of shallow-water and coastal marine ecosystems, especially in tropical and subtropical waters, and on a broader basis it raises significant questions about paleo-environmental interpretations and carbon cycle models based on sedimentary and fossil evidence.

Staffing of the Office at NIOZ:

Judith van Bleijswijk continued as project assistant in the first four months of the year, in which period Han Lindeboom, Chair of LOICZ Scientific Steering Committee acted as part-time Executive Officer. In May 1998, Chris Crossland from Australia joined the IPO as Executive Officer, followed by Hartwig Kremer from Germany who became Deputy Executive Officer at the end of June.

In August, LOICZ data analyst Martijn van der Zijp left the office after three years of developing the LOICZ Typology Database. Also in August, Maarten Scheffers from the National Institute for Coastal and Marine Management (RIKZ) was appointed as liaison officer between LOICZ and the Coastal Zone Management Centre in The Hague.

Cynthia Pattiruhu and Mildred Jourdan continue to provide office management and support.

Funding:

In addition to core funding support for the IPO from the Netherlands government, LOICZ has gained significant project funding from WOTRO and is finalising arrangements with UNEP-GEF. Other project proposals are with the European Union, World Bank, Inter-American Institute and START. In-kind support, especially from NIOZ and RIKZ, and many national government agencies underpins activities.

DATA MANAGEMENT GROUP

Contributors: *T.F. de Bruin, C.N. van Bergen Henegouw, H. Ridderinkhof*

In 1996 the Data Management Group (DMG) has been formed as a seperate group within the department of Physical Oceanography, funded by GOA (presently ALW) and NIOZ.
The main tasks of the DMG are to assist scientists during all phases of a project and to archive and to keep available all data of ALW and NIOZ cruises.

In the philosophy of the DMG the Internet plays an increasingly important role in the exchange of data and information. Therefore much emphasis was put on the presentation and availability of oceanographic data on the Internet. The website of the DMG (http://www.nioz.nl/en/facilities/dmg/meta/) was revised to give users a more easy access to the data, held in the database. Internet technology is used to dynamically link the information in the database to the webpages. New datasets are continuously added as soon as they become available.

In 1998 the DMG presented the data and meta-information of several major research projects also in the form of a series of special webpages. Through these pages users anywhere in the world have direct access to the data of the Netherlands Indian Ocean Programme (NIOP), the Deep Chlorophyll Maximum project (DCM) and the NIOZ-TESO Marsdiep project. Other projects will follow.

Apart from these projects, websites for the secretariats of the National Oceanographic Data Committee (NODC) and the International Research Ship Operators' Meeting (ISOM) were designed and added to the DMG-site. Also, support was given to the development of the general NODC-site.

In 1998 all chief-scientists of cruises onboard R.V. Pelagia were supplied with a special Excel workbook to enter cruise metadata. This Excel workbook will be replaced by a stand-alone database-application next year, which was developed in the latter half of this year.

All data, collected in digital form during the cruises, were archived on CD-ROM and stored in a safe, for use in case of an emergency. To facilitate the (inter)national exchange of preliminary data among the participants of a cruise, password protected FTP-areas were furnished. Members of the DMG participated in two cruises, notably the TripleB- and the PROVESS cruises. If necessary the postprocessing of the CTD data was done by the DMG. During the MERLIM98 and the ESCAPE cruises, the DMG cooperated with M. Wernand to assist the chief-scientists in the acquisition and interpretation of satellite images from the SeaWifs sensor. In the case of the MERLIM98 cruise, this proved to be essential for a successful cruise.

The DMG is also responsible for the underway measurement systems onboard R.V. Pelagia. In 1998 the agreement between NIOZ and the Royal Netherlands Meteorological Institute (KNMI), concerning the use of meteorological sensors onboard R.V. Pelagia, was finally effectuated and meteorological sensors from KNMI were installed onboard.

The subtasks of the DMG include the development and maintenance of an Antarctica data inventory for the Antarctic research projects in the Netherlands.

2. Publications and Presentations

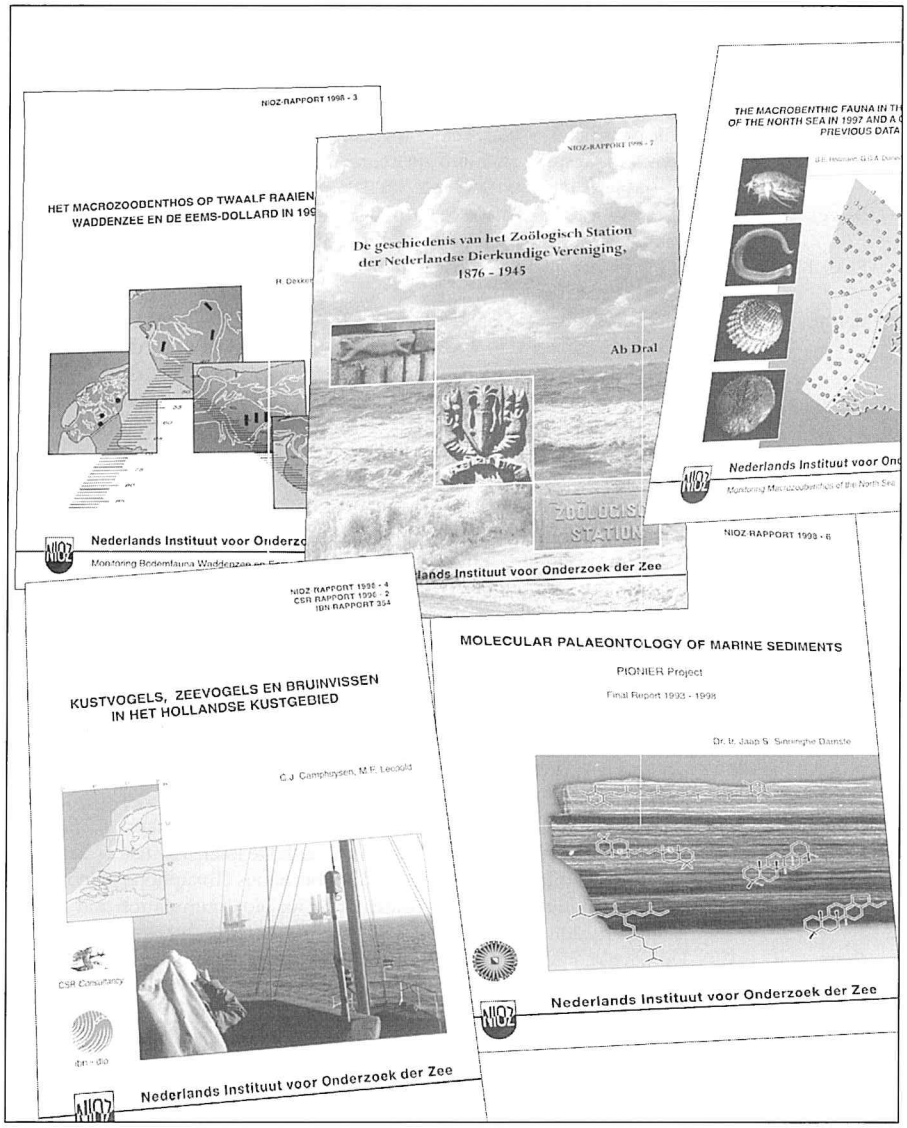


Photo: H. Hobbelink

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Dissertations

Bakker, D.C.E. Process studies of the air-sea exchange of carbon dioxide in the Atlantic Ocean. RUG, Groningen: 220 pp.

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Walker, P.A. Fleeting images. Dynamics of North Sea ray populations. UvA, Amsterdam: 145 pp.

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Zdanowski, K.M. & J.H. Vosjan. UV-b sensitivity of Antarctic bacteria. 25th Polar Symposium, Warsaw, Poland, 16-17 September.

Oral presentations

Arietta, J.M.& G.J. Herndl. Separation of bacterioplankton communities by capillary zone electrophoresis. 6 th European Marine Microbiology Symposium, Sitges, Spain, 17-21 May.

Baars, M.A. Pelagic ecosystems, with special reference to the North Sea and the Arabian Sea. Lecture Series Marine Ecosystems, RUG, Haren, 12 June.

Bak, R.P.M. Coral population structure as adaptive response to environmental change. International Society for Reef Studies. Perpignan, France, 4 September.

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

Bak, R.P.M. Coral reefs and pollution. Lecture RUG, Groningen, 26 May.

Bak, R.P.M. Coral reefs biogeography. Lecture series RUG, Groningen, 19 January.

Bak, R.P.M. The coral reef as sensor of world climat/environmental change. Sea Research in the Netherlands (KNAW-NWO), Amsterdam, 9 June.

Bak, R.P.M. Coral reefs and environmental change - adaptation, acclimation or extinction? SCOR Symposium, Boston, USA, 7 January.

Bergman, M.J.N. Beam trawl fisheries in the North Sea: impact on the benthic ecosystem. Lecture for students IHE (Delft) Water and environmental resources management, NIOZ, 13 May.

Bergman, M.J.N. Fishing mortality in megafaunal benthic populations due to trawl fisheries in the Dutch continental shelf in the North Sea in 1994. Heraklion, Greece, 6 October.

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Bergman, M.J.N. Improvements to the Triple-D, a benthos dredge to sample megafaunal abundances. ICES BEWG, Heraklion, Greece, 24 April.

Bergman, M.J.N. Results, conclusions and recommendations of the IMPACT-II project: The effects of different types of fisheries on the North Sea and Irish Sea benthic ecosystems). ICES BEWG, Heraklion, Greece, 24 April.

Bergman, M.J.N. The immediate effects of bottom fishing on in- and epifaunal communities in sandy sediments. Anglesey, UK, 8 December.

Beukema, J.J., K. Essink & R. Dekker. Ups and downs of the predatory worm *Nephtys hombergii* at the margin of its area of distribution and consequences for the abundance of its prey *Scoloplos armiger* and *Heteromastus filiformis*. European Marine Biology Symposium, Wilhelmshaven, Germany, 7-11 September.

Blokker, P., H. Van Den Ende, J.W. de Leeuw & J.S. Sinninghe Damsté. Algaenans: Resistant aliphatic biopolymers in green microalgae. 'Laboratoire d'Océanographie et de Biogéochimie (LOB)', Centre d'Océanologie de Marseille, Marseille, France, 4 November.

Blokker, P., J.S. Sinninghe Damsté, H. Van Den Ende & J.W. De Leeuw. Structural comparison of algal microfossils with extant algaenans using ruthenium tetroxide degradation. Oldenburg meeting 98, NIOZ, 28-29 May and 8th Annual Goldschmidt conference Toulouse, France, 30 August-3 September.

Blokker, P., J.S. Sinninghe Damsté, H. Van Den Ende & J.W. De Leeuw. Algaenans: aliphatic biopolymers in green algae. BioCentrum Symposium Cellular Development, Amsterdam, 23 October.

Blokker, P., J.W. De Leeuw, J.S. Sinninghe Damsté & H. Van Den Ende. Algaenans in zygospore wall of *Chlamydomonas mocoica*. 8th International Conference on the Cell and Molecular Biology of *Chlamydomonas*, Tahoe City, USA, 2-7 June.

Booij, K. Measure your measure. Undergraduate course 'Environmental Chemistry' Faculty of Earth Sciences, Uu, Utrecht, 4 February.

Booij, K. Stretching the Huckins et al. (1993) model to the limit. 5th International workshop on Semipermeable Membrane Devices. Kansas City, USA, 18-20 May.

Booij, K. The thermodynamic basis of partition coefficient correlations. Undergraduate course 'Environmental Chemistry', Faculty of Earth Sciences, UU, Utrecht, 4 March.

Booij, K. 'Measuring contaminant-pressure with semi-permeable devices (SPMDs)'. Symposium Biologische beschikbaarheid van organische stoffen. Utrecht, 15 Oktober.

Booij, K. Distribution of organic micropollutants in the North Sea. Koninklijk Nederlands Meteorologisch Instituut, De Bilt, 5 November.

Booij, K. Fate of toxic substances in the marine environment. NEBROC basic course in marine sciences, NIOZ, 19 November.

Boom, A., S. Schouten, J.S. Sinninghe Damsté, J.W. De Leeuw, J.J. Boon, & H. Hooghiemstra. Stable Carbon isotopic record of climatic change from a tropical mountain ecosystem in Colombia, Oldenburg meeting, NIOZ, 28-29 May and 8 th Annual Goldschmidt conference, Toulouse, France, 30 August - 3 September.

Boon, J.P. Marine pollution research and policy in the Netherlands. NSC/NWO Joint symposium on ocean space utilisation. Tainan, Taiwan, 16-17 February.

Boon, J.P. The possible role of biomarkers in monitoring the health status of marine mammal populations. Spring School 'Biomarkers in Ecotoxicology' of the Research School Environmental Chemistry & Toxicology (M&T), NIOZ, 27-29 April.

Boon, J.P. The role of biotransformation in the bioaccumulation and toxicity of lipophilic organic contaminants in marine mammals and birds. Van Hall Institute, Leeuwarden, 26 March.

Boon, J.P., W.E. Lewis, H.J.C. Klamer, D. Pastor i Rodriguez, P.G. Wester & J. De Boer. Influence of biotransformation on the bioaccumulation and genotoxicity of organohalogen compounds in marine mammals and birds. Annual meeting of the Dutch Toxicology Foundation, Utrecht, 15 January.

Boon, J.P., W.E. Lewis, H.J.C. Klamer, D. Pastor i Rodriguez, P.G. Wester & J. De Boer. Biotransformation of lipophilic organohalogen compounds in marine mammals and birds. Possible consequences for bioaccumulation and genotoxicity. NIOZ, 29 January.

Bouman, H.A., B.D. Irwin, T. Platt, M.R. Wernand & G.W. Kraay. Modelling primary production in the subtropical North Atlantic. Ocean Optics XIV (SPIE), Kailua-Kona, Hawaii, USA, 10 -13 November.

Brummer, G.J.A., E. Koning, H.T. Kloosterhuis, J. Van Iperen, A.J. Van Bennekom, W. Helder, G.M. Ganssen, S.M.-H. Conan, A.T.C. Broerse, S.R. Troelstra & K.A.F. Zonneveld. Preservation of monsoonal export fluxes across the sediment-water interface. 4e Nederlands Aardwetenschappelijk Congres, Veldhoven, 7-8 May.

Brummer, G.J.A., H.T. Kloosterhuis & W. Helder. Monsoonal contrast in Arabian Sea ^{13}C-DIC. Workshop on the ^{13}C of the DIC in the oceans, Amsterdam, 7-8 September.

Buitenhuis, E., K.R. Timmermans & H.J.W. De Baar. Zn-C co-limitation of *Emiliania huxleyi*. British Phycological Society, Winter Meeting, Royal Holloway, London, UK, January 5-8.

Cadée, G.C. Shell damage and shell repair in *Nacella concinna*, King George Island, Antarctica. Symposium Ned. Malac. Ver. Rotterdam, 21-22 November.

Camphuysen, C.J. Seabirds and discards: the dramatic expansion of the northern fulmar in the North Atlantic in the context of fishery waste as an artificial food supply. NEBROC course, NIOZ, 27 November.

