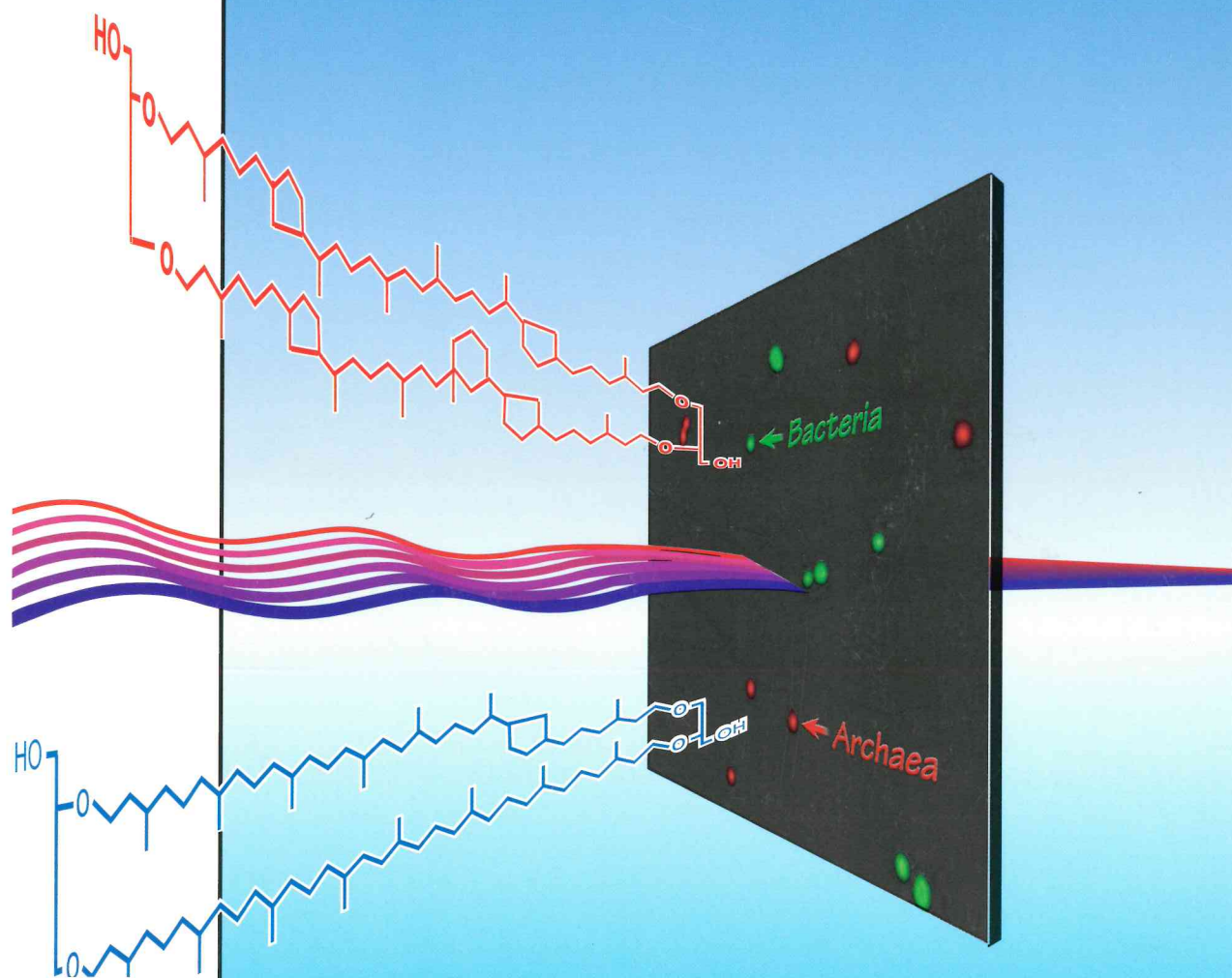




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ROYAL NETHERLANDS INSTITUTE FOR SEA RESEARCH (NIOZ)

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ANNUAL REPORT 2004

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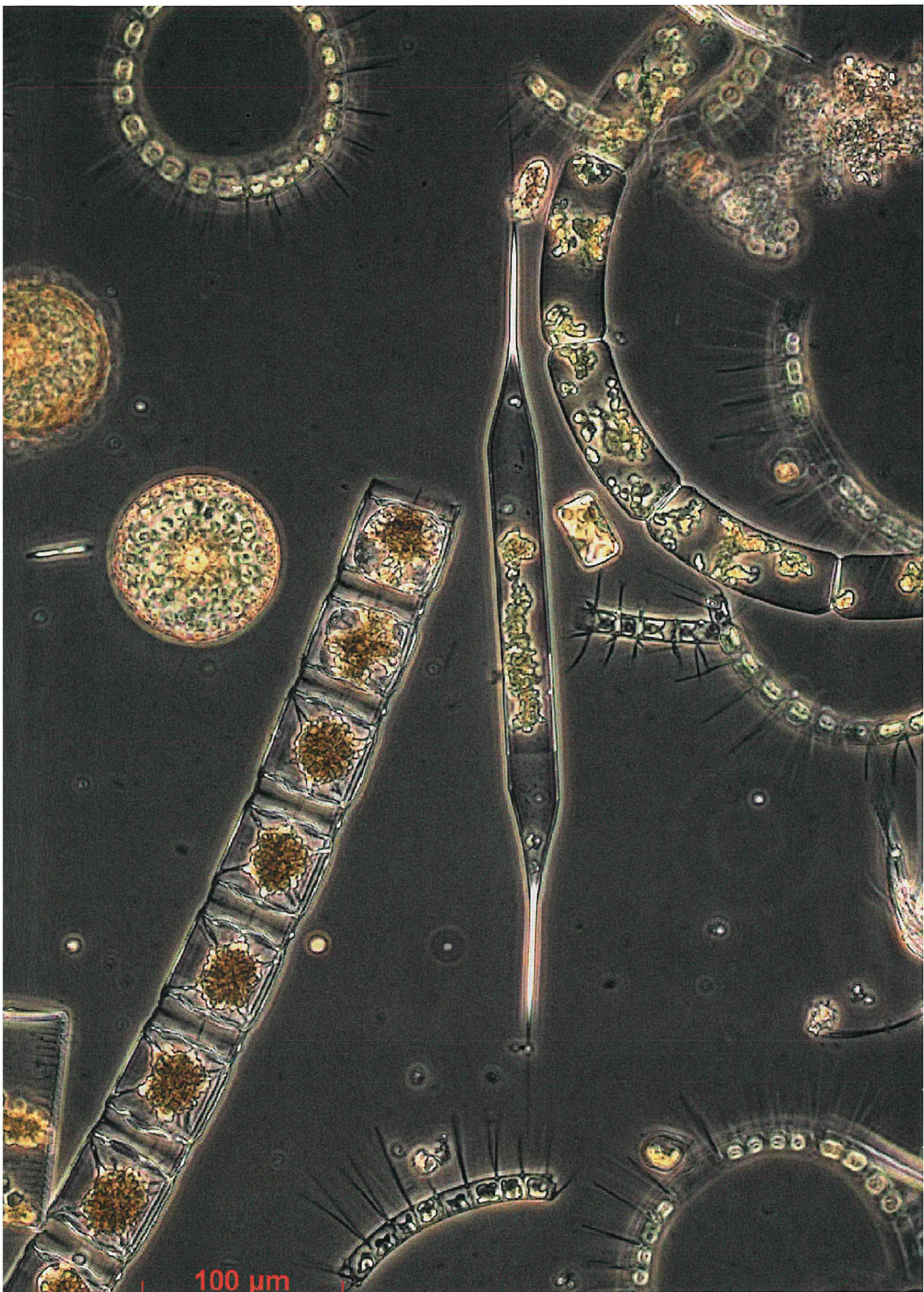
Cover: two tetra-ether lipid molecules from the cell membrane of marine archaea (crenarchaeota). Based on a ratio reflecting the abundance of five-carbon rings in their structure, NIOZ scientists have developed the 'TEX₈₆' index as a tool to measure the surface temperature of present and past seas and oceans. Background picture: Eva Teira (NIOZ).

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ROYAL NETHERLANDS INSTITUTE FOR SEA RESEARCH (NIOZ)



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September population of the
Marsdiep phytoplankton.

Photo taken by Jolanda van Iperen
with Axiovert200, dark-field illumina-
tion.

INTRODUCTION

The year 2004 was characterized by some important changes in the directorate of Royal NIOZ and in the research strategy. The first event of major importance was the resignation of Prof. dr. Jan W. de Leeuw per 1st July. Jan will continue to perform some external tasks, e.g. representing Royal NIOZ in the 'Partnership for the Observation of Global Oceans' (POGO) as incoming chair and as chair per 30 November, and in the Executive Board of the Marine Board of the European Science Foundation through the Royal Netherlands Academy of Arts and Sciences (KNAW). For his scientific achievements in biogeochemistry and for all he did for the science development of Royal NIOZ and his managing activities, Jan received the prestigious Royal award 'Knight in the Order of the Lion of the Netherlands'.



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Royal NIOZ was not successful in finding a new director. To find a way out of this dilemma, the Board of the Royal NIOZ foundation chose to attract on a temporary basis a managing director, Ir. Jan Smit, and a part time scientific director, Prof. dr. Johan E.

Meulenkamp. Both appointments are for a period of two years.

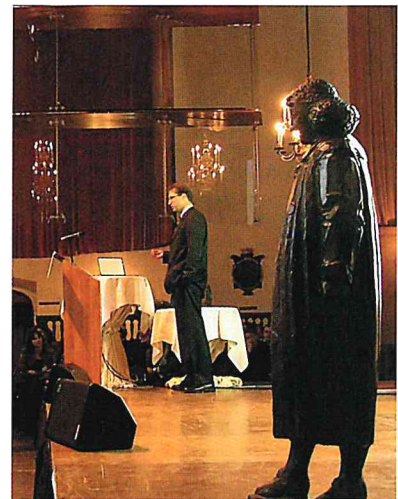
Along with the appointment of both new directors and the subsequent departure of the Controller/Head of business management, Drs. ir. Rob G. Haas, some changes were made, including the installment of a Facility Management group and a Marine Research

Facilities group. In the overall management of the institute, the existing consultative structure was replaced by a Science Council, composed of the heads of the five scientific departments, and a Management Team, which includes representatives of both scientific and non-scientific staff.

By the end of the year, the Science Council completed the concept of the new science plan in which the primary research objectives of Royal NIOZ for the forthcoming years are brought together in the four multidisciplinary programmes 'Open Ocean Processes, Benthic Boundary Layer Processes, Coastal Systems and Past Ocean Processes'.

As to the scientific output in 2004, seven theses were successfully submitted at the Amsterdam, Utrecht and Groningen Universities. The five scientific departments jointly published 140 articles in peer reviewed journals and books. Six articles were published in Nature and Science, of which two had a NIOZ scientist as the principal author.

The year 2004 was very successful in terms of awards granted to NIOZ scientists. The highest possible award in science in The Netherlands, the NWO Spinoza prize, was awarded to Prof.dr.ir. Jaap Sinninghe Damsté for his outstanding work in biogeochemistry. Prof. dr. Theunis Piersma received three awards; from the Prince



Bernhard Cultural Foundation for his pioneering contribution to nature preservation in the Wadden Sea, the first triennial Wetlands International Luc Hoffmann Medal for Wetland Science and Conservation and

the annual prize of the German Ornithologist's Society for his work on the ecology of a wading bird (the knot, *Calidris canutus*).