Camphuysen, C.J. Seabirds of the Scottish Islands, the Faeroe Islands and Jan Mayen. Plancius/Oceanwide presentation, Maarn, 17 January.

Camphuysen, C.J. Oiled seabirds in the Netherlands, recent trends . Studiedag Staatsbosbeheer, Renesse, Schouwen-Duiveland, 27 March.

Camphuysen, C.J. An airport in the North Sea: an alternative? TNLI workshop, Amsterdam, 26 May.

Camphuysen, C.J. Seabirds of the Scottish Islands, Harp Seals in the Jan Mayen pack ice & Cetaceans in the Greenland Sea. Plancius/Oceanwide presentation, Amsterdam, 7 November.

Camphuysen, C.J. Foraging strategies of piscivorous seabirds at sea: searching for prey in a constantly changing environment, MIFOS workshop, Aberdeen, 16 November.

Camphuysen, C.J. Oiled seabirds and their research in the Netherlands. Lezing voor Vogelwerkgroep Texel, Den Burg, 30 November.

Camphuysen, C.J. Seabirds and commercial fisheries: populations trends of piscivorous seabirds explained? Workshop Effects of fishing on non-target species and habitats: biological, conservation and socio-economic issues, Beaumaris, Anglesey, Wales, 9 December.

Conan, S.M.-H. & G.J.A. Brummer. Fluxes of planktic foraminifera in response to monsoonal upwelling in the Somalia Basin. FORAMS'98, Monterey, Mexico, 5-11 July.

De Baar, H.J.W. Carbon dioxide uptake in the Southern Ocean. Workshop of the EU Environment and Climate Program, Brussels, 30 November.

De Baar, H.J.W. Four lectures in NEBROC graduate course, NIOZ, Texel, 18-19 November.

De Baar, H.J.W. Carbon dioxide uptake in the Southern Ocean: the CARUSO project. EU Climate and Environment Conference, Vienna, 21 October.

De Baar, H.J.W. Lecture series Introductory Oceanography, Department of Marine Biology, University of Groningen, Groningen, February.

De Baar, H.J.W. Pollutant metals; Greenhouse gases. Lecture series in course Marine Environment, University of Groningen, Groningen, May.

De Baar, H.J.W. The iron fist of the Antarctic Ice Sea: Control on plankton production and worldwide carbondioxide budget. National Day of the Sea, UNESCO Year of the Oceans, New Metropolis, Amsterdam, 9 June.

De Baar, H.J.W., C. Lancelot, E. Hannon, S. Becquevort & C. Veth. On the rate of diatom growth: ecosystem modeling of blooms and carbondioxide draw-down in the Southern Ocean. SCOR Symposium on Biogeochemistry of Iron in Seawater, Amsterdam, November 1-5.

De Baar, H.J.W., J.T.M. De Jong, R. F. Nolting, M.A. Van Leeuwe, K.R. Timmermans, M. Templin, M.M. Rutgers Van Der Loeff & J. Sildam. Low dissolved iron and the absence of diatom blooms in remote Pacific waters of the Southern Ocean. AGU Ocean Sciences Meeting, San Diego, USA, February 9 - 13.

De Baar, H.J.W., K.R. Timmermans, M.A. Van Leeuwe, J.T.M. De Jong, R.F. Nolting, L. Gerringa & C. Lancelot. Meteorology and low availability of iron control the diatom blooms in Atlantic and Pacific sections of the Southern Ocean. British Phycological Society Winter Meeting, Royal Holloway, London, UK, January 5-8.

De Baar, H.J.W., L.J.A. Gerringa, J.T.M. De Jong, M.A. Van Leeuwe, R.F. Nolting, K.R. Timmermans & V. Schoemann. Low dissolved iron and the absence of diatom blooms in remote Pacific waters of the Southern Ocean. Antarctic Symposium KNAW, Amsterdam, 5 June.

De Leeuw, J.W. Molecular characterization of marine UDOM. DOM/SLIM workshop, NIOZ, 19-20 October.

De Wilde, H.P.J., R.J.W. Visser & W. Helder. Methane and nitrous oxide in European estuaries. 2 nd annual ELOISE conference, Huelva, Spain, 30 September- 3 October.

De Wilde, P.A.W.J. Lecture series, Marine Ecosystems, Ecosystem of the North Sea. RUG, Groningen, 9 June.

Dekker, R. Adaptations to environmental variability in estuarine invertebrates. NEBROC course NIOZ, 15-27 November.

Dekker, R. High bivalve recruitment after severe winters in the Wadden Sea: rule or probability. Workshop on bivalve recruitment in the Wadden Sea, Sylt, Germany, 10 November.

Fonds, M. & S. Groenewold. Secondary effects of trawling on demersal and benthic scavengers. Workshop on Trawling effects, Anglesey, UK, 7-10 December.

Fransz, H.G. On the scale of persistence in marine zooplankton populations, GLOBEC Open Science Meeting, Paris, 17 May.

Gerringa, L.J.A. Chemical speciation and biological availability of iron in seawater. NEBROC course, NIOZ, Texel, 19 November.

Gerringa, L.J.A. & H.J.W. de Baar. Positive feedback of enhanced UV-B via Iron chemistry of seawater on phytoplankton growth and CO_2 fixation in the Southern Ocean. Netherlands Antarctic Programme, The Hague, 21 December.

Gerringa L.J.A., K.R. Timmermans & H.J.W. De Baar. The reality of the ocean versus laboratory cultures of algae with respect to Fe availability research. British Phycological Society, Winter Meeting, Royal Holloway, London, UK, January 5-8.

Gerringa, L.J.A., R.F. Nolting, K.R. Timmermans, H.J.W. De Baar & M.J.W. Swagerman. Interpretation of Fe III speciation data of samples with two organic ligand classes from the Pacific region of the Southern Ocean. AGU Ocean Sciences Meeting, San Diego, USA, February 9 - 13.

Gerringa, L.J.A., M. Boye, H.J.W. De Baar, K.R. Timmermans, C.M.G. Van Den Berg. Iron limitation of phytoplankton growth in natural oceanic waters versus artificial laboratory media with EDTA. SCOR Symposium on Biogeochemistry of Iron in Seawater, Amsterdam, November 1-5.

Grice K., J.M. Van Rooij, W.C.M. Klein Breteler, S. Schouten & J.S. Sinninghe Damsté. Stable carbon isotope signals in copepods, their faecal pellets and particulate organic carbon (POC): ecological and biogeochemical implications. Australian Geochemistry Conference, Canberra, Australia, 28-30 September.

Groenewold, S. & M. Fonds. The effects of discards and damaged benthos, produced by beamtrawl fishery, on benthic scavengers in the southern North Sea. ICES Benthos working group, Heraklion, Greece, 5-8 October.

Helder, W. An evaluation of the application of oxygen micro- and mini-electrodes in deep-sea research. 'Jean-Claude Relaxans Goodbye Symposium', Arcachon, France, 20 November.

Helder, W. Application of benthic chamber and profiling landers in marine research, EAWAG, Zürich, Switzerland, 22 April.

Helder, W. Application of pH- ISFET and resistivity probes in profiling landers. EU-MAST ALIPOR workshop. Aberdeen, UK, 8 January.

Helder, W. Benthic fluxes and carbon mineralisation in the Adriatic Sea. EU-MAST-MATER workshop. Venice, Italy, 9 June.

Helder, W. Biogeochemistry of sediments of the Adriatic and Ionian Sea. Symposium on the Oceanography of the Adriatic Sea, Trieste, Italy, 22 September.

Helder, W. Early diagenesis. NEBROC course, NIOZ, 26 November.

Herndl, G.J. & I. Obernosterer. Photoreactivity of marine dissolved organic matter: differential response of bacterioplankton for surface versus mesopelagic waters. Society of Environmental Toxicology and Chemistry, Charlotte, USA, 15-19 November.

Herndl, G.J. Interaction between phyto- and bacterioplankton: role of turbulence and physico-chemical interactions. Verwey-dagen, NIOZ, 27 January.

Herndl, G.J. Role of polysaccharide formation in the development of harmful agal blooms. Workshop on Marine Harmful Algal Blooms: research in Europe. Kalmar, Sweden, 5-7 November.

Herndl, G.J. The microbial loop. Lecture Series Marine Ecosystems, RUG, Haren, 13 June.

Herndl, G.J., J.M. Arrieta, I. Obernosterer & B. Reitner. Role of ultraviolet radiation in the Mediterranean Sea: interaction between mixing processes, photochemistry and microbial activity. 35 th CIESM Congress, Dubrovnik, Croatia, 1-5 June.

Herndl, G.J., J.M. Arrieta, I. Obernosterer & B. Reitner. Role of ultraviolet radiation in aquatic systems: interaction between mixing processes, photochemistry and microbial activity. 8 th International Symposium on Microbial Ecology, Halifax, Canada, 9-14 August.

Herndl, G.J., K. Stoderegger & J.M. Arrieta. Bacterioplankton capsule formation and its role for the oceanic DOM. Ocean Science Meeting, San Diego, USA, 9-14 February.

Herndl, G.J., K. Stoderegger & J.M. Arrieta. Exopolymer production by bacterioplankton, its release into the ambient water and factors influencing the degradability. 6 th European Marine Microbiology Symposium, Sitges, Spain, 17-21 May.

Jansen, J.H.F. & R.R. Schneider. Interactions between South Atlantic Ocean and Africal climate. Climatic variability at present and in the past. NEBROC Workshop, Bremen: 2-4 February.

Koning, E., G.J.A. Brummer, J. Van Iperen & T.C.E. Van Weering. Biogenic silica as indicator for (paleo)upwelling in a Somalian margin core. 3rd OPALEO Workshop, Brest, France, 4 December.

Lavaleye, M.S.S. & G.C.A. Duineveld. Megabenthos, sediment community oxygen demand data and bottom features of two transects off NW Spain (June-July 1997). OMEX II-II workshop, Faro, Portugal, 5-8 April.

Lavaleye, M.S.S. Dutch biological research in the deep sea. Studentenvereniging, RUU, Utrecht, 20 January.

Lavaleye, M.S.S. The benthic intertidal fauna of Roebuck Bay, W. Australia, and the ROEBIM-97 expedition. Western Australian Museum, Perth, Australia, 31 July.

Lavaleye, M.S.S. The results of the ROEBIM-97 expedition. Australian Naturalist Club, Perth, Australia, 31 July.

Lindeboom, H.J. Ecology and economy of productivity of marine ecosystems. Directors meeting Dutch Marine Research Institutes, Den Haag, 3 December.

Lindeboom, H.J. Fisheries, conflict or harmony? Public discussion Ecomare, Texel, 24 March.

Lindeboom, H.J. LOICZ, Land Ocean Interactions studies in Africa. Nairobi, Kenia, 2 September.

Lindeboom, H.J. LOICZ, the way forward in Europe. ELOISE meeting, Huelva, Spain, 30 September-4 October.

Lindeboom, H.J. LOICZ, the way forward. IGBP-SSC meeting, Denver, USA, 17-21 February.

Lindeboom, H.J. Long-term variability of marine ecosystems and the effects of fisheries. Lecture for students IHE, NIOZ, 13 May.

Lindeboom, H.J. Long-term variability of marine ecosystems and the effects of fisheries. Lecture for students RUG, Groningen, 10 June.

Lindeboom, H.J. Results effects of trawl fishery. Mini-symposium 'Visserij en een veranderende maatschappij, Urk, 28 October.

Lindeboom, H.J. The need for closed areas as conservation tools. Workshop 'Effects of fishing on non-target species and habitats', Beaumarais, UK, 7-10 December.

Lindeboom, H.J. The possibilities of the North Sea. NRLO-meeting on 'Use of aquatic biomass', Schiphol, 12 March.

Lindeboom, H.J. The research of long-term ecosystem changes in the NEBROC cooperation. NEBROC Workshop, Bremen, Germany, 2-4 February.

Lindeboom, H.J. Vissen de vissers achter het net in 2000? Wageningse Kennisdagen, LUW, Wageningen, 17 April.

Lohse, L. Benthic mineral cycling in marine ecosystems: Adriatic Sea versus North Sea, Abdus Salam International Center for Theoretical Physics. Trieste, Italy, 11 November.

Lohse, L. Advective pore water transport and sediment resuspension accelerates benthic mineralisation in sandy, non-accumulating continental shelf sediments, European Marine Biology Symposium, Wilhelmshaven, Germany, 7-11 September.

Lohse, L. Benthic carbon mineralisation along a shelf-slope transect in the north-eastern Atlantic, University of Southern California, Los Angeles, USA, 5 February; AGU Ocean Sciences Meeting, San Diego, USA, 9-13 February; NIOZ, 26 February; University of Odense, Denmark, 27 May; University of Aarhus, Denmark, 28 May.

Maas, L.R.M. & G. Van Der Schrier. Reduction of the diffusionless Lorenz equations to a map, Mathematical Institute UU, Utrecht, 31 August.

Maas, L.R.M. A brief introduction to inertial waves, Coriolis-Lab, LEGI, Grenoble, France, 2 April.

Maas, L.R.M. Do inertial waves exhibit geometric focusing? : The 2D equatorial case, the geometry of 3D inertial waves, and possible indications from a lab-experiment, Coriolis-Lab LEGI, Grenoble, France, 2 April.

Maas, L.R.M & A. Doelman. Chaotic tides, Scientific Meeting Mathematical Physics Netherlands, Amersfoort, 13 March.

Maas, L.R.M. Geometric focusing of internal waves: theory and observations, LEGI, Grenoble, France, 26 March.

Megens, L. Molecular and carbon isotope analyses of POM fractions. DOM/SLIM workshop, NIOZ, 19-20 October.

Muyzer, G. Diversity, stability and productivity in cyanobacterial communities. Symposium on identification and function of non-culturable bacteria, Nijmegen, 20 November.

Muyzer, G. Genetic fingerprinting of microbial communities –present status and future perspectives. 8 th International Symposium on Microbial Ecology, Halifax, Canada, 9-14 August.

Pancost, R.D. & J.S. Sinninghe Damsté. Carbon isotope excursions: Application of CSIA. Lecture at the 'Institut Français du Pétrole', Paris, France, 9 October.

Philippart C.J.M. & G.C. Cadée. Coastal eutrophication and primary producers. ECSA Workshop on the Role of intertidal seagrass beds - organisms and fluxes on ecosystem level, Biologische Anstalt Helgoland, Sylt, Germany, 8-12 August.

Philippart, C.J.M. Plants in the sea. NIOZ Public Day, Radio Texel, NIOZ, 4 October.

Philippart, C.J.M. Short- and long-term effects of bottom fisheries on the North Sea ecosystem. SCOR general meeting, NIOZ, 1-5 November.

Philippart, C.J.M. Strategies in soft-sediment communities: II. Internal dynamics . NEBROC course, NIOZ, 15-27 November.

Philippart, C.J.M. Temporal scales of biological processes in marine waters. NWO Symposium on Sustainable use and conservation of marine living resources, KNAW, Amsterdam, 19 May.

Philippart, C.J.M. Trilateral workshop Shellfish fishery seaward of the islands CWSS, Wilhelmshaven, Germany, 10 March.

Philippart, C.J.M. Workshop parameters ecosystemquality North Sea, RWS, Rijswijk, 4 June.

Philippart, C.J.M., G.C. Cadée, R. Riegman & W. Van Raaphorst. Long-term changes in community structure of phytoplankton in the Marsdiep, the westermost tidal inlet of the Wadden Sea, NIOZ, 9 April.

Piersma, T. Adaptive organ flexibility in migratory shorebirds. Zoological Laboratory, RUG, Groningen, 16 April.

Piersma, T. Does extent of breeding plumage reliably signal parasite resistance in high-Arctic breeding shorebirds? Special Meeting of the International Wader Study, Cape Town, South Africa, 13 August.

Piersma, T. Ecology of avian migration. Lecture series Evolutionary Ecology. Subfaculty of Biology, UU, Utrecht, 28 January.

Piersma, T. Energy budget studies of migratory waders. Introduction at Dynamic Energy Budget (DEB) Workshop, NIOZ, 23 April.

Piersma, T. Evolution of the migration of Red Knots. Lecture series Evolutionary Ecology. Subfaculty of Biology, UU, Utrecht, 28 January.

Piersma, T. Intercontinental shorebird migrations. Symposium 'Dutch research on migratory species' in association with the scientific council meeting of the Bonn Convention, Wageningen, 4 June.

Piersma, T. Methods of studying the functional ecology of protein and organ dynamics in birds. International Ornithological Congress, Durban, South Africa, 17 August.

Piersma, T. Migration: energetic consequences of large-scale seasonal movements in shorebirds. Lecture series Animal Ecology, RUG, Groningen, 17 April.

Piersma, T. Migration: survival strategies in a variable environment. Lecture series Animal Ecology, RUG, Groningen, 17 April.

Piersma, T. Shellfisheries problems in the Dutch Wadden Sea. Discussion forum at Annual Meeting of the Netherlands Wadden Sea Society (Waddenvereniging), The Hague, 6 June.

Piersma, T. The science of bird migration and the role of Frisian plover-catchers. Presentation Het Friesche Vogelvangersbelang, Jorwert, 24 January.

Piersma, T. Wader and Wadden Sea research at NIOZ. Lecture and excursion IVN, NIOZ, 18 February.

Ridderinkhof, H. & H. Van Haren. Detailed Ferry Observations on Variability in Physical Parameters at the Marsdiep Tidal Inlet. 9th PECS (Physics of Estuaries and Coastal Seas) conference, Matsuyama, Japan, 24 September.

Ridderinkhof, H. Chaotic mixing in tidal current fields. Transport in Atmospheres and Oceans workshop (ESF), Porto, Portugal, 1-4 April.

Riegman, R. Eutrophication effects on ecosystem dynamics. Global Ecology and Oceanography of Harmful Algal Blooms Workshop, IOC and SCOR meeting, Havreholm, Denmark, 12-18 October.

Riegman, R. Size differential control of marine phytoplankton communities. Forschungs-und Technologiezentrum Westküste (FTZ), Büsum, Germany, 8-10 June.

Rospondek, M., J. Köster, J. Fenner & J.S. Sinninghe Damsté. Molecular palaeontological record of diatom contribution to the Oligocene Menilite Formation, the Outer Carpathians, SE Poland. 16th Carpathian-Balkan Geological Association Congress, Vienna, 30 August-2 September.

Schäfer, H. & G. Muyzer. Successional variation of bacterioplankton diversity in the Mediterranean Sea. 8th International Symposium on Microbial Ecology, Halifax, Canada, 9-14 August.

Schneider, R.R. & J.H.F. Jansen. Paleo-environment of the South Atlantic Ocean. Climatic variability at present and in the past. NEBROC Workshop, Bremen, Germany, 2-4 February.

Schoemann, V., C. Lancelot, J.T.M. De Jong & H.J.W. De Baar. Interactions of Fe, Mn and Al with a *Phaeocystis* bloom in an Arctic fjord. SCOR Symposium on Biogeochemistry of Iron in Seawater, Amsterdam, November 1-5.

Schramkowski, G. A Lagrangian study of transport and mixing in the Ems estuary. SAMO days, Driebergen, 30 October.

Sinninghe Damsté, J.S. Oceanic euxinic conditions during the Cenomanian/Turonian crises: implications for the carbon cycle. SCOR general meeting. NIOZ, 4 November.

Sinninghe Damsté, J.S. Preservation of sedimentary organic matter through natural sulfurisation: An overview. 8th Annual Goldschmidt Conference, Toulouse, France, 30 August - 3 September.

Sinninghe Damsté, J.S. Sedimentary derivatives of green sulphur bacteria as a molecular proxy for the assessment of euxinic conditions in the photic zone. 8th Annual Goldschmidt Conference, Toulouse, France, 30 August - 3 September.

Sinninghe Damsté, J.S. Sulfurised carbohydrates: an important sedimentary sink for organic carbon? DOM/SLIM workshop, NIOZ, 19-20 October.

Sinninghe Damsté, J.S., J. Köster & M.M.M. Kuypers. The Cenomanian/Turonian crises: Oceanic euxinic conditions and consequences for the earth system. 4e Nederlands Aardwetenschappelijk Congres, Veldhoven, 7-8 May.

Slezak, D. & G.J. Herndl. Dimethylsulfoniopropionate and ultraviolet radiation. 6th European Marine Microbiology Symposium, Sitges, Spain, 17-21 May.

Slezak, D. Phosphate uptake kinetics and alkaline phosphatase activity in phosphate limited *Emiliania huxleyi*. Int. *Emiliania huxleyi* workshop of NWO-NOP-Global Change, NIOZ, 8-10 June.

Spaargaren, D.H. Exploitation of marine and brackish water resources. Ningde, Fujian Province, P.R. China, July.
Spaargaren, D.H. Lecture series on mariculture and marine resources. Lima, Peru, January-February.
Stolte, W. Light-limited growth and cell composition of *Emiliania huxleyi* in turbidostat. Ocean Sciences Meeting, San Diego, USA, 9-14 February.
Stolte, W. Light-limited growth of *Emiliania huxleyi*. Int. *Emiliania huxleyi* workshop of NWO-NOP-Global Change, NIOZ, 8-10 June.
Stolte, W. Modelling phosphate uptake by phytoplankton. Int. *Emiliania huxleyi* workshop of NWO-NOP-Global Change, NIOZ, 8-10 June.
Stolte, W. Phosphorus-limited growth of *Emiliania huxleyi*. Department of Marine Microbiology of the University of Bergen, Bergen, Norway, 9 July.
Stuut, J.-B. & J.H.F. Jansen. Late Quaternary SW African terrestrial-climate signals in the marine record of the SE Atlantic Ocean, compared with variations in the intensity of the Benguela upwelling system, preliminary results. NSG/NIOZ-Bremen Meeting, Bremen, Germany, 8-9 April.
Stuut, J.-B. Eolian dust on Walvis Ridge, climate signals of SW Africa in the late Quaternary. Geologisches Institut, Universität Bremen, Bremen, Germany, 11 November.
Ten Hallers-Tjabbes, C.C. & C. Ree. Interactive Case Study in Communication between scientists and policy makers for marine environmental issues, Lecture Course Marine Environmental Biology, RUG, Groningen, 25 May and Institute for Energy and Environment, RUG, Groningen, 2 June.
Ten Hallers-Tjabbes, C.C. Causes of decline in *Buccinum undatum* L., impact of TBT and sensory-behavioural disruption by contaminants. 'Niedersachsisches Landesamt für Ökologie', Wilhelmshaven, Germany, 23 January.
Ten Hallers-Tjabbes, C.C. Contaminant impact on chemoreception and chemical stimuli in biota: a potential risk for the whelk?, NIOZ, 2 April.
Ten Hallers-Tjabbes, C.C. Ecotoxicological impact of organotins. Speciation '21 Workshop on Organotin Speciation, Segovia, Spain, 16-17 March.
Ten Hallers-Tjabbes, C.C. Ecotoxicology, general principles and selected case studies in the marine environment, Lecture Course Marine Environmental Biology, RUG, Groningen, 25 May.
Ten Hallers-Tjabbes, C.C. Environmental effects arising from the use of TBT antifouling paints on commercial shipping. Marine Environmental Regulation: The Cost to the Shipping Industry, London, UK, 23-24 September.
Ten Hallers-Tjabbes, C.C. Report on decision process for antifouling in IMO-MEPC 41. London Convention 72, Scientific Group, 21 st Meeting, Cape Town, South Africa, 9 April.
Ten Hallers-Tjabbes, C.C. Scientific Overview of antifouling environmental effects. Combat or join hands? Conference 'Boats against the current', Amsterdam, 15 May.
Ten Hallers-Tjabbes, C.C. The decision process on antifouling policy in IMO-MEPC. Speciation '21 Workshop on Organotin Speciation, Segovia, Spain, 16-17 March.
Thomas, H., V. Ittekkot, C. Osterroht & B. Schneider. New production fueled by nutrient supply from Non-Redfield remineralization of organic matter. Baltic Sea Science Conference, Baltic Sea Research Institute Warnemünde, Germany, 23-27 November.
Timmermans, K.R., J.T.M. De Jong, H.J.W. De Baar, M. Davey, R. Geider, A. Aldrich, M. Boye & C.M.G. Van Den Berg. Effects of Iron on *Chaetoceros calcitrans* (Bacillariophyceae) grown in natural sea water without artificial chelators. British Phycological Society Winter Meeting, Royal Holloway, London, UK, 5-8 January; AGU Ocean Sciences Meeting, San Diego, USA, 9-13 February; SCOR Symposium on Biogeochemistry of Iron in Seawater, Amsterdam, 1-5 November.
Van Aken, H.M. ADCP observations over the continental slope in the Bay of Biscay. RvO-WST, RIKZ, the Hague, 12 February.
Van Bennekom, A.J. 'History of the multi-disciplinary marine research in the Netherlands'. Instituut voor de Geschiedenis der Natuurwetenschappen, RU, Utrecht, 17 December.
Van Der Meer, J. Interference and the spatial distribution of wintering waders. Mini-Symposium, Section Animal Ecology and Ecotoxicology, VU, Amsterdam, 22 September.
Van Der Meer, J. Marine ecology: from individuals to populations. NIOZ, 4 June.
Van der Meer, J. Population dynamics of two marine polychaetes: the relative role of density dependence, predation, and weather fluctuations. ICES Symposium Marine benthos dynamics, Heraklion, Greece, 6 October.
Van Der Meer, M.T.J., S. Schouten, J. W. De Leeuw & D.M. Ward. Biological versus abiological mechanisms explaining isotopically heavy Isua organic matter. 8 th Annual Goldschmidt Conference, Toulouse, France, 30 August-3 September.
Van Der Meer, M.T.J., S. Schouten, J.W. De Leeuw & D.M. Ward. A possible explanation for isotopically heavy Precambrian organic matter. DOM/SLIM workshop, NIOZ, 19-20 October.
Van Der Schrier, G. Bifurcation analysis of the 2-D thermohaline circulation. European Geophysical Society XXIII General Assembly, Nice, France, 20-24 April.
Van Der Schrier, G. Thermohaline circulation in simple models. Max-Planck Institut fur Meteorologie, Hamburg, Germany, 16 January.
Van Duyl, F.C. DOC-POC production by corals: a circumventional strategy to meet nutrient demands in coral reefs. Ocean Science Meeting, San Diego, USA, 9-14 February.

Van Duyl, F.C., B. De Winder, A.J. Kop & U. Wollenzien. Tidal variations in bacterial activities and carbohydrate concentrations in diatom-inhabited intertidal sediments. DOMSLIM workshop, NIOZ, 20 October.
Van Haren, J.J.M. Tidal processes as inferred from ADCP measurements. RvO-WST, RIKZ, the Hague, 12 February.
Van Raaphorst, W., J.J.M. Van Haren. Nepheloid structure and zonation of deposition/erosion across the slope of the Faeroe-Shetland Channel, NIOZ, 17 December.
Van Schanke, A., The effects of PCB 126 on Benzo[a]pyrene metabolism in dab. Annual progress report meeting of the Graduate school M&T, Ede, 20 May and PAH metabolites workshop, Aberdeen, UK, 18-21 November.
Veldhuis, M. Application of flow cytometry in phytoplankton and bacterial research Workshop on Aquatic Flow Cytometry: achievements and prospects. Forschungs-und Technologiezentrum Westküste (FTZ), Büsum, Germany, 15-16 October.
Veldhuis, M. DNA in micro-organisms: application of flow cytometry to ecology. NIOO-CL, Nieuwersluis, 11 February.
Veldhuis, M. Flow cytometry as a tool for phytoplankton analysis and selective grazing in marine ecosystems. PIG-working group meeting, NIOO-CL, Nieuwersluis, 17 April.
Veldhuis, M. Taxonomy and detection of processes at the cellular and population levels. Workshop on Marine Harmful Algal Blooms: research in Europe, Kalmar, Sweden, 5-7 November.
Veldhuis, M. Viability in Oceanic phytoplankton. MERLIM workshop, Bergen, Norway29 September.
Versteegh, G.J.M. Past river outflow and ocean circulation based on alkanes, alkenones and planktic foraminifera off Congo. Oldenburg meeting, NIOZ, 28-29 May.
Versteegh, G.J.M. & H. Kinkel. Organic biomarker geochemistry. CODENET 1th Annual Workshop, Blagnac, France, 17-22 September.
Versteegh, G.J.M., J.H.F. Jansen, E. Ufkes & J.W. De Leeuw. A palaeoenvironmental reconstruction based on alkanes, alkenones and planktic foraminifera off Congo between 7 and 22 ka. 4 e Nederlands Aardwetenschappelijk Congres, Veldhoven, 7-8 May.
Versteegh, G.J.M., P. Blokker, D. Janofske & M. Montresor. Dinoflagellate biomarkers and their geological record. Dino 6, Trondheim, Norway, 7-12 June.
Veth, C. Observation of Agulhas Rings. MARE-meeting, IMAU, Utrecht, 5 October.
Veth, C. Wind-mixed layer modelling. NEBROC-meeting, Bremen, Germany, 2-4 February.
Vosjan, J.H. Lecture series on Marine Bacteriology International Postgraduate Course, Ecological Marine Management (ECOMAMA), University of Brussels, Belgium, 5-9 January.
Wernand, M.R. Real-time SeaWiFs data acquisition. REWANET Ocean Colour Workshop, Delft, 30 June.
Wiebinga, C.J. Analysis of dissolved organic carbon. DOC/SLIM workshop, NIOZ, 20 October.
Wiebinga, C.J. Bacterioplankton dynamics in the ocean. Bigelow Laboratory for Ocean Sciences, West Botthbay Harbor, Maine, USA, 24 February.
Wiebinga, C.J., M.A. Baars & H.J.W. De Baar. Carbon dynamics in the Arabian Sea at the onset and maximum of upwelling off Somalia and off Oman (May and August 1995). AGU Oceans Science Meeting, San Diego, USA, 9-13 February.
Witbaard, R. 100 years of environmental history saved in the shells of *Arctica islandica*. International course on Coastal and fisheries management, NIOZ, 19 August.
Witbaard, R. Food supply and benthic response at the Porcupine Abyssal Plain, Scientific Meeting Mast III project Bengal, Gif sur Yvette, France, 26-28 October.
Witbaard, R. Spatial differences in benthic activity in the Agean Sea. 3rd MTP-II Workshop on the variability of the Mediterranean Sea, Rhodos, Greece, 15-17 October.
Witbaard, R. Tree of the Sea. 3 rd Dutch Geoscientific Congress, Veldhoven, 7-8 May.
Zimmerman, J.T.F. Tides, EC-MAST III Advanced study course on Hydro- and morphodynamic processes in coastal seas. Renesse, 28 June-11 July.