In addition to these awards, the Marine Research Facilities group was greatly acknowledged through the award granted to RV Pelagia by the Voluntary Observing Ship Climate Project (VOSCLim) for being the most frequent reporting weather station in 2003. For master Hans Groot, who left Royal NIOZ in 2004 for early retirement, this was a nice 'finishing touch' at the end of his long career at Royal NIOZ, where he started as an able seaman in 1971.

Another expression of successful achievement of the sea going staff was the further construction of the underwater research vehicle MOVE! as part of the firm alliance between Royal NIOZ and German institutes. An expression of progress in the development of high tech equipment concerns the construction of a High Pressure Sampler prototype, allowing samples from the deep sea to be brought to the sea-surface while maintaining their original pressure.

The major building activities were finalized with the official opening of the 'Ocean-wing' for our Marine Technology department. This allowed Fen Schilling, who has been coaching all major building activities during the last five years on behalf of Royal NIOZ, to leave for his well-deserved retirement too. In the years to come, our staff will concentrate on the upgrading of the older parts of the institute.

7



The institute's second research vessel, the RV Navicula, got an entirely new and larger wheelhouse and interior in the spring. The ship is now ready to serve the institute again in the Wadden Sea and the coastal area of the North Sea for the next ten years.

Royal NIOZ continued its long-term policy to establish and further develop and strengthen the

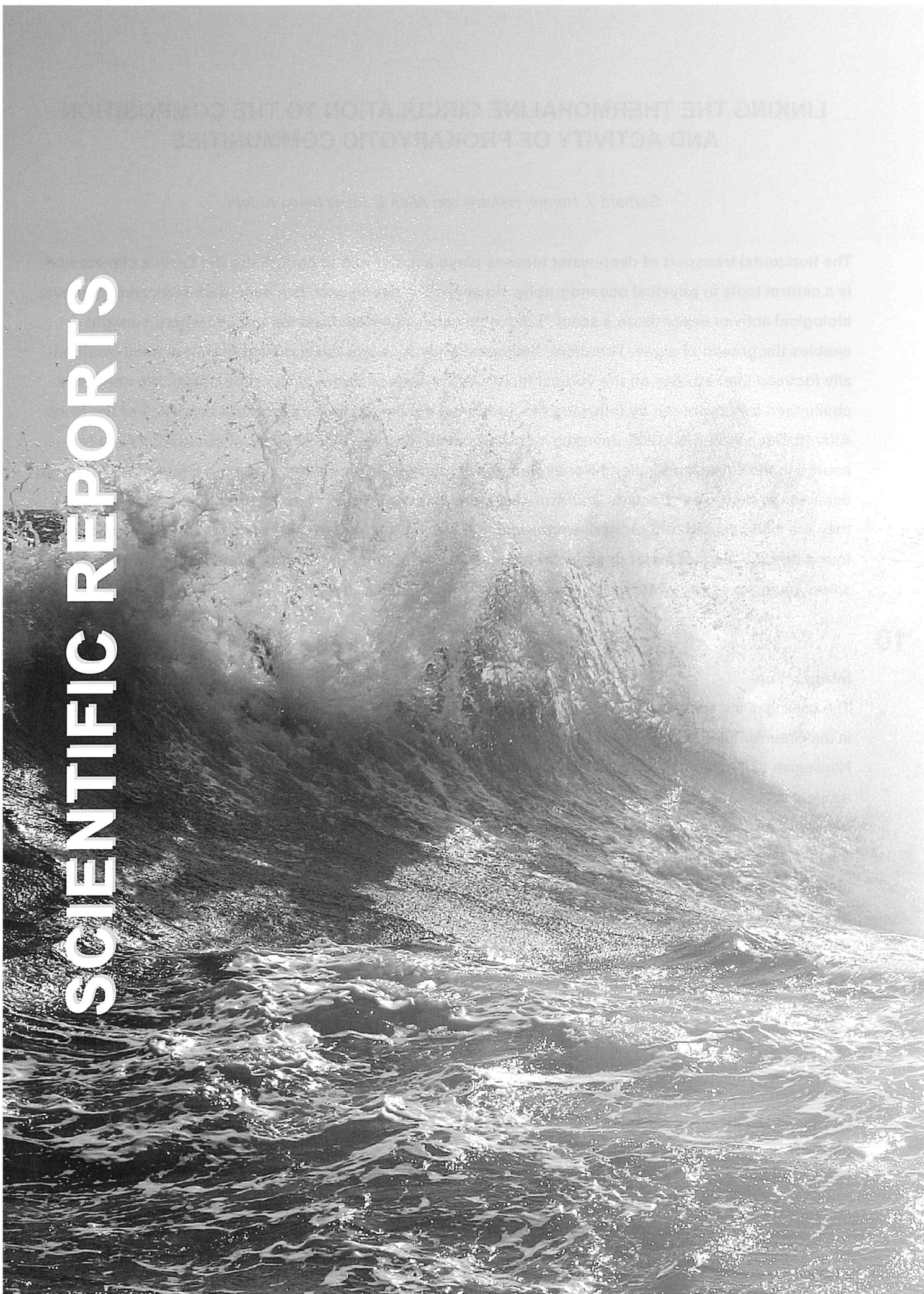
formal and well structured collaboration agreement with numerous research institutes and university faculties in The Netherlands and abroad. In the context of these collaborations, Royal NIOZ greatly acknowledges the decision of the Netherlands Organisation for Scientific Research (NWO) to honour the application of the institute to initiate the NEBROC-2 programme. Parallel to this, the German NEBROC counterpart institutions in Bremen and Bremerhaven equally were granted their application.

NIOZ staff also started to prepare the appropriate documents for a formal assessment of its research and management; the corresponding peer review will take place in May 2005. This peer review will be of particular importance for the institute and its sea going research partners in The Netherlands, since it will take place in the context of two recently submitted reports on the future of marine research in The Netherlands. The recommendations included in the report of the Committee Marine Facilities (CMF) and the report of the Committee Future Position Royal NIOZ in Sea-going Research (CNTZ) stress the importance of Royal NIOZ as the main centre of future sea going research in The Netherlands. On the other hand, both reports plead for strengthening of existing collaboration agreements with, in particular, universities and to develop formal and structural collaborations with research institutes active in the field of 'applied' research. A major step forward in this context was the signing of a formal collaboration agreement between Utrecht University and Royal NIOZ in the spring of 2004.

Johan E. Meulenkamp, scientific director

Jan Smit, managing director

SCIENTIFIC REPORTS



LINKING THE THERMOHALINE CIRCULATION TO THE COMPOSITION AND ACTIVITY OF PROKARYOTIC COMMUNITIES

Gerhard J. Herndl, Hendrik van Aken & Jesus Maria Arrieta

The horizontal transport of deep-water masses plays a major role in controlling the Earth's climate and is a central topic in physical oceanography. However, the deep ocean is a cold, dark environment where biological activity depends on a scant "rain" of organic materials from the surface where sunlight enables the growth of algae. Therefore, biological and biogeochemical oceanographers have traditionally focused their studies on the vertical flux from the surface layers to the deep ocean. We now have challenged this approach by following the horizontal movement of the two major branches of the North Atlantic Deep Water (NADW), covering a stretch comprising roughly 50 years of circulation from its source in the Greenland-Iceland-Norwegian Sea as part of the global thermohaline circulation. Although deep-sea prokaryotes (Bacteria and Archaea) were present in lower numbers than in surface waters, they are well adapted to their dark environment and exhibit higher activity than previously assumed. We found that the distinct major deep-water masses harbor distinct prokaryotic communities with successional changes as the water mass progresses in the oceanic conveyor belt.

Introduction

The cooling of the surface waters in the Greenland-Iceland-Norwegian (GIN) Sea and the subsequent large scale deep water formation is known as the North Atlantic Deep Water (NADW) formation. It is the major driving force of the oceanic conveyor belt system, connecting the waters of all our oceans (Fig.1) Recently, it has been found that the deep water formation in the GIN Sea is more variable than hitherto assumed. This variability in the deep water formation influences the circulation pattern of the oceanic conveyor belt system which, in turn, influences

both, the global climate and the oceanic carbon cycling (see Intermezzo).

The multidisciplinary project TRANSAT, funded by ALW-NWO focuses on the link between the

thermohaline ocean circulation and the transformation processes of dissolved organic matter (DOM) by the microbial community. We followed the two major branches of the NADW from their formation in

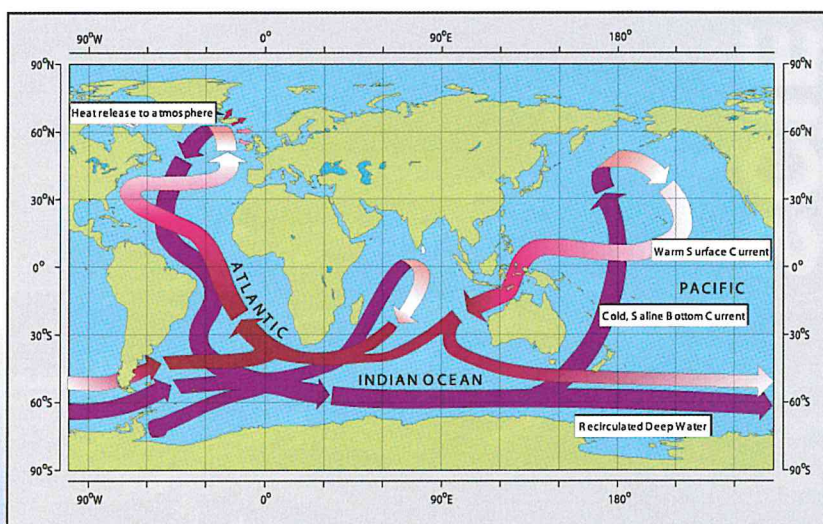


Fig. 1. Simplified conveyor belt scheme of the oceanic thermohaline circulation.

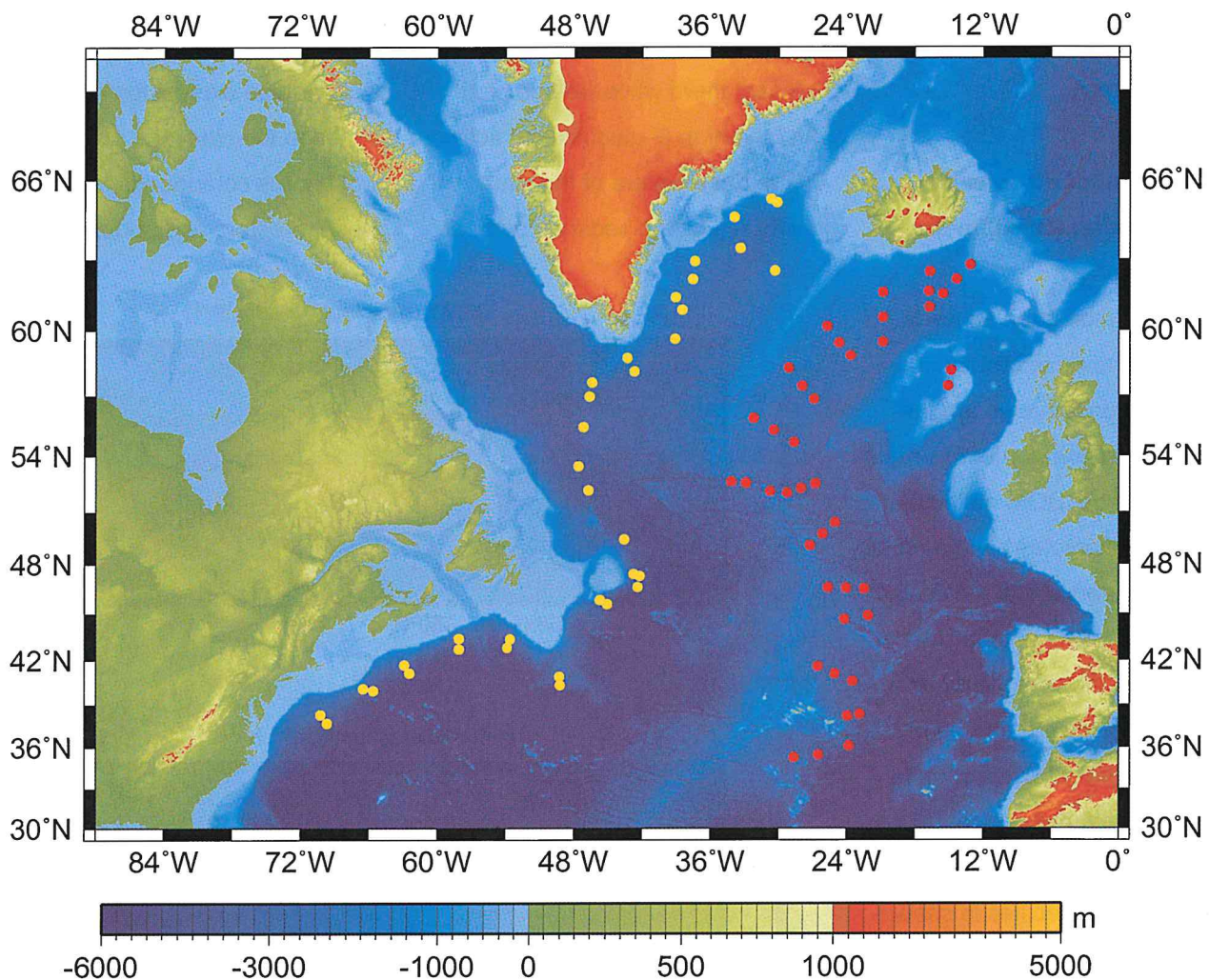


Fig. 2. The TRANSAT cruise tracks following the two branches of the North Atlantic Deep Water (NADW) from near its region of formation in the Greenland-Iceland-Norwegian Sea over more than 4000 km corresponding to about the first 50 years of NADW in the oceanic conveyor belt. Stations occupied are indicated by red dots for TRANSAT-1 and yellow dots for the TRANSAT-2 cruise.

the GIN-Sea over more than 4000 km (Fig. 2), and determined the community composition and the major activity parameters of the prokaryotic (Archaea and Bacteria) community such as cell production, respiration and enzymatic activity. These biological parameters were related to the physical and chemical characteristics of the major water masses.

As the NADW gets older, along the TRANSAT-transects from north to south, the apparent oxygen utilization increased, coinciding with a decrease in dissolved organic carbon, nitrogen and phosphorus. At the same time, the levels of inorganic nitrogen and phosphorus increased in concentrations by 20% and 30%. The spatial development of all these parameters

indicate remineralization activity of the deep water prokaryotic community, making nutrients available for new life. These signs of high activity of the deep water community were confirmed by single cell analyses using micro-autoradiography combined with a highly sensitive fluorescence in situ hybridization technique (more details of this technique are given in the contribu-

tion of Eva Teira et al. under the Department of Biological Oceanography).

Degradation of dissolved organic matter (DOM) in the deep ocean

The DOM in the deep ocean is considered to be refractory in nature and prokaryotes are the principal transformers of this material. Most of the DOM molecules used by prokaryotes have a molecular weight above 600 molecular weight (MW). The uptake sites at the cell wall, however, allow only molecules smaller than 600 MW to pass; thus prokaryotes produce enzymes that are active outside the cell (ecto-enzymes). They cleave large molecules in seawater, and thereby enable the cells that synthesize these enzymes to take up the small cleavage products – a process coined 'hydrolysis-uptake coupling'. Surprisingly, a higher ecto-enzymatic activity per prokaryotic cell was found in the deeper layers than in surface waters, indicating active transformation of deep water DOM by the prokaryotes. This is illustrated in Fig. 3 for two of such enzymes, β -glucosidase and phosphatase. The β -glucosidase activity in the NADW was particularly high above the Charlie-Gibbs Fracture zone. As

indicated by remote sensing, an intensive phytoplankton bloom was present there while we sampled and the high β -glucosidase activity in the deep waters of this area might reflect the sedimentation of

phosphate to maintain prokaryotic activity. There is evidence that this phosphatase expression might be related to the cleavage of organo-phosphorus compounds, such as phospho-esters and phospho-

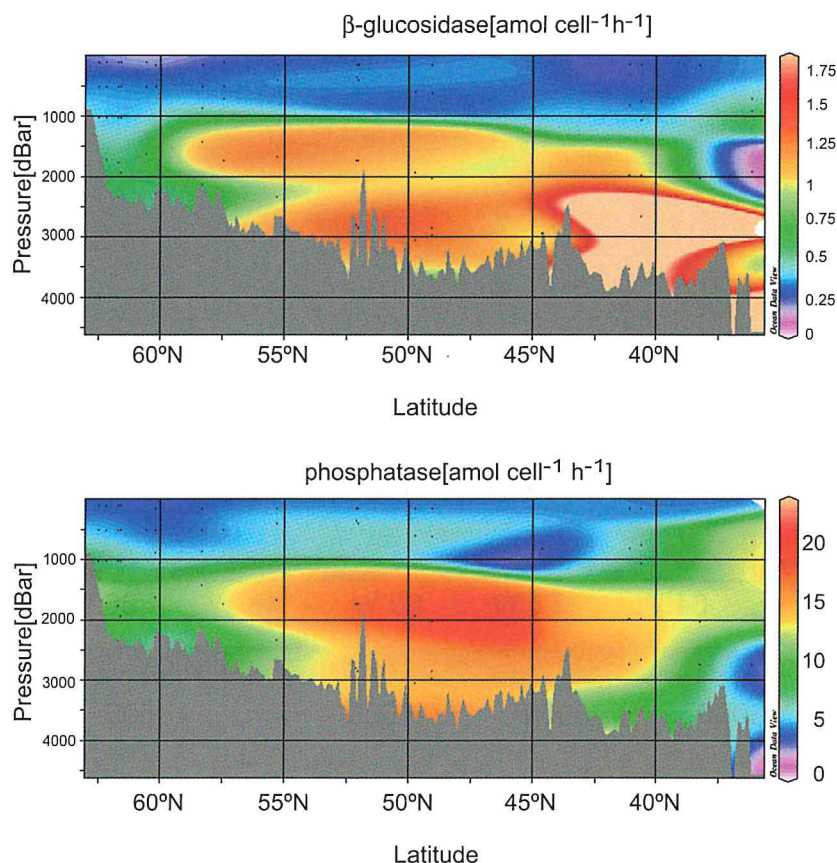


Fig. 3. Dynamics in prokaryotic ectoenzyme activity per cell in the water masses sampled during TRANSAT-1. Upper panel: β -glucosidase, lower panel: phosphatase.

dead material from the bloom. We also detected high phosphatase activity in the deep ocean, which was quite unexpected since the endproduct of phosphatase activity, inorganic phosphate, is present at high concentrations in these deep waters, thus there is no reason to express phosphatase to obtain

nates. Thus, the deep water prokaryotic community might express phosphatase activity not to acquire phosphorus but rather carbon to sustain its energy source for metabolic activity.

Most of the DOM pool still cannot be characterized on a molecular level. Moreover, the characteriz-



able portion of the DOM declines with depth in the water column. While about 20-40% of the DOM can be characterized in oceanic surface waters, only about 5-10% of the deep water DOM is characterizable on a molecular level. It is therefore impossible to determine the subtle alterations in the composition of the DOM pool in the oceanic conveyor belt as the water gets older. As prokaryotic species have evolved over 3 million years in earth history, one might expect

that a substantial part of the heterotrophic component of the marine prokaryotes have attained a high level of speciation in utilizing different components of the DOM pool as a carbon and energy source. Consequently, changes in the composition of the prokaryotic community likely reflect the subtle changes in the quantity and quality of the DOM and might therefore be a more sensitive indicator of changes in the DOM pool than chemical analyses allow us to

resolve currently. Since the composition and the quality of the DOM probably changes during the lateral transport of the major water masses driving the thermohaline ocean circulation mainly due to prokaryotic activity, we hypothesized that these major water masses carry not only their own distinct DOM pool but related to that, also their specific prokaryotic community.



The shipboard party.

Bacterioplankton community composition

Fingerprinting techniques of the 16S rRNA gene enabled us to obtain an overview of the composition of the prokaryotic community in a specific sample. By comparing all the different samples collected in the different water masses, similarity analyses can be performed. For the bacterioplankton, we demonstrated that each of the six specific clusters identified were affiliated to specific major water masses (Fig. 4). Thus, each of the major water masses of the North Atlantic carries its own specific 'bacterioplankton community fingerprint', most likely reflecting the subtle differences in the chemical composition of the DOM in these water masses.

More detailed analyses are currently performed to refine this emerging view on the link between the major water masses driving the thermohaline ocean circulation, the deep-water microbiota and its activity, the composition of the DOM pool and its transformation rate. These complex interactions will be resolved in the frame of a

multidisciplinary theme as formulated in the new Science Plan of the NIOZ where physical and microbiological oceanographers are working in concert with biogeochemists to shed light on the largely unexplored 'Dark Ocean Processes'.

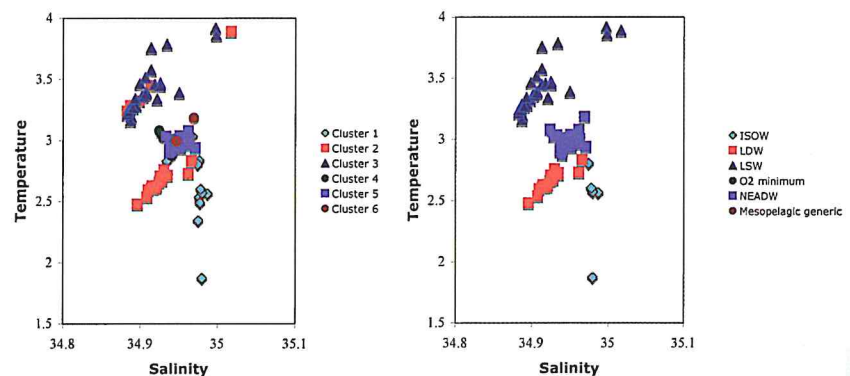


Fig. 4. Specific bacterioplankton communities (clusters 1-6, left panel) match with specific water masses (right panel) as defined by the salinity-temperature characteristics. ISOW-Iceland-Scotland Overflow Water, LSW-Labrador Sea Water, NEADW-North East Atlantic Deep Water, LDW-Lower Deep Water, O2 minimum-oxygen minimum layer. Bacterial community analysis was done by terminal restriction fragment length polymorphism (T-RFLP) of the 16S rRNA gene.

The oceanic conveyor belt and the remineralization of DOM

While the turnover of the water masses in the oceanic conveyor belt system is around 1500 years, the turnover of dissolved organic matter (DOM) in the deep waters is much longer, around 6000 years. Thus, on average, the deep water DOM is cycled 4 times within the conveyor belt system before it is completely remineralized. As a consequence of conveyor belt circulation of deep water masses, the deep water DOC concentration decreases from around 45 μM in the NADW to 37 μM in the deep waters of the Pacific, i.e., a decline of 8 μM C = 20% of the original concentration. Recently, it has been hypothesized that the degradation of the deep water DOC must take place in a non-continuous way involving interactions between abiotic transformation of DOC (chemical, photochemical) and microbial degradation and remineralization.