EXTERNAL PROFESSIONAL FUNCTIONS

M.A. Baars

- member JGOFS Indian Ocean Synthesis and Modelling Group (SCOR)
- member Working Group JGOFS Nederland
- co-editor Journal of Sea Research
- member Plankton Interaction Group, NWO-ALW
- board member 'Stichting ter Bevordering van de Nederlandse Oceanografie' (SBNO, Amsterdam)

R.P.M. Bak

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

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

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

J.P. Boon
- board member of the Research School Environmental Chemistry and Toxicology (M&T)
- member committee 'Environmental Contaminants and Reproduction (ecotoxicology)', Dutch Health Council (Gezondheidsraad)
- member ICES Marine Chemistry Working Group
- member ICES Working Group on Biological Effects of Contaminants
- member 'commissie voor de milieu-effect rapportage'
- member of the scientific advisory group of the project 'integrale normstelling PCB's of the RIVM/Ministry VROM

G.J.A. Brummer
- member NWO/GOA research program committee 'Tracing a seasonal upwelling'
- member NWO/ALW 'gebruikers-adviesgroep verankerde systemen'
- member board NEBROC programme

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

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

R. Daan
- member workinggroup 'Monitoring rond Mijnbouwinstallaties'

H.J.W. De Baar
- professor General Oceanography, University of Groningen
- associate editor Marine Chemistry
- chairman committee Joint Global Ocean Flux Study (JGOFS)
- chairman SCOR Netherlands at KNAW
- member advisory committee on zinc in environment and human health of the National Health Council
- member NWO/NOP Programmeringsgroep Thema 1
- coordinator MERLIM research programme EU-MAST
- coordinator CARUSO research programme EU Climate and Environment
- member board NEBROC programme
- member Marine Life Sciences Platform (MLP) for ALW/NWO

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

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

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- member ICES Benthos Ecology working group

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- member Editorial Board of Wallaceana
- member Editorial Board of the Marine Pollution Bulletin
- member Editorial Board of Ecotoxicology

M. Fonds
- member Mariculture Committee ICES

H.G. Fransz
- member JGOFS-NL working group
- chairman Netherlands GLOBEC working group
- member GLOBEC international working group for numerical modelling (NMWG)
- member ASMO-working group for International Model Comparison
- member 'Beoordelingscommissie aanvragen ALW4'

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

G.J. Herndl
- member Editorial Board of Aquatic Microbial Ecology
- member Dutch JGOFS commission
- Instructor-In-Chief Aquatic Microbial Ecology, Course, Biological Station Lake Neusiedl for the University of Vienna
- member Scientific Committee ASLO meeting, Copenhagen 2000
- Organizer European Aquatic Microbial Ecology Meeting in the year 2000
- member Scientific Committee Intern. Symposium Microbial Ecology Amsterdam 2001
- coordinator MICOR research programme EU Climate and Environment

J.H.F. Jansen
- member Scientific Committee IGBP-PAGES-IMAGES 2 (The Intern. Marine Past Global Change Study
- member Dutch Ocean Drilling Project (ODP) working group
- member GEONETH, Geoscience Network of the Netherlands for International Cooperation
- member Scientific Committee 4e Nederlandse Aardwetenschappelijk Congres (NAC IV), Veldhoven

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

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

H.J. Lindeboom
- chairman Scientific Steering Committee LOICZ
- member Scientific Committee for the IGBP
- member Board of the Sir Allistair Hardy Foundation of Ocean Sciences
- member SCOR Working group 105, IMPACT of World Fisheries on Marine Ecosystems
- member ICES working Group 'Effects of Fisheries'
- coordinator EU-project 'Dynamo'
- member UNESCO working group 'Year of the Ocean 1998'

- 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
- coordinator NAM project 'Dutch Coastal Zone and Wadden Sea'
- coordinator Dutch research group 'Productivity, Ecology and Economy'.
- 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

L.R.M. Maas
- external examiner of thesis of Nicolas Perenne of LEGI (Grenoble), Universite Joseph Fourier, France.

M. Mulder
- member workinggroup 'Monitoring rond Mijnbouwinstallaties'

G. Muyzer
- member SCOPE Committee on Soil and Sediment Biodiversity and Ecosystem Functioning.
- member editorial board of FEMS Microbiology Ecology
- NATO ASI Lecturer on Advances in Molecular Ecology, Sicily, Italy, 20-31 March

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

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

C.J.M. Philippart
- editor Journal of Sea Research
- member NL-GLOBEC committee

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

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

R. Riegman
- co-editor Journal of Sea Research

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

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

D.H. Spaargaren
- secretary 'Commissie voor buitenlandse marien-biologische instituten', KNAW, Amsterdam
- member Board of advisory editors Crustaceana
- treasurer organising committee 4th International Crustacea Congress, Amsterdam, July 1998
- chairman science committee subtheme Physiology & Biochemistry ICC4

M.H. Stoll
- member Joint Global Ocean Flux Study Data Management Task Team (JGOFS-DMTT)

C.C. Ten Hallers-Tjabbers
- Advisor to IUCN for the London Convention 1972
- External advisor Faculty of Zoology & Anthropology, University of Porto, Portugal

H.M. Van Aken
- chairman Nederlandse Oceanografen Club
- member ICES Working Group on Ocean Hydrography

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

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

A.J. Van Bennekom
- member 'Academie Raad voor de Aardwetenschappen', KNAW
- member Working Group on Oceanic Hydrography, ICES
- guest editor Journal of Sea Research (D. Eisma special issue)
- editor Circumpolar Journal

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

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

J. Van Der Meer
- editor of 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)

H.W. Van Der Veer
- member organizing committee 4th International Symposium on Flatfish Ecology, Moorehead City, U.S.A.
- adjunct associate professor of Zoology, North Carolina State University, Raleigh, USA
- adjunct associate professor of Marine Science, University of South Carolina, Columbia, USA
- member Working Group on Recruitment Processes (ICES)
- special editor Proceedings 3rd International Symposium on Flatfish Ecology

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

W. Van Raaphorst
- member 'Begeleidingsgroep Eutrofiëring BEON'
- member 'Werkgroep habitats, graadmeters en monitoring, BEON'
- member Dutch LOICZ commission
- editor Journal of Sea Research

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
- member Editorial Board Marine Geology
- member Scientific Committee IMAGES
- member Proposal Review Committee for EU TOBI and GLORIA HCM and TMR programmes
- special guest editor Progress in Oceanography Volume OMEX Benthic Processes
- special guest editor Deep Sea Research Volume Netherlands Indian Ocean Program

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

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

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

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

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

J.T.F. Zimmerman
- Professor Fysische Oceanografie, Rijksuniversiteit Utrecht
- member editorial board Continental Shelf Research
- IAPSO representative national UGGI comite (ARA-KNAW)
- member Committee 'Milieueffectrapportage'
- member 'themacommissie kustonderzoek' (BOA-NWO)
- member New York Academy of Sciences

MEETINGS AND COURSES HELD AT NIOZ

Herndl, G.J. & B.R. Kuipers. **Course Marine Ecosystems** for the University of Groningen at NIOZ, 22-26 June.
The course was devoted to microbial processes under different inorganic nitrogen: phosphorus concentrations using the mesocosm facilities at NIOZ. A phosphorus vs. nitrogen limited system was established prior to the course and the students examined the biomass distribution of phyto- and bacterioplankton as well as microzooplankton. Dissolved organic carbon concentrations and the ectoenzymatic activity of the bacterioplankton revealed clear differences between the 2 systems. Actvity measurements using non-radiolabel techniques complemented the exercise. At the end of the course a simple carbon budget was constructed based on the standing stocks and the fluxes measured during the course.

Stolte, W. Int. ***Emiliania huxleyi*** **workshop** of NWO-NOP-Global Change, NIOZ, The Netherlands, 8-10 June.

H.W. Van der Veer. **Ices Working Group** on Recruitment Processes, 7-9 October.

The 10th **Verwey Symposium** was held from 26-28 January, as part of the national PhD programme in Marine Life Sciences organized by RUG and NIOZ. The symposium is integrated in the educational programme of the Graduate School of Functional Ecology.

The **course Marine Ecosystems** (15 students) which is part of the Marine Biology programme of the RUG, was held from 8-26 June. During the first week Prof. Dr. W.J. Wolff and several NIOZ scientists gave a series of lectures in the Biological Centre at Haren. The second and third week were, as in other years, dedicated to practical work at NIOZ. A programme of benthos and fish sampling, guided by the department MEE, was carried out with the Pelagia in the North Sea (Frisian Front, Oyster Grounds) and with the Navicula in the Wadden Sea. In the department BIO a phytoplankton springbloom was studied in pelagic mesocosms. These experiments included a/o. flowcytometrical measurements of grazing on bacteria. The extensive 'Results Report' (two parts) was finished at 26 June. The students prepared individual reports during the last week of the course, preceding their final examinations at the RUG.

Spring School 'Biomarkers in Ecotoxicology' of the Research School Environmental Chemistry & Toxicology (M&T), April 27-29.

Oldenburg meeting, May 28-29.

DOM/SLIM workshop, October 19-20.

The course **Practical Physical Oceanography** (11 students) was held from 17-26 June and was coordinated by C. Veth. The course is intended for university students who want to learn the practical side of physical oceanography. Students came mainly from the IMAU (UU), Physical Geography (UU) and the UT. During the course measurements have been done in the North Sea with the Pelagia and in the Marsdiep tidal inlet with the Navicula. The experiments in the Marsdiep were part of the 'Schulpengat Project'.

The course **Introduction to Oceanography** is part of the Marine Biology curriculum at RUG and was attended by 54 students, 24 majoring marine biology and 30 majoring environmental biology. The introductory lectures were given by Prof. Dr. Ir. H.J.W. de Baar at RUG from 9-20 February. The 24 marine biologists followed a series of practical research projects at NIOZ from 23 March till 3 April, including field work at the tidal flats and aboard the Pelagia and Navicula in the Wadden Sea and the North Sea. This practical part was coordinated by J.W. Rommets. Each student completed a written report on one of the research projects. The enthusiastic commitment of a great number of NIOZ scientific and supporting staff ensured an overall stimulating course.

Each year, a basic course on marine sciences will be given in the framework of the **NEBROC** co-operation between the Netherlands (NIOZ) and Bremen (University of Bremen, AWI, Max Planck Institute, ZMT). The course is offered to Ph.D. students of the participating institutions and, if space allows, to other European Ph.D. students in marine sciences. It replaces the former NIOZ Oceanography course.

The first NEBROC course took place at NIOZ from 16 to 27 November, and was organized by A.C. Bol, T. Bickert, J.P. Boon, H.J.W. De Baar, G.J. Herndl, J.H.F. Jansen, H.J. Lindeboom, J.W. Rommets, and C. Veth. 25 students attended the course: 5 from AWI, 7 from Bremen University, and 9 from NIOZ, together with 4 students from outside the NEBROC institutions. In the 10 days of the course, the scientific staff of the co-operating institutes gave 45 lectures, and 6 afternoons were spent for demonstrations and practical work. Besides these activities, the students gave lectures themselves during animated and stimulating early evening sessions. 'The good atmosphere and interactions between German and Netherlands students was probably the most valuable result of the joint venture, the future generation of ocean scientists laying the foundation for collaborations and friendships well into the next century' (quote from Course Evaluation). The second NEBROC course will be held at the Geological Institute of the University Bremen in fall 1999.

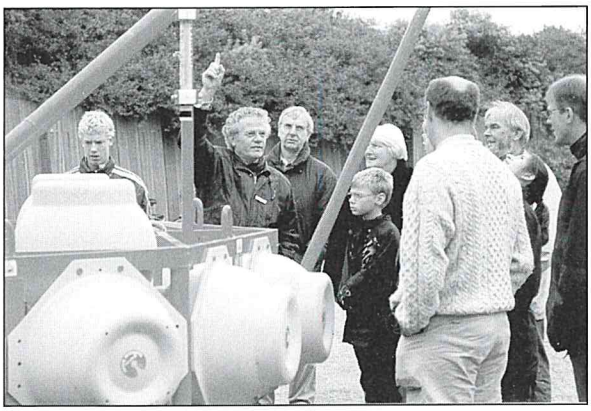
SCIENCE DAY 1998

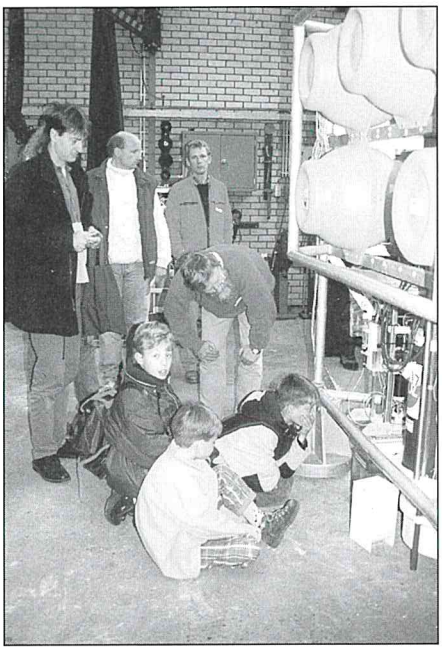
Sunday 4 October was National Science Day in the Netherlands. NIOZ also participated and held open house. An additional reason to participate was the fact that 1998 was the Year of the Oceans. Ecomare and IBN also took part in celebrating this day. A special bus service was set up to transport visitors from the TESO ferry to the various institutes. Over one hundred NIOZ personnel contributed to the success of this day. Numerous old and new research themes were highlighted and videos of some expeditions were shown in the auditorium. The exhibition room was re-arranged and the visitors were given an idea of what a marine scientist's life is like by means of a short cruise on board RV 'Navicula'. The NIOZ technicians had organised a grand show displaying and demonstrating sea-going equipment in and around the harbour shed. Naturally this attracted considerable interest. The same is true of the lecture about the continuous measurements executed by the TESO ferry 'Schulpengat', a research programme set up to mark the Year of the Oceans.

The Science Day also involved numerous activities for children. They were entertained with laboratory experiments, microscopes, shells and colouring pictures. In the canteen a live transmission was done by Radio Texel.