Due to this critical lack of a mechanistic understanding of the DOM transformation in the deep sea (which comprises the largest single system of the world's oceans with about 80% in volume) it has been impossible to make any predictions on the future development of the deep sea as a potential buffer reservoir in the biogeochemical flux of elements like carbon, nitrogen and phosphorus in a changing climate.





PHYSICAL OCEANOGRAPHY

The scientific efforts within this department are organized under three main themes:

OCEAN CIRCULATION AND HYDROGRAPHY

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

In 2004 many activities were carried out in the framework of the Long-term Ocean Climate Observations (LOCO) program. Sub-surface moorings were deployed for the first time in Lifamatola Strait (Indonesia) as part of the international INSTANT program to measure the Indonesian Throughflow as the major connection between the Pacific and Indian Ocean for a period of three years. In the North Atlantic, two profiling moorings were serviced and redeployed in the Irminger Sea, where North Atlantic deepwater is formed. This first deployment period of these moorings was very successful in that both profilers obtained observations over the entire water column for the full period.

Hydrographic observations were obtained and analyzed as part of the multidisciplinary TRANSAT program in which the biological degradation of North Atlantic Deep Water is studied.

PhD and PostDoc studies using data obtained during recent programmes, like CAMP, MARE and ACSEX continued. a PhD study on the long term variability in ocean currents using satellite altimetry and hydrographic observations was completed.

PROCESSES NEAR CONTINENTAL SLOPES, INTERNAL WAVES AND MIXING

This theme is based on theoretical and numerical studies on the interaction between internal waves in a stratified ocean and topographic features. The outcome of the models is tested in laboratory and field-observational studies. As part of the LOCO program, one array of moorings to observe the climatology of internal waves in the Canary basin was serviced and redeployed. Another internal wave mooring array that had been deployed in the Irminger Sea was successfully recovered.

A PhD study on sub-tidal motions over the continental slope in the Faeroe-Shetland Channel was completed, showing a.o. that 'solibores' may be the dominant transport mechanism for sediments, despite their intermittent occurrence.

Internal wave observations have been performed in the Mediterranean Sea, with an emphasis on the peculiarities that arise when such waves encounter thick, well-mixed layers, and near Meteor Seamount in the Atlantic Ocean, where the localized nature of the internal tides was observed by means of two towed ADCPs.

TIDAL AND MORPHODYNAMICS OF COASTAL ZONES

This theme consists of studies in the relatively shallow coastal zone using both field and laboratory observations and theoretical modelling. A detailed analysis of ongoing TESO ferry 'Schulpengat' observations on currents and suspended sediments in the Marsdiep inlet of the western Wadden Sea forms an important part of this research programme. A PhD student and a PostDoc continued their research on the spatial and temporal variability of the current field (PhD) and on the transport of fine-grained sediments through the Marsdiep inlet (PostDoc). During 2004 some 13 hour cruises with RV Navicula were undertaken to obtain additional observations on the tidal current field at sections near the ferry transect and on the concentration of suspended sediments to calibrate the backscatter intensity of the ADCP on the ferry. It appeared that available models that relate backscatter intensity to suspended sediments do not function well in strong current regimes. Therefore a novel model that takes into account the effect of turbulence on the backscatter of sound, was developed.

In a Ph.D. study, laboratory experiments were performed on the non-linear dynamics of tidal basins.

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

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

THE GENERATION OF STRONG TURBULENCE OVER CONTINENTAL SLOPES

*Phil Hosegood & Hans van Haren**

The Meridional Overturning Circulation (MOC), which represents the large scale oceanic circulation, requires a level of mixing almost 10 times more vigorous than that observed in the ocean interior; it is believed that instead enhanced mixing occurs at the oceans' boundaries. Such processes are yet to be fully understood however and until they are their impact on the oceans cannot be quantified. Our results show evidence of two processes that generate turbulence near the sea-bed and which have been essentially neglected in the scientific literature. The first is related to the asymmetric response of the bottom boundary layer to a variable flow along the continental slope, and the second to the response of the deep thermocline to strong winds at the sea surface. Their overall impact on boundary mixing could be significant when extrapolated to the continental slopes across the global ocean.

During 1999 two cruises were conducted in the Faeroe-Shetland Channel in which we measured currents, temperature, density and sediment transport over the continental slope. An initial inspection of data revealed spike-like reductions in current speed which appeared to reflect an instrumental deficiency. The search for an explanation however revealed that a physical process was actually responsible for generating turbulence to which the instrument couldn't respond. The current direction was found to rotate anti-clockwise towards the seabed due to friction and the earth's rotation. Over the Shetland slope this results in downwelling at the seabed during periods when the current flows along the slope to the

north-east, causing lighter water to be driven beneath heavier water lower down the slope (Figure 1). Such a situation is unstable and leads to turbulence, causing rapid fluctuations in the current direction which lead to the current meters under-reading the current speed. In contrast, during periods when the current flows to the south-east, heavy water flows up the slope, enhancing the stratification and inhibiting turbulence.

We also observed the thermocline rushing up the continental slope (Figure 2) in the form of a wave train which eventually breaks, very much like surface waves breaking on a beach, and causing vigorous mixing. We term such features 'solibores' because they appear both like internal bores and trains of 'solitons' (Figure 3), a particular type of wave. Our observations are unusual because of the depth of the solibores and the ori

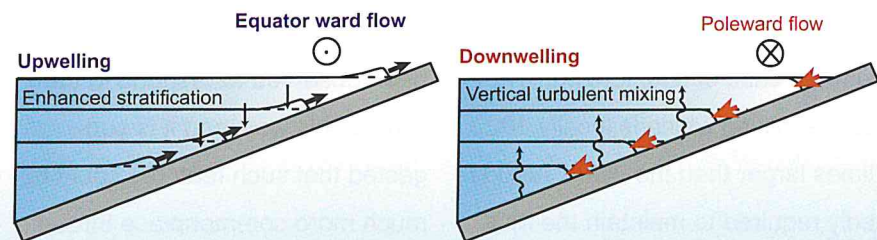


Fig. 1. The asymmetric response of the bottom boundary layer under contrasting long-slope flows and the consequences for turbulent mixing in the near-bed region.

*Corresponding author: hansvh@nioz.nl

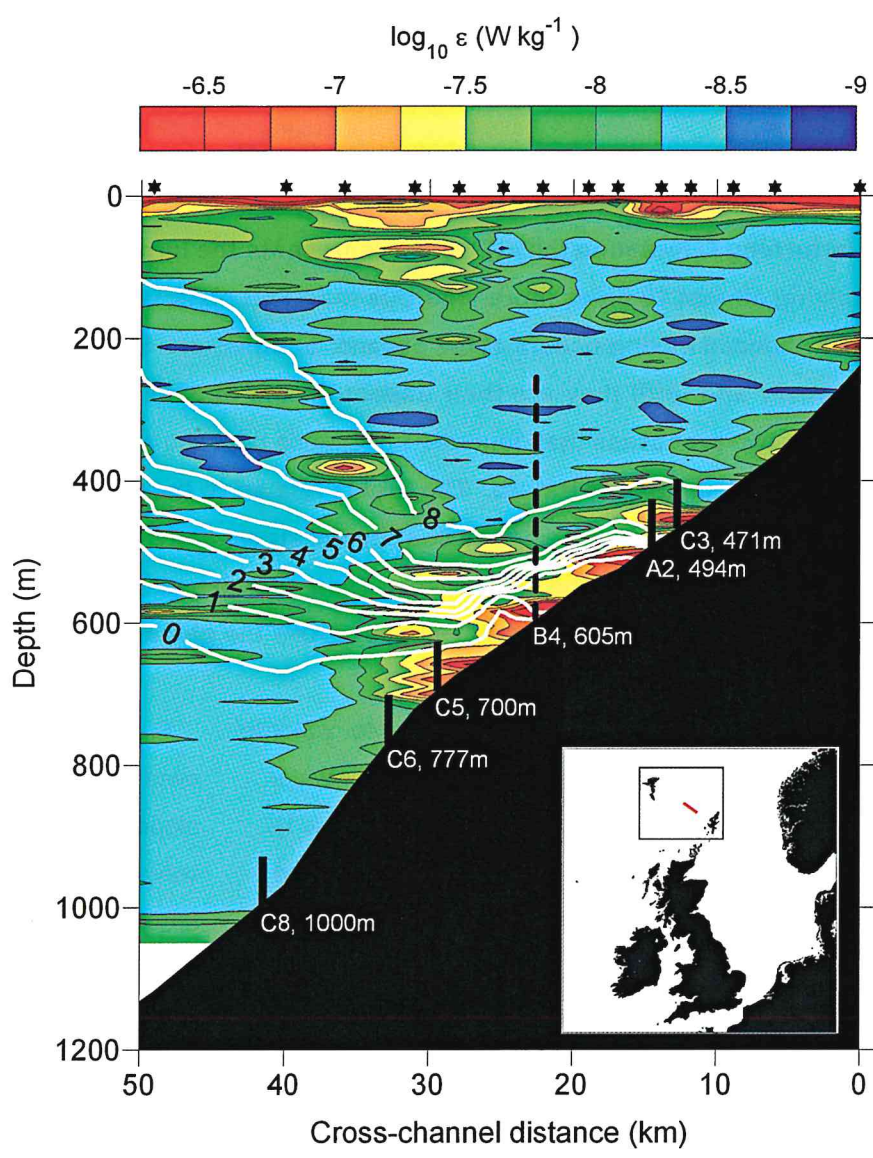


Fig. 2. Turbulence over the continental slope generated by a solibore passing up the slope and (inset) the location of the study region. The turbulence is expressed in terms of the energy dissipation rate ϵ . The white lines indicate the position of the isotherms from which the up-slope rushing nature of the solibore may be inferred.

gin of their forcing which is atmospheric rather than the usually considered case of tidal forcing. They cause mixing which is locally 100 times larger than the value supposedly required to maintain the MOC, and are furthermore able to resuspend exceptionally large amounts of sediment at the sea bed. This is

the first time that the evolution of the permanent pycnocline has been observed to respond to the wind in this way, and it is suggested that such features could be much more commonplace throughout the world's oceans than previously thought.

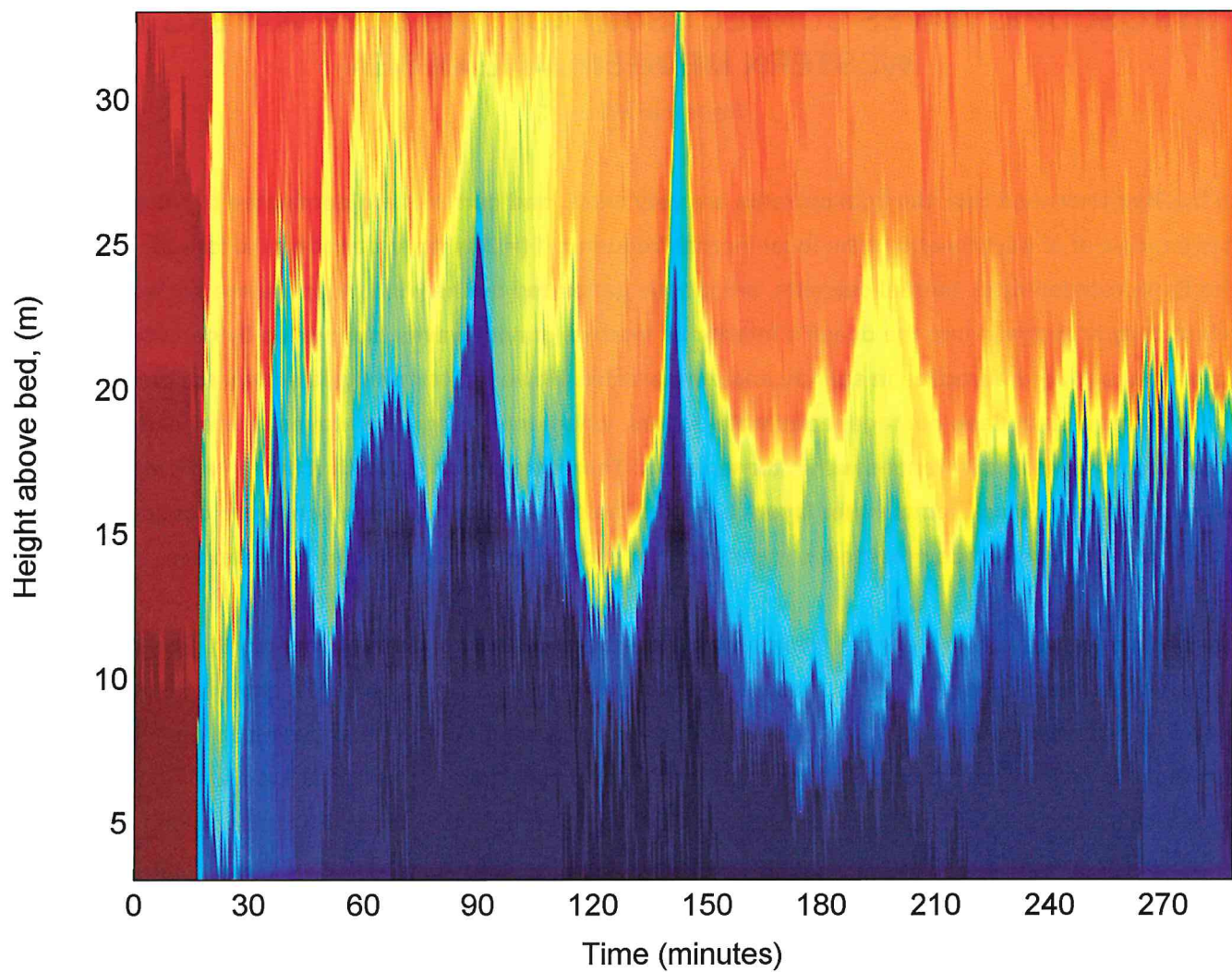


Fig. 3. Temperature during the passage of a large solibore when large sediment fluxes occurred.

GYROSCOPIC WAVES CONNECT SURFACE AND DEEP WATERS IN THE WESTERN MEDITERRANEAN SEA

Hans van Haren ^{*}, ¹

In the Mediterranean Sea, the tidal currents are very weak, and currents are dominated by waves having frequencies at or slightly above the local inertial frequency f ($= 2\Omega\sin\phi$, ϕ denoting the latitude and Ω the Earth rotation rate). Inertial currents are mostly generated by the wind, near the sea surface, from which they propagate into the ocean's interior as internal gravity waves, supported by density stratification caused by differences in salinity and temperature. However, our analysis shows anomalous inertial motions also in deep homogeneous water layers, where internal gravity waves cannot exist because there are no density differences within these layers. Therefore, we propose that these vertical motions across several homogeneous water layers between the surface and the deep ocean are caused by gyroscopic waves, which thus provide the means for the wind to perform mixing in the deep sea.

Motions that vary rapidly in the vertical, such as internal gravity waves, are presently seen as important for maintaining the deep, large-scale ocean circulation. This is because the necessary downward transport of heat via turbulent mixing might be caused by the breaking of such waves. They have frequencies σ , situated in between the local inertial frequency f and the stability frequency N that measures the rate of density decrease upward from the bottom: $f < \sigma < N$. In the vertical plane they propagate into directions that vary between purely vertical ($\sigma = N$) and purely horizontal (f), so that with conventional current meters, that measure only the horizontal currents, N -waves are in the horizontal plane observed as rectilinear, to-and-fro motions,

whilst f -waves describe circular motions (see sketch in Fig. 1).

Any variations of such circular inertial motions in the vertical (current shear) also describe circular paths. Therefore the vertical cur-

rent shear magnitude is a function that varies 'slowly with time', over time scales much larger than the inertial period ($2\pi/f$). This shear is important for the deformation of small-scale ocean motions (high-

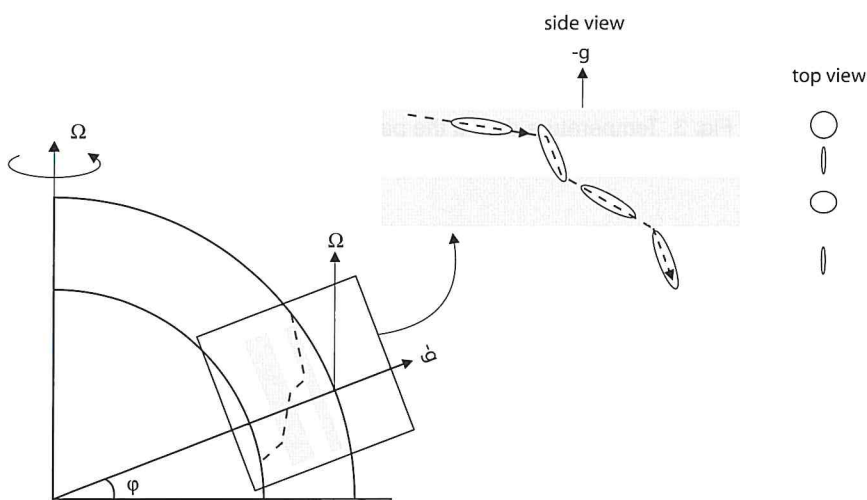


Fig. 1 Sketch of geometry of rotating earth and Mediterranean Sea, consisting of a sequence of stratified (grey bands) and homogeneous (white bands) layers. The latter support internal gravity and gyroscopic waves respectively. Near-inertial gravity waves have nearly horizontal currents associated with them, 'horizontal' being defined as perpendicular to the local, radially-inward direction of gravity. The gyroscopic waves orient themselves with respect to the direction of the Earth rotation axis, and hence are locally perceived as possibly having a strong vertical propagation component as well as currents whose projection on the horizontal plane takes the form of a rectilinear (to-and-fro) current.

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¹ En collaboration avec Claude Millot, LOB-COM-CNRS, c/o Ifremer, La Seyne-sur-mer, France

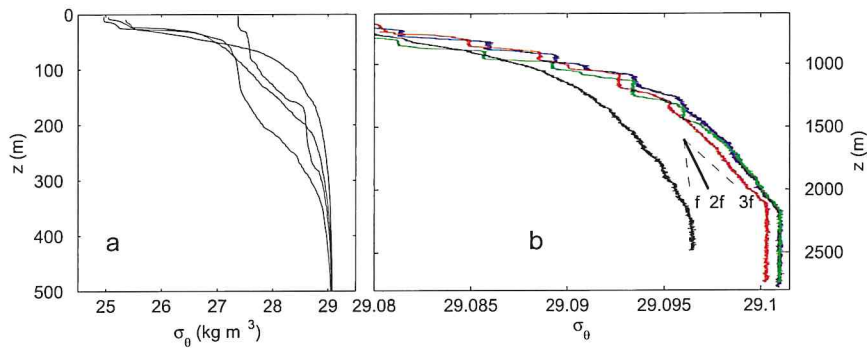


Fig. 2. Examples of potential density-depth profiles obtained using CTD in the Western Mediterranean Sea. *a.* 0–500 m with potential density referenced to the surface. *b.* The lower 2200 m of the profiles. The short sloping lines indicate density stratification yielding $N = f$, $3f$ (dashed lines) and $N = 2f$ (heavy solid line).

frequency internal waves) to the point of breaking, thereby inducing deep-ocean turbulent mixing. In the ocean, the internal wave shear is predominantly found at inertial and tidal frequencies, albeit each has a different character. Within the physical oceanographic community, it is debated what motions of the two dominant frequencies are most important for small-scale internal wave generation. Internal waves of tidal frequencies are generated in localized areas via surface-tide interaction with topography, mostly near the shelf break (where the continental shelf plunges into the abyss). In contrast, inertial motions are generated anywhere in the ocean, but mostly near the surface via interaction with the atmosphere. One of the key questions is how energy from near-inertial motions is transferred into the deep ocean. To study the potential importance of

inertial motions on deep-ocean mixing separately from tidal currents, instruments have been moored in the Western Mediterranean Sea, one of the few areas where tides are weak enough to be neglected.

However, it is not as simple as it looks: although the Western Mediterranean Sea is ideal for such study because of its depth (~3000 m), it is also one of the few ocean sites where deep-water formation occurs in winter. As free

turbulent convection, responsible for the formation of this deep-water, is found at intermediate depths, a key problem is induced: the homogeneous ($N = 0$) layers formed by these processes cannot support internal gravity waves, so that near-inertial internal gravity waves can principally not exist given the observed density profiles (Fig. 2).

Nevertheless, (horizontal) motions near f are found dominant at all observational depths (100, 1000, 1800 and 2700 m), and between 1000–2700 m depth their amplitude barely varies (Fig. 3). There is a difference however in that the near-inertial motions at 100 and 1800 m (where $N > f$) are more or less circular in the horizontal plane, as expected for internal gravity waves, while, in contrast, the near-inertial motions at 1000 and 2700 m (where $N = 0$) are rectilinear,

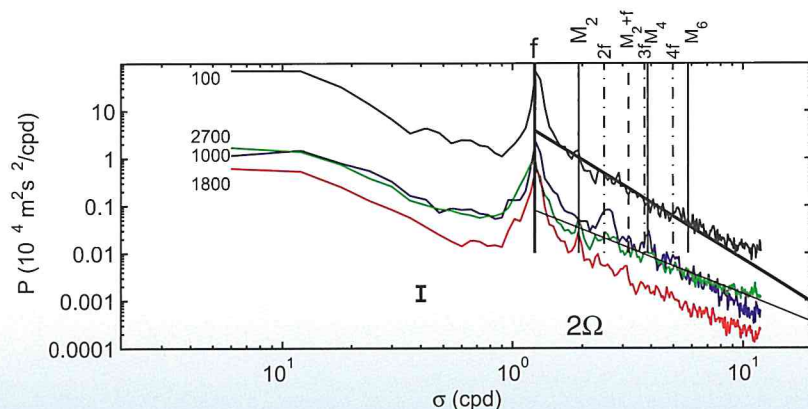


Fig. 3. Kinetic energy spectra (P) derived from 4 months of current meter observations at 100 m (black), 1000 m (blue), 1800 m (red) and 2700 m (green). Vertical lines denote lunar tidal frequencies M_n and inertial frequency f . Thick and thin SLOPING solid lines denote slopes of σ^{-3} and σ^{-2} respectively.

which has not been observed before (Fig. 4). Our interpretation is that *these motions are the horizontal projection of motions that were propagating nearly vertically.*

These represent a kind of waves known as gyroscopic waves, which are restored by the Coriolis force due to the rotation of the Earth.