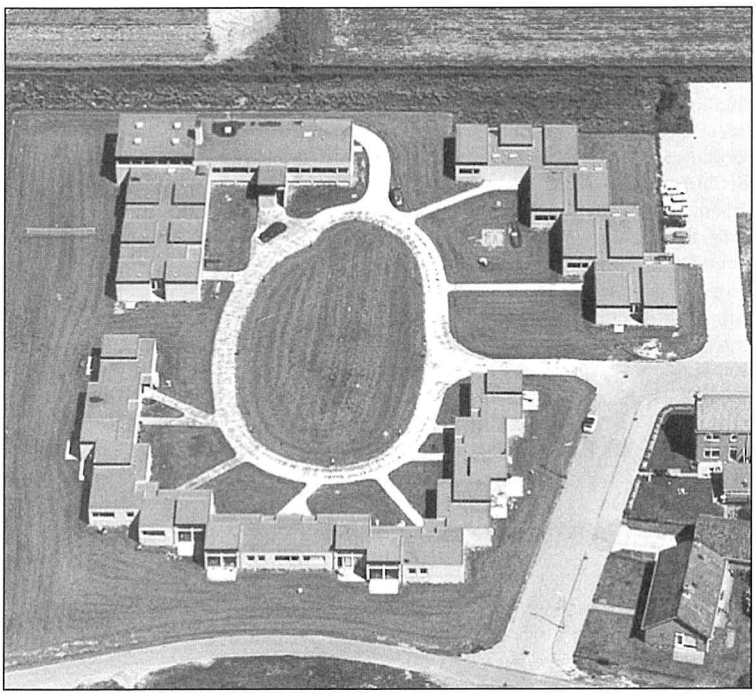
NIOZ received over 1200 visitors. 72% were from Texel, 3% from Den Helder, 21% from the rest of the country and 4% from abroad.

Thanks to the efforts and enthusiasm of a large part of the NIOZ personnel, many people have had the pleasure of learning something about marine research.





3. Guest scientists, visitors and students



The NIOZ Guest house

GUEST SCIENTISTS

- Battley, P., Department of Ecology, Griffith University, Nathan, Brisbane, Australia, 16-24 January; 1 November-31 December.
- Boyd, H., Canadian Wildlife Service, Ottawa, Canada, 20-30 October.
- Cardoso, J.F.M.F. University of Porto, Portugal, October-31 December.
- Koski, M., Finnish Institute of Marine Research, Helsinki, Finland, 9 February-16 April.
- Landys, M., Department of Zoology, University of Washington, Seattle, Washington, U.S.A., 26 March-1 June.
- Letcher, Dr. R.J., RITOX, University of Utrecht,19-30 January & 6-10 April.
- Morrison, Dr. R.I.G., Canadian Wildlife Service, Ottawa, Canada, 17 May-2 June.
- Nebel, S., University of Göttingen, Göttingen, Germany, 20 October-31 December.
- Pausz, C., Institute of Zoology, University of Vienna, Austria, 2 January -31 March.
- Ratiarison, S., University of Utrecht/University Pierre & Marie Curie, Paris, 15 May-1 June.
- Santos, M., University of Porto, Portugal, 15 January-15 February.
- Schäfer, H., University of Bremen, Germany, 1 October -30 December.
- Schlick, B., Institute of Zoology, University of Vienna, Austria, 1 October-31 December.
- Sephton M., Open University, UK
- Slezak, D., Department of Marine Biology, University of Vienna, Austria, 1 January - 31 March.
- Steiner, F., Institute of Zoology, University of Vienna, Austria, 1 October-31 December
- Stoderegger, K., Institute of Zoology, University of Vienna, Austria, 2 January-31 July
- Werne J., Northwestern University, Chicago, USA.
- Amaro, T.P.F. University of Porto, Portugal, October-31 December.
- Winter, C., Department of Marine Biology, University of Vienna, Austria, 3 January - 31 October.
- Wu Min, The East China Sea Monitoring Center of Oceanic Administration, Shanghai, PR China, 16 June - 31 December.
- Stadnitskaya, A. Moscow State University, 17 September-17 December.

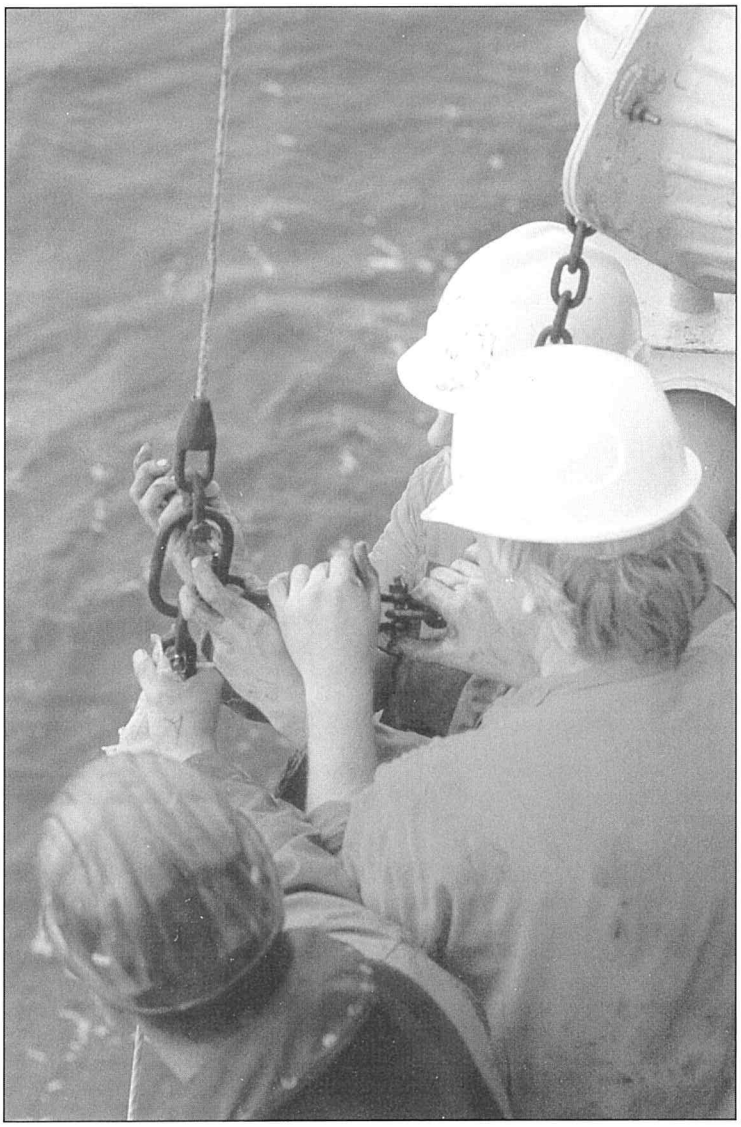
VISITORS

- Grossi V., University of Marseille, France.
- Lewan Dr. M.D., U.S. Geological Survey, Denver, USA.
- Rullkötter J., University of Oldenburg, Oldenburg, Germany.
- Volkman Dr. J.K., CSIRO Australia, Division of Oceanography Marine Laboratories, Hobart, Australia.
- Barter, Dr. M., Australasian Wader Studies Group, Melbourne, Australia.
- Buurma, Drs. L., Defensie-Luchtmachtstaf, Den Haag.
- Canevari, Dr. P., Bonn Convention on Migratory Species, Bonn, Germany.
- Eijsink G. CETESBI, Sao Paulo, Brasil.
- Gwinner Prof. Dr. E., Max-Planck Institut für Verhaltensphysiologie, Andechs, Germany.
- Karasov, Prof. Dr. W.H., University of Wisconsin, U.S.A.
- Scheiffarth, G., Institut für Vogelforschung/University of Oldenburg, Wilhelmshaven, Germany.
- Starck, Prof. Dr. J.M., University of Jena, Jena, Germany.
- Woodley, K., Miranda Shorebird Observatory, Firth of Thames, New Zealand.
- Ydenburg, Prof. Dr. R.C., Department of Biological Sciences, Simon Fraser University, Vancouver, Canada.
- Wilson, Dr. J.B., Royal Holloway University, London, UK.
- Denis, Dr. M., Centre d'Oceanologie de Marseille, Marseille, France.
- Flynn, Dr. K., University of Wales, Swansea, UK.
- Geider, Dr. R., Marine Biological Laboratory, Plymouth, UK.
- Hall, T., University of Athens, Greece.
- Jürgens, Dr. K., Max-Planck-Institute for Limnology, Plön, Germany.
- Kramer, Mag. G., University of Rostock, Germany.
- Marshall, Dr. H., Marine Biological Laboratory, Plymouth, UK.
- Martin, Dr. V., Université de Bretagne Occidentale, Brest-Iroise, France.
- Paasche, Prof. Dr. E., University of Oslo, Norway.
- Sulzenberger, Dr. B., ETH Zürich, Switzerland.
- Weinbauer, Dr. M., National Biotechnology Center, Braunschweig, Germany.
- Wilhelm, Prof. Dr. S., University of Tennessee, Knoxville, USA.

UNDERGRADUATE UNIVERSITY STUDENTS

- Broker, K., UvA
- Cabrera, Y., UvA
- De Leeuw, R., TUT
- De Ranitz, E.H., UvA
- Den Haring, S., UvA
- Hofmans, H.E., Dept. of Earth Sciences, UU
- Nijgh de Sampayo, E., UvA
- Nijhuis, N.J., Dept. Marine Biology, RUG
- Öllers, M., IMAU, UU
- Poos, J.J., RUG
- Pörtzgen, N, TUD
- Praagman, H., UvA
- Reneerkens, J., RUG
- Renshof, S., UvA
- Rouveroy, M. UvA
- Scheper, B.B., UvA
- Schur, M., UvA
- Smit, M.W.J., TUT
- Terpstra, P. UvA
- Van Der Put, A., UvA
- Van Rheede, T., UvA

4. Support Services



Bay of Biscay Boundary project. Photo: Marijke Smit

RESEARCH VESSEL 'PELAGIA'

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

The largest sea-going facility is RV PELAGIA, a 66 m multipurpose research vessel developed for oceanographic research in coastal seas, on continental shelves and in the ocean. RV 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 7 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.

Maintenance

In the beginning of this year RV Pelagia has had her first 6-year overhaul with motor revision and installation of a new electronic sea-chart system and a meteo-station of the Royal Dutch Metereological Institute KNMI. Freshly painted she came out in perfect condition. At the end of the year after an extensive research cruise programme the ship was docked for maintenance of hull and upgrading of installations. When in dry-dock a 75 kHz ADCP transducer was installed underneath the ship. The maintenance took 9 weeks.

RV Pelagia during maintenance. Photo: C. Blaauboer.

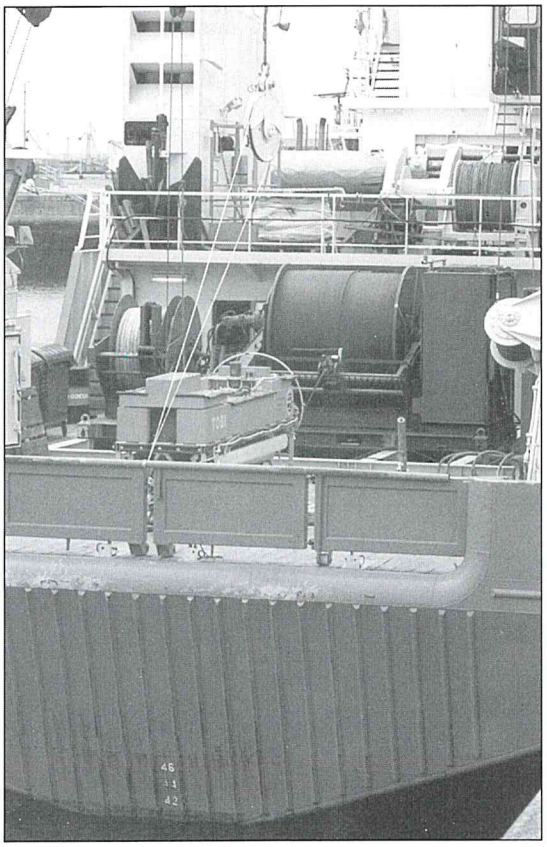
Operations at sea

Starting 1 March RV PELAGIA has executed and extensive research cruise programme of 233 days (40 weeks). For the national oceanographic community she performed the North Sea programme ESCAPE and the Triple-B programme on the Iberian Margin in the Bay of Biscay. For the testing of new over-side equipment, the Scanfish, a collaborative test cruise was performed in the Skagerrak. Of the 1998 cruise programme 39 days were on behalf of the national programme. For the institute's community the main part of the sea-going work was performed for programmes partly funded by the European Union. These were ENAM - Farroes Margin, Rockal Trough west of Ireland, MERLIM - North Atlantic north of Madeira, OMEX-2 - Iberian Margin Bay of Biscay and PROVESS - northern North Sea. (117 days). For the NIOZ-pro-

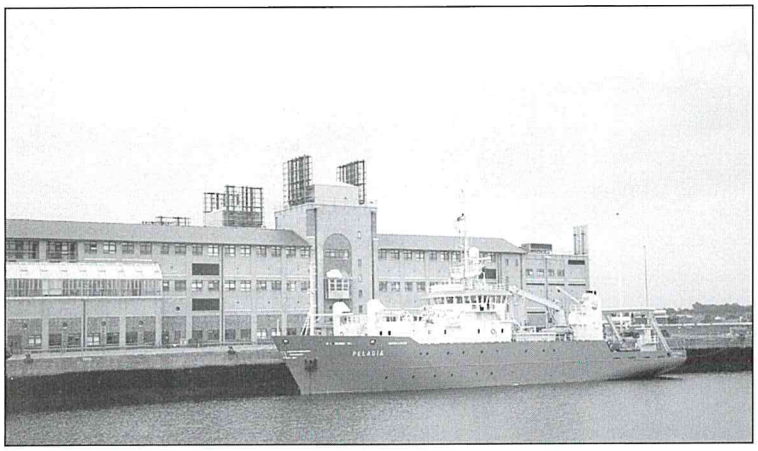
grammes Biomarkers and Frisian Front she cruised in the southern North Sea and Doggerbank. (11 days).

For university courses of RUG (in March and June) and UU (in June) she spent 7 days at North Sea nearby Texel.

As to chartering out the vessel, RV PELAGIA was successful in performing a deep towed sonar research cruise (TOBI) in the North Atlantic for the University of Southampton, and an environmental baseline study for the Dunstaffnage Marine Laboratory (Oban, Scotland). In connection with the ENAM research cruise, extra seismic and sediment sampling work was performed for two different oil-companies. For charters the ship was 59 days at work.



RV Pelagia at the quay of the Southampton Oceanographic Centre loading TOBI.
Photo: M.J. Rietveld.



Logistics

To accommodate the research cruises diplomatic clearance has been obtained from UK, Ireland, France, Spain, Portugal, Denmark and Norway. Port calls for change of crew and scientific party as well as (un)loading scientific equipment took place in Vigo, Oban, Southampton, Cork and Galway.

ISM Code

In co-operation with the Royal Association of Netherlands Shipowners (KVNR) preparations were undertaken for compliance with the International Safety Management Code. Implementation will take place in an integrated management system (IMaS) together with ISO 9000 and new crew legislation.