These waves are characterized by strong vertical currents and by a shear magnitude that varies rapidly. Apparently, they constitute at f a smooth transition between internal gravity waves in the stratified layers and gyroscopic waves in the homogeneous layers. It is suggested that these gyroscopic

waves are the only means for internal waves to propagate to the deep ocean, crossing layers of $N = 0$, and thus they dominate deep-ocean mixing.

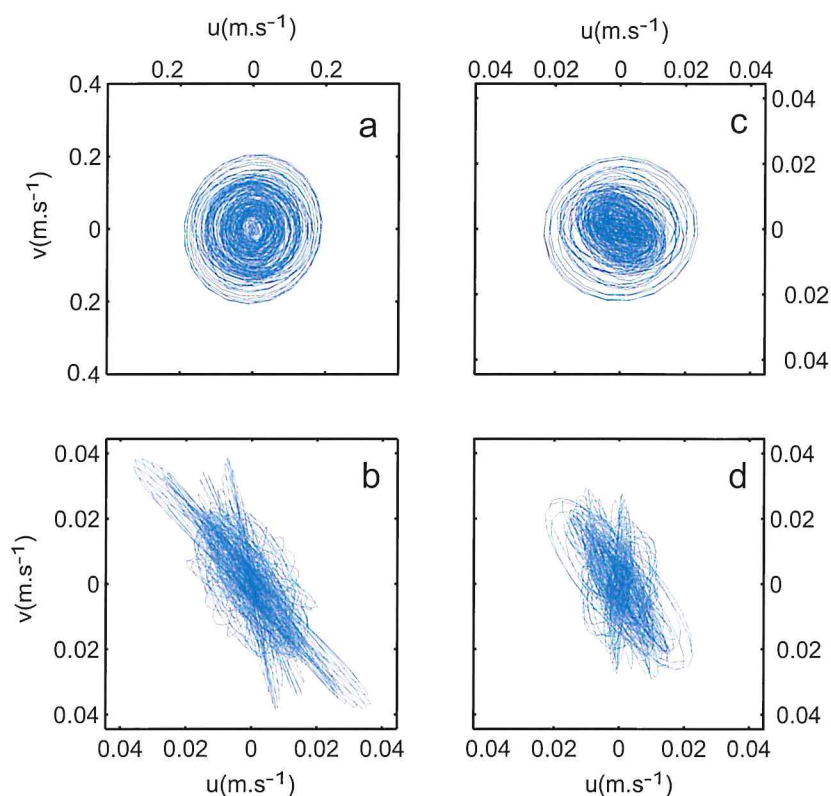


Fig. 4. Horizontal current records of near-inertial, band-pass filtered data $[0.90f, 1.10f]$ at depths: a. 100 m (Note different scale from the others), b. 1000 m, c. 1800 m, d. 2700 m.

CLIMATE-RELATED CHANGE OF SEA LEVEL OBSERVED WITH SATELLITE ALTIMETRY

Denis L. Volkov & Hendrik M. van Aken*

Long-term changes of sea level cause challenging concerns for people living in coastal areas. These changes occur mainly due to the variations of the seawater density and the amount of water in the ocean. Recent advances in satellite altimetry provided high-accuracy regular and nearly global measurements of sea level. Due to earth rotation, large-scale surface currents (gyres) in the open ocean away from the equator are determined by the spatial distribution of sea surface heights (so-called geostrophic currents) which can be derived from satellite altimetry data. Our results show that the sea levels and the associated velocities of the surface geostrophic circulations in the subtropical and sub-polar gyres of the North Atlantic and North Pacific Oceans varied out of phase with each other in the decade 1992-2002. This is probably a natural phenomenon.

The evolution of satellite altimetry from Seasat (1978) to TOPEX/Poseidon (1992) and Jason-1 (2001) has led to the present ~5 cm state-of-the-art overall accuracy in determination of the sea surface height (SSH). SSH can be measured by estimating the range R from the satellite to the sea surface (Fig. 1). Radar altimeters onboard the satellites transmit a short pulse of microwave radiation at high frequency towards the sea surface. A part of this pulse is reflected back to the altimeter after hitting the sea surface. The round trip time t for the pulse to travel from the satellite to the sea surface and back to the satellite scaled by the speed of light c (at which electromagnetic waves travel in vacuum) yields the range $R=ct/2$. After

correcting the range measurements for atmospheric refraction and sea state biases, SSH is obtained by subtracting the range from the satellite altitude, which is

precisely determined relative to a reference ellipsoid. Subtracting from SSH an equipotential surface called the geoid (determined by mass distribution of earth and sea

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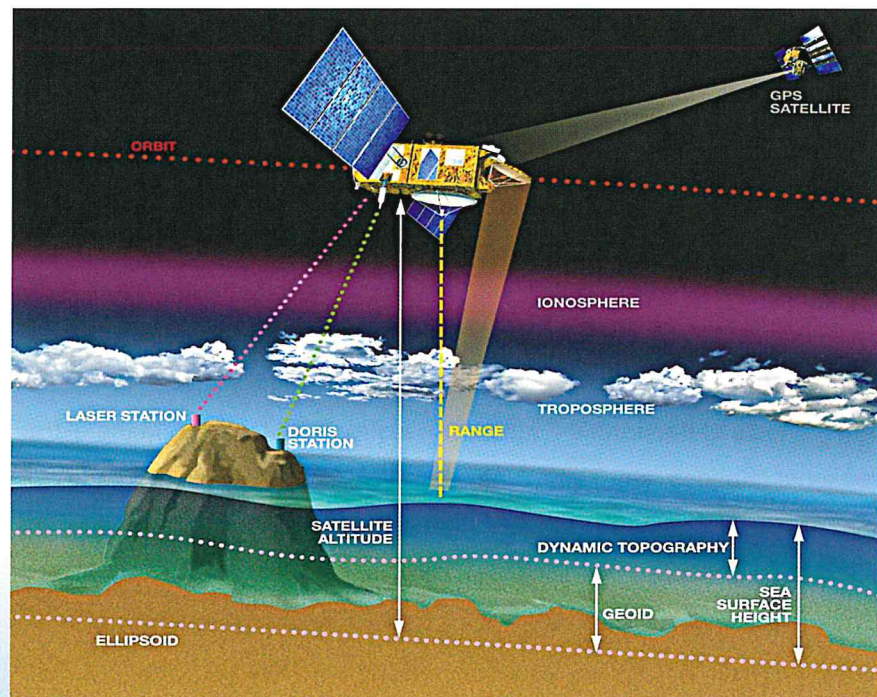


Fig. 1: Principle of sea surface height measurements with satellite altimetry. The picture is borrowed from <http://www.aviso.oceanobs.com>.

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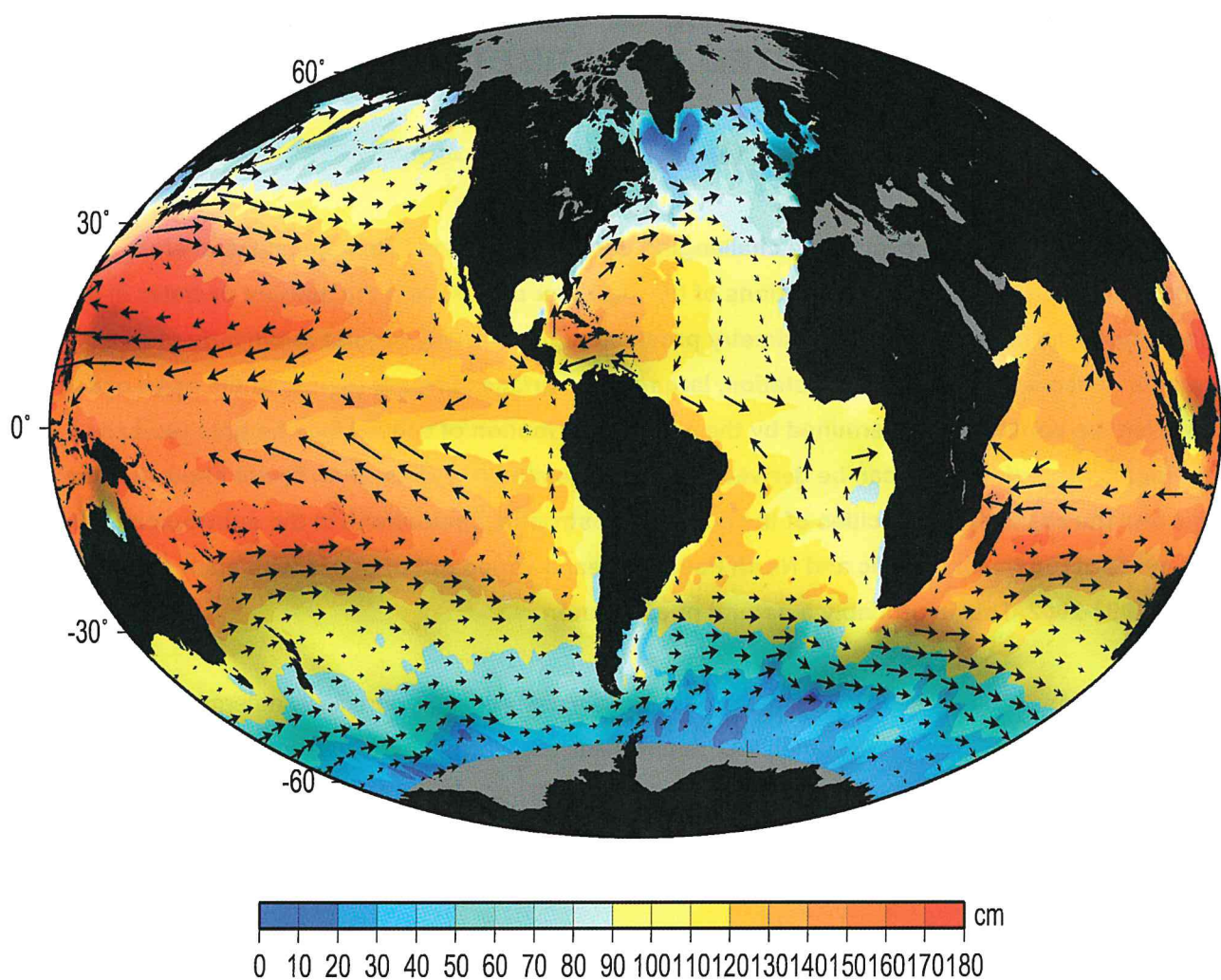


Fig. 2: Global mean dynamic topography and surface geostrophic circulation. Colors indicate mean sea level, see legend. The picture is borrowed from <http://www.aviso.oceanobs.com>.

floor) gives dynamic topography - the sea surface made up by dynamic effects in the ocean (Fig. 2): wind stress, geostrophic currents, effects of the earth's rotation, seasonal changes, etc. The advantage of satellite altimetry over in situ measurements is that satellites provide nearly global observations every 10 days. This allows studying oceanic processes with spatio-temporal scales from oceanic

eddies with diameters in the order of 50 km and larger phenomena.

Here we present decadal trends of sea level and surface geostrophic circulation in the extratropical North Atlantic (NA) and North Pacific (NP) estimated by linear regression from satellite altimetry data for the period from December 1992 to November 2002 (Fig. 3). The observed trends in the NA are substantially different from

those in the NP. In the subpolar and eastern areas of the NA sea level was rising while in the areas of the Gulf Stream and the North Atlantic Current (NAC) it was decreasing. In the NP the decadal increase of sea level occurred in the Kuroshio extension, in the North Pacific Current (NPC), and in the Western Subarctic Gyre. At the same time sea level decreased in the Bering Sea, Alaska gyre and

near the Californian coast. The decadal trends in geostrophic velocities in the NA suggest that the anticlockwise circulation in the subpolar gyre (Labrador Sea and Irminger Basin) and clockwise circulation in the subtropical gyre declined between 1992 and 2002. The geostrophic currents in the Labrador Sea and Irminger Basin decelerated with 2 – 3 cm/s. A slowdown of the geostrophic velocities also occurred in the NAC and in the Gulf Stream. The northern wall of the NAC associated with the Subarctic Front as well as the NAC flow around the Newfoundland Rise decelerated with 2 – 4 cm/s. In contrast to the NA, the decadal trends in geostrophic velocities in the NP showed a strong intensification of the geostrophic flow of the Kuroshio extension around 35°N with 10 cm/s and a 2 – 8 cm/s increase of geostrophic velocities in the NPC. The anticlockwise circulation in the subpolar Alaska

gyre intensified with an increase in geostrophic velocities in the Alaskan Current of about 2 cm/s. Intensification also took place in the California Current where the southward geostrophic flow increased by about 1 – 2 cm/s. An anomalous clockwise geostrophic flow developed in the Western Subarctic Gyre suggesting a deceleration of the Alaskan Stream along the Aleutian Islands and its possible deviation south-westwards.

Thus we conclude that throughout the decade 1992-2002 the subtropical and subpolar gyres of the NA decelerated while the subtropical and subpolar gyres of the NP intensified. A deceleration of a subtropical gyre is associated with a decrease in sea level, an intensification with an increase in sea level. The reverse is the case for the subpolar gyres; i.e. a deceleration of the subpolar gyre is associated with an increase of sea level (intensification with a decreasing

sea level). Previous studies have shown that from 1955 to 1996 sea level was decreasing in the subpolar NA and subtropical NP while it was rising in the subtropical NA and subpolar NP. Therefore, we propose that decadal trends observed in 1992-2002 may be a part of gyre-scale interdecadal oscillations that are not necessarily related to the anthropogenic global change, and thus may be of a natural origin. Based on our observations, we suggest that the subtropical and subpolar gyres of the NA may vary out-of-phase with the subtropical and subpolar gyres of the NP. When the former spin down (sea level rises in the subpolar gyre and decreases in the subtropical gyre), the latter spin up (sea level rises in the subtropical and decreases in the subpolar gyres) and vice versa. We look forward to confirm or refute this hypothesis with longer altimetry records in the future .

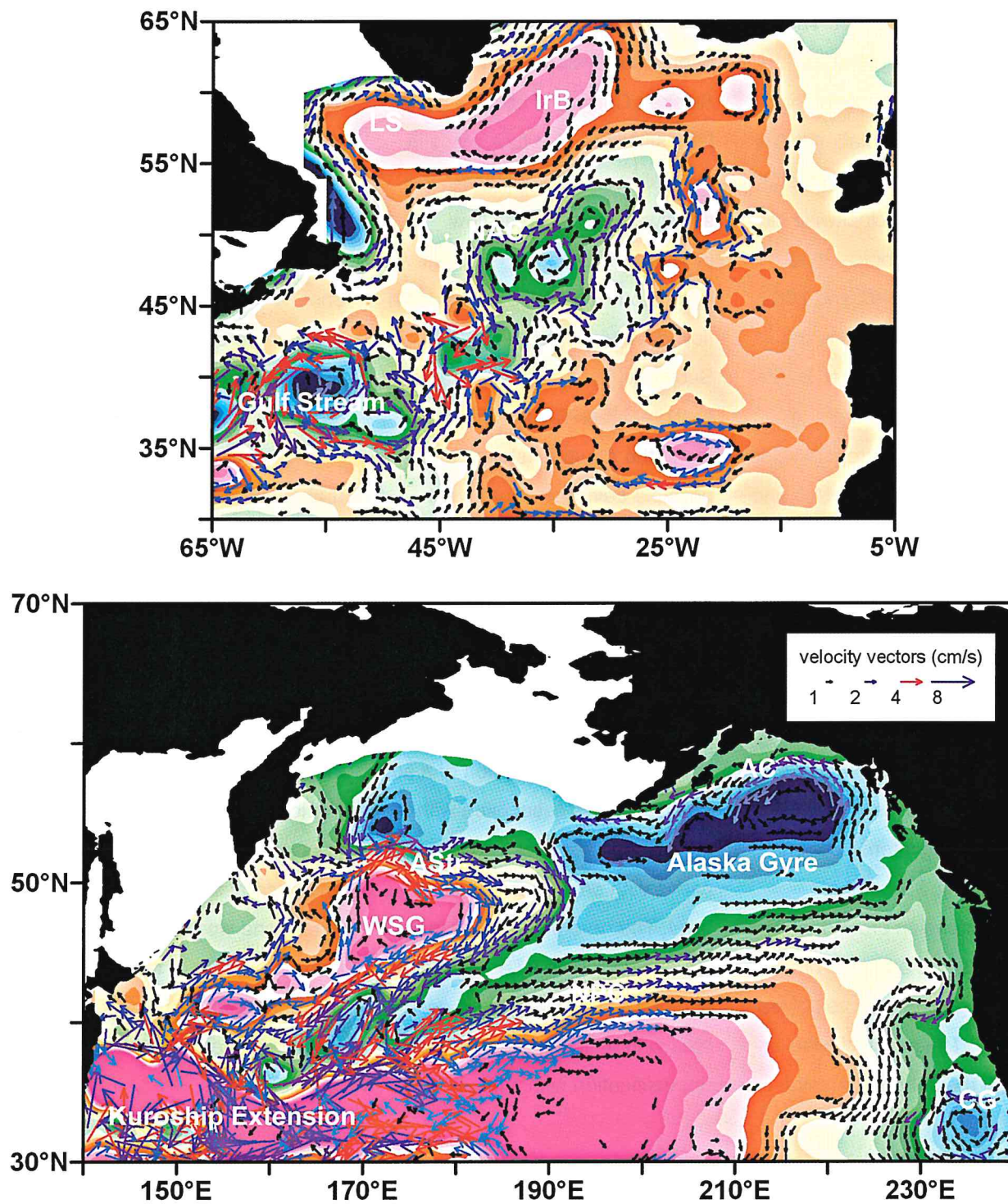
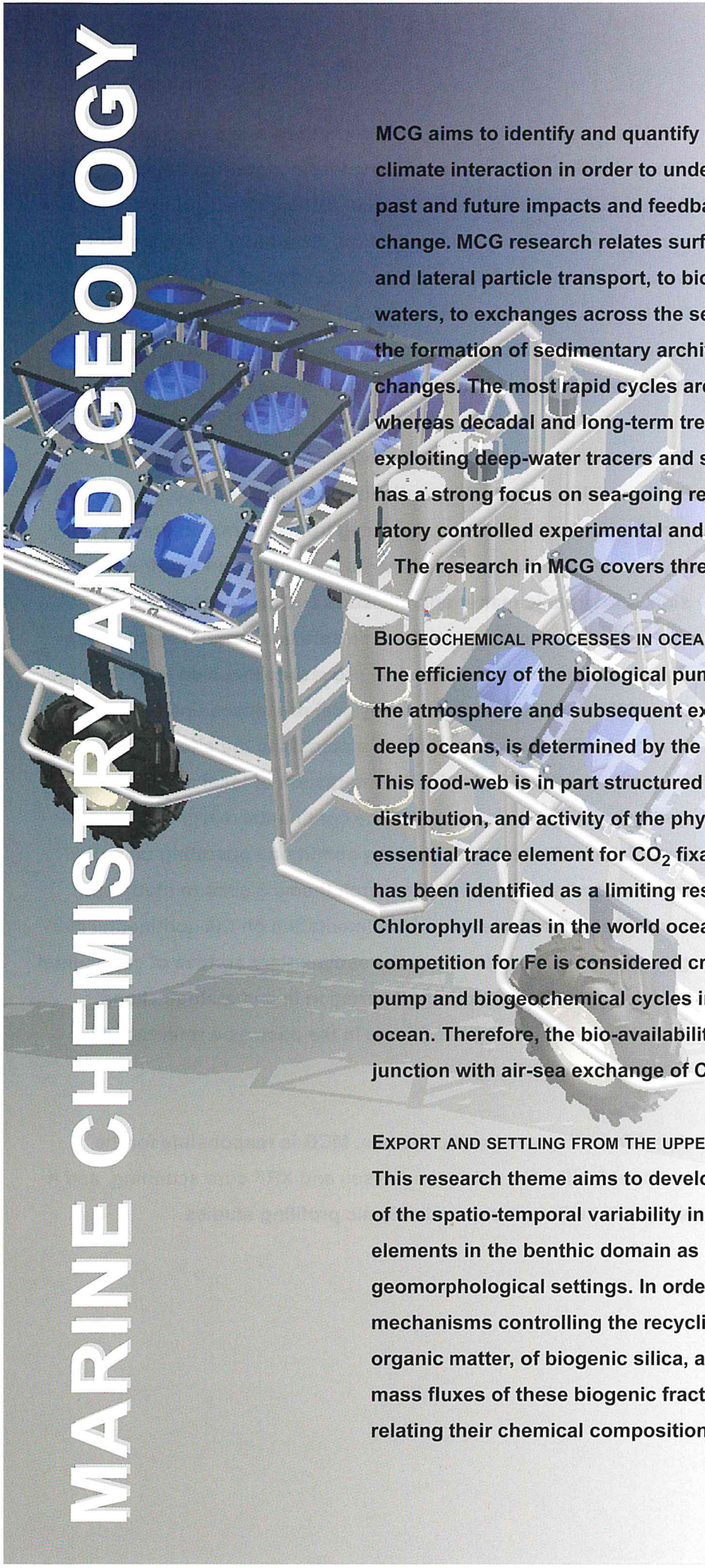


Figure 3: Maps of the geographical distribution of sea level trends (cm) and the derived geostrophic velocity trends (cm/s) over December 1992 – November 2002 in the North Atlantic Ocean (top panel) and in the North Pacific Ocean (bottom panel). The colors indicate the difference in height in cm. Arrows indicate the directions of the surface currents. Abbreviations: North Atlantic: NAC – North Atlantic Current, IrB – Irminger Basin, LS – Labrador Sea North Pacific: NPC – North Pacific Current, CC – California Current, AC – Alaska Current, AStr – Alaskan Stream, WSG – Western Subpolar Gyre.