NIOZ harbour

To guarantee sufficient depth the NIOZ harbour was dredged with a new water injection method. Every other year dredging will be necessary.

RENOVATION OF NIOZ BUILDINGS

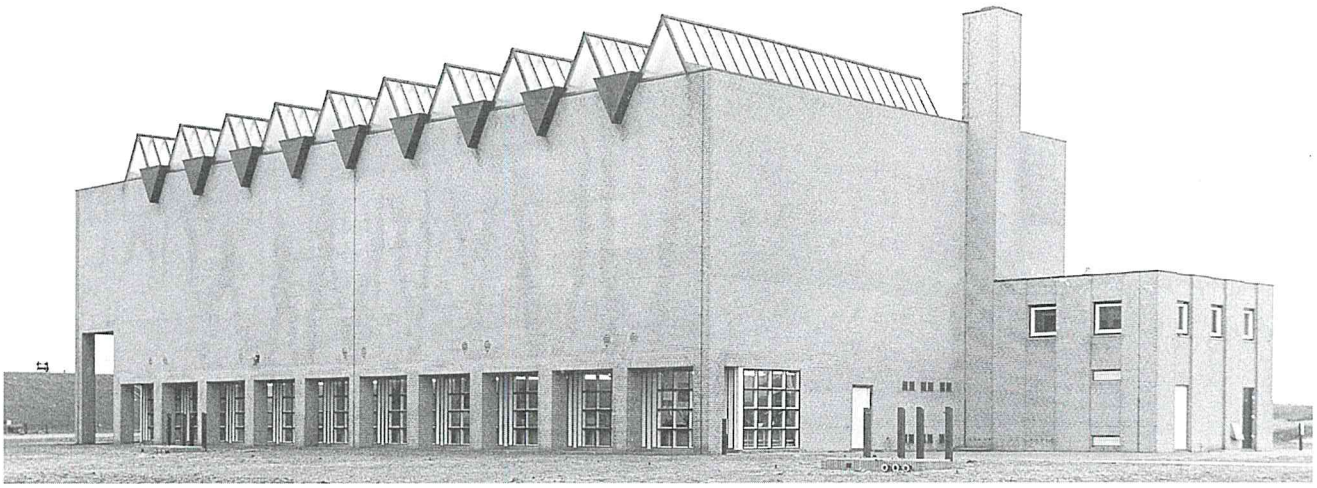
The NIOZ buildings were designed thirty years ago and construction was completed in the mid 1970s. Part of the buildings are old fashioned and do not comply any longer with todays legal, safety and scientific requirements. Besides the increase of the NIOZ staff, urges for additional laboratory and office space.

Five years ago an expert's study, laid down in the report 'Restructuring housing NIOZ Texel', gave evidence of the need for additional working space. Moreover the wear and tear of the Aquarium building, the experimental facility, where large quantities of sea water are handled, became apparent. Another study recommended extensive renovation, which together with a number of amendments and modernizations would provide a 'state-of-the-art' facility.

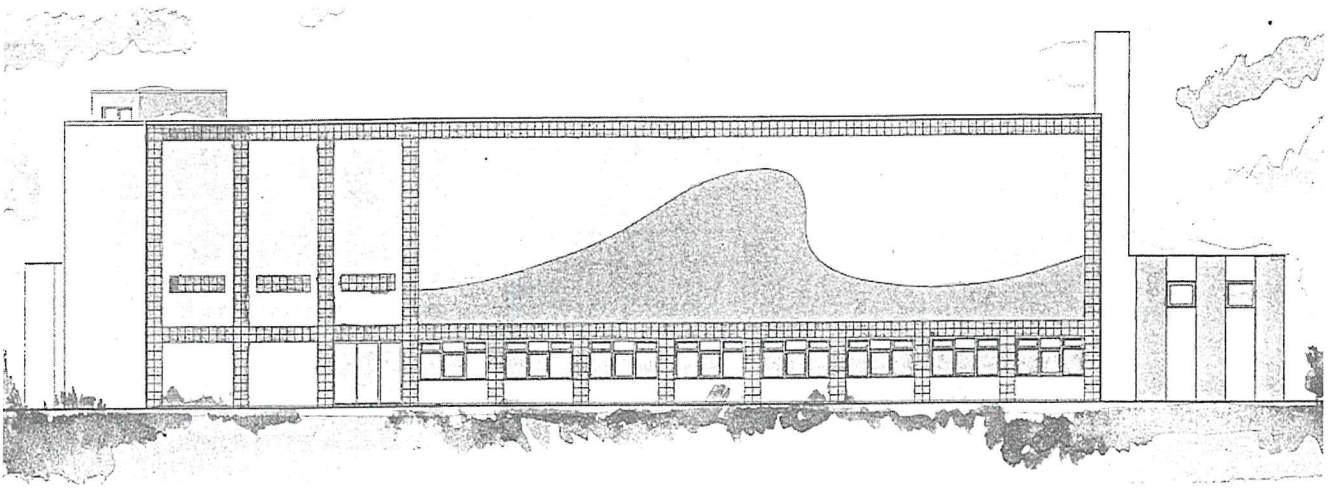
The guest house is one of the oldest parts of the NIOZ buildings. Upgrading is needed particularly as the standards on housing have evolved considerably since the 1970s. The project for extending and upgrading the institute's buildings will be completed with a new canteen and extensive renovation of the main building and its general facilities. Part of the project is the completion of phase 2 of the Experimental Shorebird facilities.

NWO has made budget reservations up to 16.675 million guilders, and has given permission to present a preliminary project design. This design has been made in cooperation with Temid bv, an independent consultancy on construction.

The proposals with detailed construction plans and drawings were submitted for approval to NWO in November 1998. After being submitted for a counter check the NWO board will decide early in 1999. On approval, construction will start in late spring 1999.



The NIOZ aquarium building as it looked like when it was just build in 1971. Photo: H. Hobbelink.



The NIOZ aquarium building, an artist impression of the new situation. Drawing provided by TEMID BV.

5. Sociaal Jaarverslag

Photo: Henk Hobbelink

ALGEMEEN

De aanhoudend krappe financiële situatie in 1998 vergde dat wederom een zeer stringent financieel beleid werd gevoerd. Dat betekende, dat ook in 1998 vacatures niet zonder meer konden worden vervuld, maar alleen nadat kon worden aangetoond dat dit beslist noodzakelijk was om de bedrijfsvoering en het wetenschappelijk onderzoek niet in gevaar te brengen. Verjonging en vernieuwing van de wetenschappelijke staf bleven daarbij het uitgangspunt.

Hoewel met zeer veel inspanning, heeft het NIOZ 1998 met een sluitende begroting kunnen afsluiten. Ook dit jaar heeft de succesvolle verhuur van de Pelagia een belangrijke bijdrage geleverd aan het nakomen van de nog openstaande financiële verplichtingen .

In het verslagjaar werd NWO gereorganiseerd, wat behalve het opheffen van de naar discipline gerangschikte stichtingen betekende dat de aan NWO verbonden instituten, waaronder het NIOZ, niet meer rapporteren aan de gebiedsbesturen, maar aan het algemeen bestuur van NWO. Het Algemeen Bestuur van NWO heeft daartoe de eenheid Centrale Programma's opgericht. Uitgangspunt blijft de eigen verantwoordelijkheid van het bestuur en de directie van het instituut.

Ter voorbereiding van het in 1999 te houden peer-review, dat aanbevelingen zal doen voor de toekomst van het NIOZ en de daarvoor benodigde financiële en personele middelen, heeft het NIOZ in 1998 voortvarend een aanvang gemaakt met de door NWO gewenste zelfevaluatie. Deze zelfevaluatie zal begin 1999 gereed zijn en geeft ook een blik vooruit op de toekomst.

In het kader van de arbeidsvoorwaarden zijn per 1 augustus 1998 de regeling Arbeidsduurverkorting en de Seniorenregeling van kracht geworden. Met de ambtenarencentrales werd overeenstemming bereikt over een nieuw Sociaal Beleidskader. In het najaar zijn de onderhandelingen gestart voor een nieuwe CAO, die per 1 januari 1999 de CAR zou moeten vervangen.

Ten aanzien van de plannen voor nieuwbouw en renovatie kan worden gemeld, dat in samenwerking met het raadgevend bureau Temid bv, een gedegen voorontwerp met daarbij behorende kostenraming is uitgewerkt. Dit voorontwerp is medio november aan NWO ter goedkeuring voorgelegd. De planning is erop gericht, dat in het voorjaar van 1999 de bouw een aanvang kan nemen.

BESTUUR EN WETENSCHAPCOMMISSIE

Bestuur Stichting NIOZ

In 1998 is Ir. D. Tromp als bestuurslid tot het NIOZ bestuur toegetreden. Hij volgde Ktz.b.d. D. Loeber op, die per 1 januari 1998 zijn bestuurslidmaatschap heeft beëindigd.

Per 31 december 1998 was het bestuur als volgt samengesteld:

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

Het bestuur kwam in het verslagjaar 1998 viermaal met de directie in vergadering bijeen, op 5 maart, 28 september en 11 december in Amsterdam en op 15 mei op Texel. Bij deze laatste gelegenheid werd op feestelijke wijze afscheid genomen van Ktz. b.d. D. Loeber.

De vergaderingen werden, namens de algemeen directeur van NWO, tot en met september 1998 bijgewoond door Dr. J Dijkhof, en daarna 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.

Als opvolgers voor prof.dr. V. Smetacek en prof.dr. W. Wolff die in 1997 afscheid namen, hebben prof.dr. R.J. Law en prof.dr. K. Lochte in de Wetenschapcommissie plaatsgenomen.

De Wetenschapcommissie was per 31 december 1998 als volgt samengesteld:

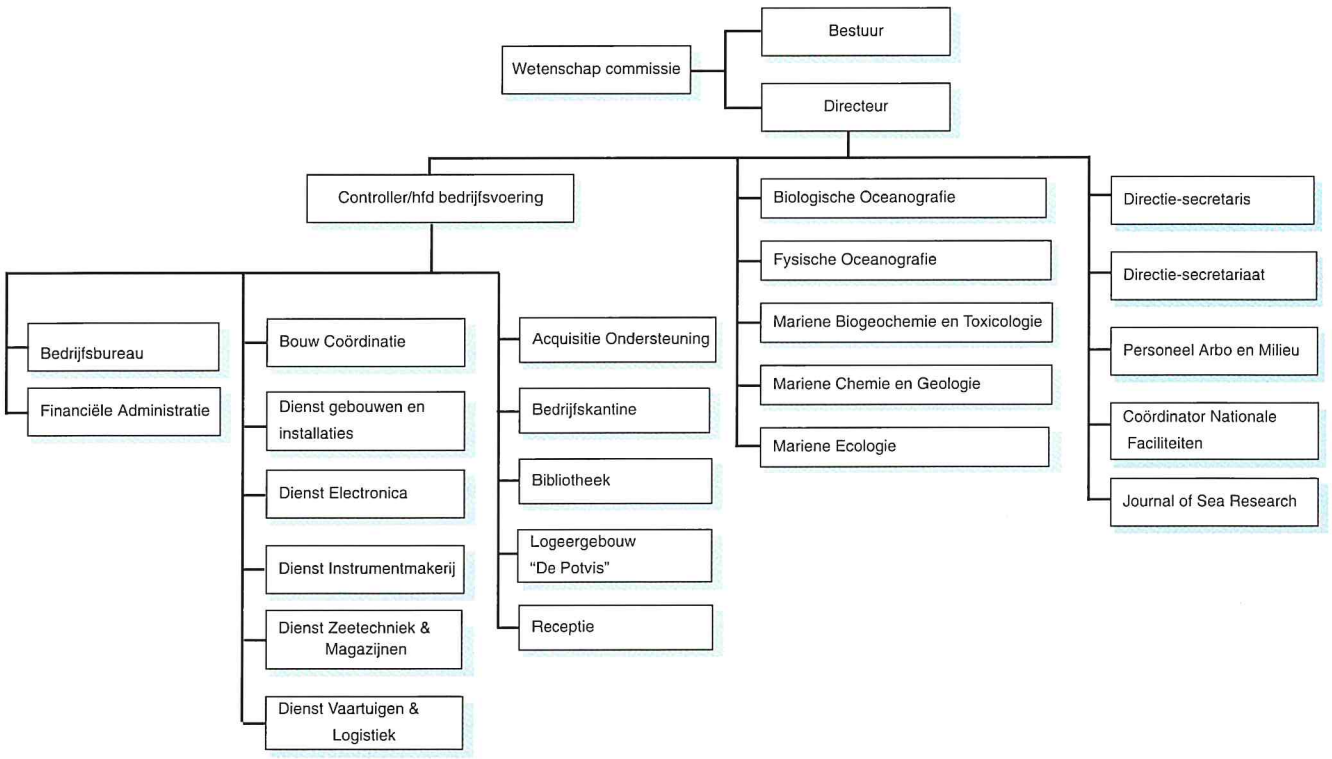
Prof.dr. W. van Delden, voorzitter	Vakgroep Genetica, faculteit Biologie Rijksuniversiteit Groningen
Prof.dr. J.C. Duinker	Hamburg, Duitsland St. Laurent de Cuves, Frankrijk
Prof.dr.ir. G.J.F. van Heijst	Afd. Technische Natuurkunde, Technische Universiteit Eindhoven
Prof.dr. R.J. Law	Centre for Environment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

De Wetenschapcommissie kwam in 1998 bijeen op 26-27 november te Texel. De voorbereiding voor het in 1999 te houden peer review van het NIOZ was het hoofdonderwerp van de vergadering.

Voorafgaande aan de vergadering werd het Schulpengat ferry project gepresenteerd. Na de vergadering bracht de commissie een bezoek aan de afdeling Biologische Oceanografie waar een presentatie over de toepassing van moleculaire biologie werd gegeven als belangrijk instrument voor de oceanografie, en het nieuwe moleculair biologisch laboratorium werd bezocht.

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

ORGANOGRAM



PERSONEELSLIJST 31-12-98

DIRECTIE

Leeuw J.W. de Prof. dr.	34.2 uur	directeur
Rietveld M.J. Drs.		directie-secretaris
Directiesecretariaat		
Hart-Stam J.M.G.		dir. secretaresse
Blaauboer-de Jong C.S.	30.4 uur	dir. secretaresse
Bol-den Heijer A.C.	29.25 uur	dir. secretaresse
Barten-Krijgsman N.	15.2 uur	dir. secretaresse

STAFEENHEDEN

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

CORE PROJECT OFFICE (LOICZ/IGBP)

Crossland C.J. Prof. dr		executive officer	m.i.v. 11-05
Kremer H.H. Dr		deputy executive officer	m.i.v. 01-07
Zyp M. van der Drs.		junior data-analist	tot 10-08
Bleijswijk J.D.L. van Dr.	15.0 uur	onderzoeker	tot 01-11
Pattiruhu C. Drs.		office-administrator	
Jourdan M.T.	16.0 uur	administratief medewerkster	

WETENSCHAPPELIJKE AFDELINGEN

AFDELING FYSISCHE OCEANOGRAFIE

Ridderinkhof H. Dr. ir.		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	
Schramkowski G.P. Dr.		projectonderzoeker NWO/GOA	tot 01-12
Bruin T.F. de Drs.		datamanager MRF	
Gemmrich J.R.		projectonderzoeker	m.i.v. 01-04
Gerkema T. Dr.		onderzoeker	m.i.v. 01-11
Wilpshaar J.M.R. Ir.		OIO NWO/BOA	
Schrier G. van der Drs.		OIO NWO/GOA	
Ligtenberg J. Drs.		OIO	m.i.v. 01-06
Manders A.M.M. Drs.		OIO NWO	m.i.v. 01-09
Eijgenraam F.		automatiseringsdeskundige	
Nieuwenhuis J.		middelbaar electronicus	
Wernand M.R.	36 uur	senior onderzoekmedewerker	
Ober S. Ing.		senior onderzoekmedewerker	
Hillebrand M.T.J.		senior onderzoekmedewerker	
Manuels M.W.		onderzoekmedewerker	
Hiehle M.A.		senior laboratoriummedewerker	
Koster R.X. de		systeemanalist	

AFDELING MARIENE CHEMIE EN GEOLOGIE

Helder W. Dr.		hoofd	
Raaphorst W. van Dr. ir.		senior onderzoeker	
Baar H.J.W. de Prof. dr. ir.	30.4 uur	senior onderzoeker	
Weering T.C.E. van Dr.		senior onderzoeker	
Jansen J.H.F. Dr.		senior onderzoeker	
Bennekom A.J. van Drs.		senior onderzoeker	
Brummer G.J.A. Dr.		onderzoeker	
Timmermans K.R. Dr.		onderzoeker	
Stigter H.C. de Drs.	24.0 uur	projectonderzoeker OMEX	
Stoll M.H.C. Dr.		onderzoeker	
Lohse L. Dr.	32.0 uur	projectonderzoeker	tot 16-12
Wilde H.P.J. de Ir.		projectonderzoeker	
Haas H. de Dr.		projectonderzoeker	
Gaast S.J. van der		senior onderzoekmedewerker	
Vaars A.J.		applicatietechnicus	
Nolting R.F.		senior onderzoekmedewerker	
Kloosterhuis H.T.		senior onderzoekmedewerker	
Ooijen J.C. van		senior onderzoekmedewerker	
Bakker K.M.J.		onderzoekmedewerker	
Malschaert H. Ing.		onderzoekmedewerker	
Boer W. Ing.		onderzoekmedewerker	
Iperen J. van	8.0 uur	senior laboratoriummedewerker	
Kalf J.		senior laboratoriummedewerker	
Witte A.J.M.	19.0 uur	laboratoriummedewerker	
Epping H.G. Dr.		onderzoeker	m.i.v. 01-05
Koning F.A. Drs.	34.2 uur	onderzoeker	m.i.v. 01-06
Jong J.T.M. de Ing.		projectassistent NWO/GOA	
Grutters M.C.H. Drs.		OIO	
West S. Drs.	OIO		m.i.v. 01-03
Loncaric N. Drs.		OIO	m.i.v. 01-09
Thomas H. Dr.	onderzoeker		m.i.v. 01-09
Richter T.O. Dr.	onderzoeker		m.i.v. 15-09
Schefuss E.	OIO NWO		m.i.v. 01-03
Visser R.J.W. Ing.		projectmedewerker NWO	m.i.v. 01-11
Croot P.L. Dr.	onderzoeker		m.i.v. 01-12
Laan P.	laboratoriummedewerker		m.i.v. 01-09

AFDELING MARIENE BIOGEOCHEMIE EN TOXICOLOGIE

Boon J.P. Dr.		hoofd	
Everaarts J.M. Dr.		senior onderzoeker	
Sinninghe Damsté J.S. Dr. ir.	34.2 uur	senior onderzoeker	
Booy K. Dr.	32.0 uur	onderzoeker	
Versteegh G.J.M. Dr.		onderzoeker	
Mensink B.P. Dr.		projectonderzoeker	van 15-01 tot 23-02
Kok M.D. Drs.		OIO NIOZ/pionier	tot 15-09
Schanke A. van Ir.	32.0 uur	OIO	
Höld I.M. Drs.		OIO NWO/pionier	tot 01-05
Blokker P. Drs.		OIO NWO	
Meer van der M.T.J. Drs.		OIO NASA	
Dongen B.E. van Drs.		OIO	m.i.v. 01-09
Smittenber R.H. Ir.		OIO NWO	m.i.v. 01-09
Pool W.G. Dr.		senior onderzoekmedewerker	
Baas M.		onderzoekmedewerker	
Rijpstra W.I.C.	19.0 uur	onderzoekmedewerker	
Dekker M.H.A. Ing.	32.0 uur	onderzoekmedewerker	
Lewis W.E.	23.0 uur	senior laboratoriummedewerker	
Weerlee E.M. van		laboratoriummedewerker	
Fischer C.V. Drs.	28.0 uur	laboratoriummedewerker	
Slootweg P.M.		projectmedewerker	m.i.v. 01-01
Kinkel H.		projectonderzoeker	m.i.v. 01-06
Pancost R.D.		beursaal	
De Lurio J.L.		beursaal	m.i.v. 01-04 tot 01-12

AFDELING BIOLOGISCHE OCEANOGRAFIE

Herndl G.J. Dr.		hoofd
Ruardij P. Drs.		onderzoeker
Fransz H.G. Dr. ir.		senior onderzoeker
Baars M.A. Dr.		senior onderzoeker
Klein Breteler W.C.M. Dr.		senior onderzoeker
Vosjan J.H. Dr.		senior onderzoeker
Veldhuis M.J.W. Dr.		senior onderzoeker
Duyl F.C. van Dr.		senior onderzoeker
Riegman R. Dr.		senior onderzoeker
Kuipers B.R. Dr.		onderzoeker
Boelen P. Drs.	OIO	t/m 31-12
Embsen E.G.M. Ing.		automatiseringsdeskundige
Kraay G.W.		senior onderzoekmedewerker
Kop A.J. Ing.		onderzoekmedewerker
Oosterhuis S.S.		onderzoekmedewerker
Noordeloos A.A.M. Ing.		senior laboratoriummedewerker
Noort G.J. van		senior laboratoriummedewerker
Gonzalez S.R.		senior laboratoriummedewerker
Witte H.J.		senior laboratoriummedewerker
Schogt N.		laboratoriummedewerker
Schoemann V.F.	projectonderzoeker	tot 01-04
Snoek J. Ing.	30.4 uur	projectmedewerker NWO
Visser P.M. Dr.	projectonderzoeker NWO	tot 01-10
Stolte W. Drs.	32.0 uur	projectonderzoeker NWO
Muyzer G. Dr.	hoofd moleculair lab.	m.i.v. 01-06
Stoderegger K.E.	projectonderzoeker	m.i.v. 01-08
Pausz C.	projectonderzoeker	m.i.v. 01-04

AFDELING MARIENE ECOLOGIE

Lindeboom H.J. Dr.		hoofd
Meer J. van der Dr.		senior onderzoeker
Wilde P.A.W.J. de Prof. dr.	senior onderzoeker	tot 01-07
Beukema J.J. Dr.		senior onderzoeker
Bak R.P.M. Prof. dr.		senior onderzoeker
Spaargaren D.H. Dr.		senior onderzoeker
Fonds M. Dr.		senior onderzoeker
Cadée G.C. Dr.		senior onderzoeker
Veer H.W. van der Dr. ir.		senior onderzoeker
Piersma T. Dr.		senior onderzoeker
Wolf P. de Dr.		gastonderzoeker
Bergman M.J.N. Ir.		onderzoeker
Duineveld G.C. Drs.		onderzoeker
Daan R. Dr.		onderzoeker
Dekker R. Drs.		onderzoeker
Philippart C.J.M. Dr.		projectonderzoeker
Lavaleye M.S.S. Drs.		projectonderzoeker
Witbaard R. Dr.		projectonderzoeker NWO
Santbrink J.W. van Drs.		toegevoegd projectonderzoeker tot 01-07
Drent J. Drs.		OIO NWO
Epstein N.	24.0 uur	OIO
Gils J. van Drs.		OIO RUG
Edelaar W.M.C. Drs.		OIO RUG
Luttikhuizen P. Drs.		OIO RUG
Dapper R.		automatiseringsdeskundige
Berghuis E.M.		senior onderzoekmedewerker
Nieuwland G.		senior onderzoekmedewerker
Spaans B. Drs.		senior onderzoekmedewerker
Hegeman J.		onderzoekmedewerker
Duiven P.		onderzoekmedewerker tot 01-09
Kok A.		onderzoekmedewerker
Mulder M.		onderzoekmedewerker
Witte J.IJ.		onderzoekmedewerker
Puyl P. van der		laboratoriummedewerker

Bruin W. de	laboratoriummedewerker	
Zuidewind J.	laboratoriummedewerker	
Weele J.A. van der	project-assistent	tot 17-08
Winter C.	project-assistent	
Dekinga A. Drs. Ing.	project-medewerker NWO	
Koutrik A. van	laboratoriummedewerker	

ONDERSTEUNENDE DIENSTEN

Dienst gebouwen en installaties

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

Receptie

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

AON

Aggenbach R.P.D.		eerste medewerker
Hart W.	24.0 uur	medewerker

Bibliotheek

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

Redactie

Beukema J.J. Dr.	24.0 uur	hoofdredacteur
Bak-Gade B.	20.0 uur	assistent redacteur

TECHNISCHE DIENSTEN

Bakker C.L.	hoofd	tot 01-11
Manshanden G.M.	32 uur	automatiseringsdeskundige
Bonne E.		medewerker (detachering)

Instrumentmaken

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

Electronica

Groenewegen R.L. Ing.		hoofd
Koster B. Ing.		plv. hoofd
Franken H. Ing.		hoger electronicus
Laan M.		hoger electronicus
Derksen J.D.J.		electronicus Pelagia

Zeetechniek

Porto H.H. de		hoofd
Schilling J.		plv. hoofd
Polman W.		medewerker
Bakker M.C.		medewerker
Blom J.J.		medewerker
Wuis L.M.		medewerker
Boom L.		medewerker
Porto S.W. de		medewerker Inventarisbeheer
Nieuwenhuizen J.M.		medewerker Inventarisbeheer
Ran A.		hoofd Magazijn
Gieles S.J.M.		medewerker Magazijn

Vaartuigen en logistiek

Buisman T.C.J.		hoofd
Zwieten C. van		medewerker tot 15-07
Eelman A.		chauffeur (detachering)
Souwer A.J.		medewerker

Groot J.C.	gezagvoerder Pelagia	m.i.v. 01-03
Ellen J.C.	1e stuurman Pelagia	m.i.v. 14-09
Duyn M.D. van	2e stuurman Pelagia	
Pieterse J.M.	hoofdwerktuigkundige Pelagia	
Seepma J.	1e werktuigkundige Pelagia	
Kalf J.J.	2e werktuigkundige Pelagia	
Grisnich P.W.	scheepstechnicus Pelagia	
Saalmink P.W.	scheepstechnicus Pelagia	
Stevens C.T.	scheepstechnicus Pelagia	
Adriaans E.J.	schipper Griend	
Star C.J. van der	schipper Navicula	
Tuntelder J.C.	scheepstechnicus/kok Navicula	
Vis van der P.C.A	machinist/motordrijver Navicula	
Jongejan W.P.	komvisser	

ARBEIDSVOORWAARDEN

Ontwikkeling Collectieve Arbeidvoorwaardenregeling

Hoewel het streven er op was gericht om per 1 januari 1999 een nieuwe CAO te sluiten, bleek in de loop van het jaar dat dit niet haalbaar was. Allereerst moest, in de vorm van een Convenant Decentralisatie Arbeidsvoorwaarden, tussen de Werkgeversvereniging Onderzoekinstellingen (WVOI*), de Minister van Onderwijs, Cultuur & Wetenschappen en de Centrales overeenstemming worden bereikt over de verzelfstandiging van de onderzoekinstellingen als CAO-partij. Hierdoor zal voor de WVOI de mogelijkheid ontstaan om in het vervolg zelf de loononderhandelingen te voeren met de Centrales.

Ook bestond nog onduidelijkheid over de financiële beleidsruimte die aan de WVOI ten behoeve van het arbeidsvoorwaardenpakket ter beschikking zou worden gesteld.

Wel is er binnen de WVOI gewerkt aan de Nota van Inzet voor de CAO-onderhandelingen.

Tussen de WVOI en de Centrales is overeenstemming bereikt over een nieuwe seniorenregeling ter vervanging van de per 1 december 1997 vervallen SOP-regeling, over de invoering van de Arbeidsduurverkorting voor de sector Onderwijs en Onderzoek die per 1 augustus 1998 in werking is getreden en over het Sociaal Beleidskader NWO-FOM-SMC-NIOZ (zie hierna).

* De WVOI bestaat uit de Koninklijke Bibliotheek (KB), het Rijksinstituut voor Oorlogsdocumentatie (RIOD), de Koninklijke Nederlandse Academie voor Wetenschappen (KNAW) en de Nederlandse organisatie voor Wetenschappelijk Onderzoek (NWO) waarin vertegenwoordigd o.a. het NIOZ.

Seniorenregeling Onderzoekinstellingen

De Seniorenregeling biedt aan medewerkers die ten minste 5 jaar in dienst zijn bij een WVOI-instelling de mogelijkheid om vanaf 57-jarige leeftijd korter te gaan werken. Hiertoe stelt de werkgever maximaal 416 "seniorendagen" beschikbaar. Met deze dagen kan een voltijds medewerker in de leeftijd van 57 tot 65 jaar de feitelijke werktijd per week verminderen met maximaal 40% van de aanstellingsomvang. Voor deeltijdwerkers geldt de regeling naar evenredigheid. Over een seniorendag wordt 90% bruto salaris doorbetaald.

De zogenaamde leeftijdsdagen, de ADV-dagen en de 60+ regeling (half uur per dag korter werken) zijn met invoering van de nieuwe regeling komen te vervallen.

Arbeidsduurverkorting

De nieuwe regeling Arbeidsduurverkorting voor de sector Onderwijs en Onderzoek omvat zowel de oude als de nieuwe ADV aanspraken. Het totaal gecreëerde volume kan op verschillende wijze worden ingezet door een keuze te maken uit een viertal varianten: de weekvariant, jaarvariant, meerjarenvariant en de uitbetalingsvariant. Met de Ondernemingsraad zijn afspraken gemaakt over de toepassing van deze varianten en over de omvang, de vormgeving en de rapportage van de uit de Arbeidsduurverkorting voortvloeiende herbezetting. Om het proces van invoering voldoende tijd te geven is besloten om de feitelijke implementatie pas per 1 januari 1999 in te voeren en om de nieuwe ADV aanspraken over het tijdvak 1 augustus - 31 december (1998) toe te kennen als drie vrij opneembare ADV dagen.

Bij het NIOZ geldt de jaarvariant als standaard. Medewerkers die voorkeur hadden voor een andere variant moesten hiertoe een verzoek indienen. Van de uitbetalingsvariant, die geldt voor deeltijdwerkers met een aanstellingsomvang van 32 uur per week of minder, hebben zeven medewerkers gebruik gemaakt. Drie onderzoekers in opleiding hadden voorkeur voor de uitbetalingsvariant die specifiek voor deze categorie geldt (eenmalige uitbetaling van maximaal 38 ADV-uren). Voor de meerjarenvariant hebben zes medewerkers een verzoek ingediend. Voor de weekvariant bestond geen voorkeur.

Teneinde de Regeling Arbeidsduurverkorting, die een op de individuele werknemer toegesneden en daardoor administratief gecompliceerde regeling is, beheersbaar te maken is na overleg met de Ondernemingsraad besloten per 1 januari 1999 een electronisch systeem voor werktijd- en aanwezigheidsregistratie in te voeren.

Sociaal Beleidskader NWO-FOM-SMC-NIOZ

Zoals hierboven vermeld is tussen de WVOI en de Centrales overeenstemming bereikt over het Sociaal Beleidskader dat per 1 juni 1998 in werking is getreden en dat in de plaats is gekomen van de oude Reorganisatiecode.

In het Sociaal Beleidskader zijn de afspraken verwoord die van toepassing zijn op iedere organisatieverandering die gepaard gaat met belangrijke personele gevolgen. Hierbij wordt onderscheid gemaakt tussen een Organisatieaanpassing en een Reorganisatie.

Organisatieaanpassingen karakteriseren zich door geleidelijkheid (inzet van mensen en middelen veranderen, maar de hoeveelheid werk blijft op gelijk niveau). Gedwongen ontslag is in deze situatie niet aan de orde, tenzij een medewerker weigert een passende functie (binnen of buiten de organisatie) te aanvaarden. Indien er sprake is van een Organisatieaanpassing kan het overleg, inclusief over de personele gevolgen, plaatsvinden met de Ondernemingsraad.

Bij Reorganisaties gaat het om structuurveranderingen met ingrijpende personele gevolgen, waaronder ook gedwongen ontslagen. Bij dergelijke reorganisaties dient een Sociaal Plan opgesteld te worden waarover overleg moet worden gevoerd met de Centrales.

Primaire arbeidsvoorwaarden

De Minister van Onderwijs, Cultuur & Wetenschappen en de vier Centrales van Overheids- en Onderwijspersoneel hebben eind 1997 overeenstemming bereikt over een structurele salarisverhoging voor het onderwijspersoneel van 0.75% ingaande 1 januari 1998. Daarnaast werd de eindejaarsuitkering voor het jaar 1997 verhoogd van 0.5% naar 0.7%. In een eerder stadium was al overeenstemming bereikt over een salarisverhoging van 1.5% per 1 augustus 1998, een verhoging van 0.5% per 1 december 1998 en een eindejaarsuitkering van 0.5% van de in 1998 genoten bezoldiging.

De eindejaarsuitkering en de salarisverhoging werken door in de pensioenen en uitkeringen.

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 1998 heeft de Klachtadviescommissie één klacht in behandeling genomen en hierover advies uitgebracht.

Kinderopvang

Indertijd heeft het NIOZ met de Stichting Kindercentra Texel (SKT) een overeenkomst gesloten inzake een regeling voor kinderopvang van NIOZ-medewerkers. Hiertoe had het NIOZ een "kindplaats" gekocht waardoor NIOZ-medewerkers voorrang genoten bij de plaatsing van hun kind. Van deze faciliteit konden in de praktijk alleen de medewerkers gebruik maken die op Texel woonachtig zijn. Het aantal NIOZ-medewerkers dat niet op Texel woont is de laatste jaren gestaag toegenomen. Na hierover met de Ondernemingsraad overeenstemming te hebben bereikt, is besloten om de overeenkomst met de SKT te beëindigen. Vervolgens is in overleg met NWO besloten de uitvoering van de bedrijfsregeling kinderopvang over te dragen aan het bemiddelingsbureau LINK (Landelijk Informatiebureau Netwerk Kinderopvang). Dit bureau, waarbij ook NWO is aangesloten, draagt zorg voor de bemiddeling en plaatsing van kinderen van NIOZ medewerkers in het hele land.

Arbo- en milieujaarverslag NIOZ 1998
Arbo- en milieujaarplan NIOZ 1999

Inleiding

In dit verslag wordt gerapporteerd over de belangrijkste activiteiten op het terrein van Arbo en milieu die in 1998 hebben plaatsgevonden. Omwille van de leesbaarheid is de rapportage zo beknopt mogelijk gehouden.

In het volgende hoofdstuk is aangegeven welke zaken in 1999 extra aandacht verdienen: het kan worden beschouwd als een Arbo- en milieujaarplan.

Jaarverslag 1998

1. Beleid

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

2. Personeel

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

3. Ongevallen

Dit jaar waren er 2 bedrijfsongevallen of bijna-ongevallen.
Op 9 juli wilde een analiste bij MBT in lab D00 33 een van de zes schuifdeuren van de zuurkast openen. De deur van 3 m^2 veiligheidsglas brak in zeer veel brokjes en kleine schilfers. Deze vielen gedeeltelijk over haar heen en verwondden haar vinger. Om de wond te laten controleren op glassplinters werd ze door de NIOZ EHBO doorverwezen naar haar huisarts.

Aan boord van de Pelagia op de Noordzee waren op 22 oktober drie man bezig in en om een "lander" die aan dek gesjord stond. Door het afbreken van een sjoroog begon de "lander "te schuiven over het dek en raakte een voet van een van de matrozen bekneld door het bewegende apparaat, wat een pijnlijke enkel tot gevolg had. Een ander bemanningslid raakte bekneld en liep bloeduitstortingen op aan de onderkant van zijn rug en in de lies. Medisch advies werd gevraagd via Radio Scheveningen. Beiden werd rust voorgeschreven. Er zal voortaan een andere manier van sjorren worden toegepast.

4. Veiligheids- en milieuzaken

De tussen 1995 en 1998 uitgevoerde risico inventarisaties en evaluaties zijn door AVIOS Arbo in december getoetst. Rapportage over deze toetsing komt beschikbaar in februari 1999.

Er is nog geen contract afgesloten om alle gasreduceer ventielen periodiek te laten onderhouden.

Er is een controle op aarding uitgevoerd op een gedeelte van de wandcontactdozen van alle gebouwen van het NIOZ conform NEN 3140. In 1998 moest de controle worden afgerond, dit is helaas niet gelukt.

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

In de NIOZ VGWM voorschriften is op aandringen van Rijkswaterstaat Directie Noord-Holland het voorschrift over toxische stoffen uitgebreid met een paragraaf over zwarte lijst stoffen. In het register gevaarlijke stoffen NIOZ is aangegeven of de stof voorkomt op de zwarte lijst bodem, water en lucht van 1985 van het ministerie van VROM.

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

640 kg asbesthoudende bakken zijn afgevoerd naar het overslagstation van NV Huisvuilcentrale N-H.

Overzicht papierverbruik in vellen A4.

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

Overzicht energieverbruik en energiekosten (in gulden)

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

Door de windmolen is nog extra 136.064 kWh voor NIOZ gebruik geleverd.

5. Bedrijfsgezondheidszorg

De radiologische werkers werden door de arbodienst gekeurd.
De bemanningen van de schepen zijn medisch gekeurd volgens de eisen van Scheepvaartinspectie.

Ziekteverzuim
Evenals in het jaar 1997 is ook in 1998 het ziekteverzuim verder gedaald (4.98% in 1998 tegen 6.03% in 1997). Bij het wetenschappelijk personeel (WP) is het ziekteverzuim nagenoeg gelijk gebleven. Bij het niet-wetenschappelijk personeel is er een afname van ruim 1½%.

De stijging van het ziekteverzuim bij de vrouwelijke medewerkers wordt grotendeels veroorzaakt door zwangerschap- en bevallingsverlof.

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

Volledigheidshalve wordt opgemerkt dat de verzuimpercentages uitsluitend betrekking hebben op het kalenderjaar 1998.

6. Bedrijfshulpverlening

Een NIOZ werknemer volgde de cursus brandwacht bij de Regionale Brandweer en slaagde voor het examen. Drie leden van de NIOZ brandweer slaagden voor het diploma hoofd-brandwacht.
Om de EHBO ploeg weer op sterkte te brengen volgden vijf medewerkers de basiscursus EHBO te Den Helder.

Ten behoeve van de EHBO voorziening zijn tien personen op herhaling-cursus geweest voor het eenheidsdiploma EHBO van het Oranje Kruis. De cursus werd gegeven door Arbodienst Den Helder.

De leden van de bedrijfsbrandweer oefenden maandelijks 2 uur.

De jaarlijkse controle van de brandmeldinstallatie en alle brandmelders is verricht evenals de controle van de kleine blusmiddelen en de vijf adembeschermingsapparaten van de brandweerploeg. Twee oude exemplaren werden afgekeurd, er werden twee nieuwe adem-beschermingsapparaten met monitor aangeschaft.

7. Investeringen

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

8. Vergunningen

Voor het verspreiden/storten van baggerspecie afkomstig uit de NIOZ-haven in de Waddenzee heeft Rijkswaterstaat Directie Noord-Holland een gedoogbesluit afgegeven in het kader van de wet Verontreiniging oppervlaktewater. Op grond van de wet Milieubeheer heeft Gedeputeerde Staten van de Provincie Noord Holland een gedoogbeschikking verleend. Directie Noord van het Ministerie van Landbouw, Natuurbeheer en Visserij verleende toestemming door een besluit volgens de Natuurbeschermingswet en de Gemeente Texel gaf een aanlegvergunning af voor nautisch baggerwerk.

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

Omschrijving	Methode	Maximum grens/eenheid	1e kwartaal 1998	2e kwartaal 1998	3e kwartaal 1998	4e kwartaal 1998
Ontsluiting	NEN 6465					
Cadmium	NEN 6458	10 mg/l	0,3	<0,2	<2	3,8
Kwik	NEN 6449	0,1 mg/l	0,3	<0,1	<0,1	<0,1
Arseen	NEN 6457	1,0 mg/l	<5	1,5	3,0	2,0
Zink	NEN 6426	1000 mg/l	38	35	17	24
Chroom	NEN 6426	1000 mg/l	<2	<2	<2	3,5
Nikkel	NEN 6426	1000 mg/l	4,0	2,5	<2	3,0
Koper	NEN 6426	1000 mg/l	41	10	5	10
Lood	NEN 6426	1000 mg/l	<10	<10	<10	<10
Molybdeen	NEN 6426	1000 mg/l	11	12	13	180
Zilver	NEN 6426	1000 mg/l	<4	<4	<4	<4
PAK EPA (16)	o-NEN 5771	4 mg/l	n.a.	n.a.	-	-
EOX	NEN 6676	100 mg/l	<1	2	<1	<1
Som van MAK	o-NEN 6407	100 mg/l	<5,3	<1,8	<1,8	<1,8
Totaal cyanide	o-NEN 6655	1 mg/l	<2	<2	<2	<2
pH	NEN 6411		6,3	6,5	6,5	7,8
Chloride	NEN 6476	mg/l	12900	14900	15400	14100
OCB-PCB	NEN 5718	0,01 mg/l	n.a.	n.a.	-	-
Geloosde hoeveelheid		m^3	13.040	16.720	12.200	15.400

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 beeindigen van ieder kwartaal toegezonden aan Rijkswaterstaat Directie Noord Holland met afschrift aan het RIZA.

Jaarplan 1999

1. Beleid
Er zal verder gewerkt worden aan het opzetten van een integraal management systeem.
2. Personeel
3. Ongevallen
4. Veiligheids- en milieuzaken
Omdat op een aantal plaatsen organismen in formaline foutief zijn opgeslagen (zie de RI&E), zal een vorstvrije en geventileerde bergruimte met vloeistofdichte vloer worden gebouwd ten behoeve van de langdurige opslag van deze collecties.
Er is een controle op aarding uitgevoerd op een gedeelte van de wandcontactdozen van alle gebouwen van het NIOZ conform NEN 3140. In 1998 was de controle nog niet afgerond, dit moet in 1999 gebeuren.
In 1997 is een overzicht gemaakt van alle gasreduceerventielen die binnen het NIOZ gebruikt worden. Hoofd DZM zal een contract afsluiten om deze apparatuur periodiek te onderhouden.
5. Bedrijfsgezondheidszorg
6. Bedrijfshulpverlening
7. Investeringen
8. Vergunningen

VERSLAG VAN DE PERSONEELSVERENIGING OVER 1998

Na een van activiteiten overladen jaar 1997 werd in 1998 wat gas teruggenomen, om zodoende weer even op adem te komen, zodat de eeuw sprankelend kan worden afgesloten. Met het milleniumprobleem als zwaard van Damocles boven ons hoofd weet je tenslotte nooit wat voor rampen er op de loer zullen liggen. Daarom willen we van 1999 een extra actief jaar maken. Voor het komend jaar staan oa de volgende activiteiten gepland: cabaret in begin januari (ijs en weder diendende), het traditionele pannenkoekenfeest met kindertoneel, en een toneeluitvoering van onze trots: de "Comédia de la NIOZ". Dit alles staat te gebeuren in de eerste maanden van het nieuwe jaar, kun je nagaan.

In februari 1998 gaf het cabaretduo Henny Weel en Hans de Pagter een optreden in de colloquiumzaal voor het personeel. Vol verve vertolkte Henny Weel de opkomst en teloorgang van Yvette Guilbert door middel van uit het Frans vertaalde chansons. Ze wist op treffende wijze de sfeer van het Parijs uit het begin van deze eeuw weer te geven, de wereld van de can-can, Moulin Rouge en de vaudeville. Helaas waren er slechts enkele mensen van de overkant aanwezig, terwijl we de avond toch zo geprogrammeerd hadden dat dat mogelijk was geweest.

Een van de uitkomsten van een eerder gehouden enquête was dat er veel belangstelling zou zijn voor een pv-reisje mits er een leuk en afwisselend programma was. Daarom hadden we besloten om nu eindelijk een keer een leuk programma samen te stellen. Dat doen we dus nooit weer want door de overweldigende belangstelling dreigden we in organisatorische problemen te komen, maar gelukkig kon alles nog net op tijd worden geklaard. We kunnen nu al verklappen dat we de volgende keer naar een kantklosmuseum gaan, dat is een stuk eenvoudiger te regelen.

Dit jaar stond er dus een bezoek aan het Gasunie-gebouw te Groningen en de Hortus Botanicus te Haren op het programma. Vooral het unieke Gasunie-gebouw, dat van buiten al een plaatje is om te zien maakte, juist van binnen, grote indruk op onze pv-leden. Indrukwekkend is de manier waarop met frisse kleuren, lichtval en ruimteindeling is omgegaan. Een bijzonder detail is dat er bij de bouw niet één winkelhaak is gebruikt.
Amper bekomen van de indrukken werd men alweer rondgeleid door de Chinese Tuinen in de Hortus. En om een beetje af te koelen kon men ook een expositie zien van Chinese ijsbeelden.
De dag werd afgesloten met een diner aan het Pikmeer te Grou.

Gezellig een biertje drinken aan het water.
Foto: C. Blaauboer.