EXTERNAL PROJECTS OF THE DEPARTMENT OF PHYSICAL OCEANOGRAPHY

- The internal wave field in the arctic ocean (INTAS, EU).
T. Gerkema, L.R.M. Maas
- GYROMED (NWO).
H. Van Haren
- Secondary tides and quasi-periodically forced nonlinear oscillators (NWO-FOM).
L.R.M. Maas, G.M. Terra
- Climatology of deep inertial motions (CLIMA-DIM, NWO).
H. Van Haren
- Integrated North Sea Programme (INP, NWO).
H. Van Haren
- Bay of Biscay Boundary Layers (TripleB, NWO).
H. Van Haren
- Processes of vertical exchange in shelf seas (PROVESS, EC-MAST3).
H. Van Haren
- Processes on the Continental Slope (PROCS, NWO-ALW).
H. Ridderinkhof, H. Van Haren, L.R.M. Maas, P. Hosegood
- Long-term Ocean Climate Observations (LOCO) (NWO-groot).
H. Ridderinkhof, H. Van Haren, L.R.M. Maas, H. Van Aken, J.T.F. Zimmerman, T. Gerkema together with Utrecht University and KNMI
- Outer Delta Dynamics (NWO-ALW).
H. Ridderinkhof, J.T.F. Zimmerman, M. Buijsman
- The transport of suspended particulate matter in the Dutch coastal zone (NWO-LOICZ).
H. Ridderinkhof, L. Merckelbach
- From on-line oceanographic observations to environmental information (FerryBox, 5th FWP of EU).
H. Ridderinkhof, F. Eijgenraam, T. Hillebrand
- Transport and circulation around Madagascar (NWO-ALW).
H. Ridderinkhof, PostDoc to be appointed
- North Atlantic Ocean Monitoring and Modelling (BSIK).
H. Ridderinkhof, H. Van Aken, L.R.M. Maas, H. Van Haren, 2 PhD's to be appointed
- Theoretical analysis of 3D internal and inertial waves (NWO-ALW).
U. Harlander & L.R.M. Maas



MARINE CHEMISTRY AND GEOLOGY

MCG aims to identify and quantify key processes involved in ocean-climate interaction in order to understand, reconstruct and predict past and future impacts and feedbacks of ocean induced climate change. MCG research relates surface ocean processes to vertical and lateral particle transport, to biogeochemistry in deep ocean waters, to exchanges across the sediment water interface, and to the formation of sedimentary archives recording past global changes. The most rapid cycles are resolved by direct observation, whereas decadal and long-term trends and cycles are deciphered by exploiting deep-water tracers and sedimentary archives. Thus, MCG has a strong focus on sea-going research, complemented with laboratory controlled experimental and analytical studies.

The research in MCG covers three major themes.

BIOGEOCHEMICAL PROCESSES IN OCEAN WATERS AND AIR-SEA EXCHANGE.

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

EXPORT AND SETTLING FROM THE UPPER OCEAN AND EARLY DIAGENESIS.

This research theme aims to develop a mechanistic understanding of the spatio-temporal variability in the biogeochemical cycling of elements in the benthic domain as governed by hydrodynamic and geomorphological settings. In order to identify the conditions and mechanisms controlling the recycling/preservation balance of organic matter, of biogenic silica, and of carbonates, studies on mass fluxes of these biogenic fractions are combined with studies relating their chemical composition to reactivity.

Primary data on hydrodynamic conditions and associated deposition and rebound fluxes are obtained from moorings equipped with (high-resolution) sediment traps, current profilers and turbidity sensors, whereas rates of mineralization, dissolution and sediment-water exchange are measured by application of autonomous benthic landers and pore water and solid phase analyses. Element budgets are constructed by applying numerical models, coupling the relevant diagenetic and transport processes.

SEDIMENTATION AND PALEOCEANOGRAPHY.

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

Apart from these scientific themes, MCG is responsible for the national facility for nutrient analyses and XRF core scanning, and it supports sediment trap and seismic profiling studies.

KEY PROCESSES CONTROLLING BIOGENIC SILICA PRESERVATION IN MARINE SEDIMENTS

Erica Koning* & Eric Epping

Diatoms, accounting for >40% of global marine primary production, are ideal tracers for upwelling and water mass transport since their productivity is tightly coupled to the 'new supply' of nutrients. The geological record of biogenic silica is therefore believed to reflect past climatic conditions and the paleoproductivity of diatoms. Although a substantial part of the biogenic silica dissolves in the water column, biogenic silica can be traced in sediments that are several 100,000 years old, suggesting effective preservation upon arrival at the sea floor.

Until recently it was believed that preservation of biogenic silica is a passive process. Settling diatom frustules would dissolve as long as they were in contact with corrosive, undersaturated bottom waters. In the sediment, dissolution would continue until thermodynamic equilibrium between the biogenic silica solid phase and the pore water was reached. Our studies however have suggested that preservation is an active process that takes place on the sediment-water interface, where solute exchange is governed by molecular diffusion. The prolonged contact between the biogenic silica solid phase and the elevated solute concentrations in the pore water, notably dissolved metals and specifically aluminium, will promote the diagenetic alteration of the biogenic silica, lower its solubility and dissolution rate and will favor preservation over

dissolution. Little is known about the rates at which these diagenetic alterations take place and which source supplies the aluminium needed for the reaction to take place.

In a series of experiments, early diagenetic processes that could occur at conditions typical for the sediment-water interface have

been simulated in the laboratory, with emphasis on the role of aluminium. To ensure the absence of any previous diagenetic alterations, all experiments were carried out using the most pristine biogenic silica possible: fresh, cultured diatoms that have not been in contact with any sedimentary component. These diatoms

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The cultured diatom *Thalassiosira punctigera* used for the experiments.

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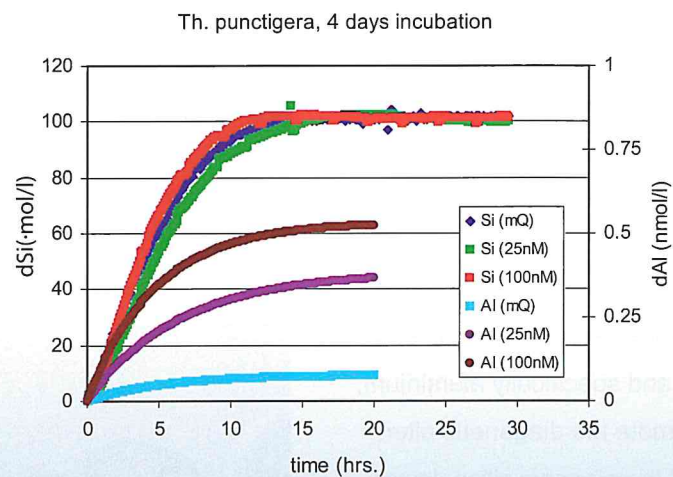


Incubation of diatom frustules of *Thalassiosira punctigera* in natural seawater at increasing concentrations of dissolved aluminium.

were incubated, at controlled temperature and pH conditions, in filtered natural, low-nutrient seawater containing a range of dissolved silica and/or dissolved aluminium concentrations representative for natural pore waters. Within only a few days of incubation, uptake of aluminium could be recorded in the diatom frustules. This aluminium had not been adsorbed on the outer surface but had been incor-

porated into the biogenic silica lattice. These results suggest that even a small flux of dissolved aluminium diffusing from the pore waters would be sufficient to rapidly induce the diagenetic alteration of biogenic silica. Such an efficient

uptake mechanism could result in efficient preservation of biogenic silica in larger areas of the ocean and would not be restricted to tropical estuaries where rivers eroding a tropical hinterland supply the aluminium.



Time series of dissolution of *Thalassiosira punctigera* after 4 days of incubation in seawater with different levels of added dissolved aluminium, showing the uptake of aluminium into the biogenic silica solid phase.

CORALS AS MONITOR OF SEASONAL RAINFALL AND CLIMATIC CHANGE

Gert D. van den Bergh*, Wim Boer, Stephanie A. Verbeek & Geert-Jan Brummer

This project was a pilot study to investigate the suitability of *Porites* coral colonies in the Berau Delta/Barrier Reef System (East Kalimantan, Indonesia) as a monitor for local and regional climatic changes on a centennial time scale.

The Berau Delta/Barrier Reef system offers a unique setting with a range of shallow marine environments from turbid near-coastal estuarine through lagoonal to open oceanic and shelf edge reef conditions. Although the Berau coastal region still has a number of pristine characteristics, it is obvious that the fragile balance between natural dynamics of the system and the impact of anthropogenic effects, such as forest clearance and fishing, is easily disturbed. During the last decades Kalimantan has been increasingly subject to severe periods of draught and forest fires, in particular during El Niño years. The anthropogenic and natural changes may have an effect on the health of coral reefs, e.g. by increased sediment loads supplied by the Berau River. In order to assess the possible effects of these changes on the reef ecosystems, it is necessary to know the natural variation and changes of a number of crucial parameters over

an extended period in the past. Living colonies of *Porites* spp, which occur from near shore to shelf edge environments within the Berau area, can provide this information.

Proxy analysis of banded *Porites* corals is widely used as a high-resolution tool for reconstructing environmental variability, notably fluctuations in Sea Surface Temperature (SST), salinity, productivity and run-off. In order to investigate the feasibility of such studies along the East coast of Kalimantan, 41 cores of up to 40 cm long were drilled in

Porites colonies from 14 sites (Fig. 1). A selection of these cores was used for a number of proxy analysis: δO^{18} (SST + salinity), δC^{13} (~productivity), Sr/Ca ratio, Mg/Ca ratio and U/Ca ratio (SST), Ba/Ca ratio and quantification of fluorescent banding patterns (~ river run-off & rain-fall). X-ray photographs were made in order to record (seasonal) variability in density of the aragonite coral skeleton. The δO^{18} and δC^{13} were analyzed at the Vrije Universiteit Amsterdam (VU). Trace elements were measured at NIOZ by an intensity ratio calibra-

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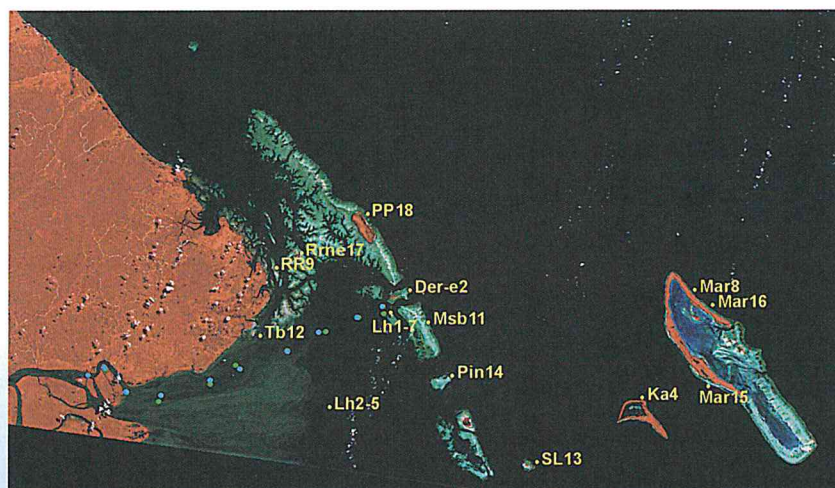


Fig. 1. Satellite image of the Berau Eastuary/Barrier Reef System with the 14 sampling locations of *Porites* spp cores.

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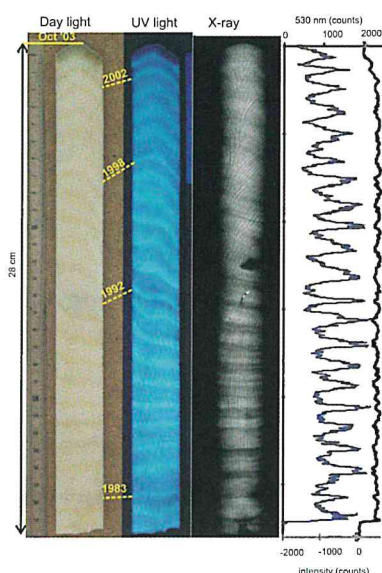


Fig. 2. Daylight, UV, X-ray images and the corresponding luminescence record of a coral core from locality RR-9. Note that the El Niño years (in yellow), are characterized by weakly developed luminescent bands.

tion method on a HR-ICP-MS (ThermoFinnegan, Element-2). Luminescence measurements were obtained at VU at a resolution of 10 measurements per mm.

δC^{13} is usually found to be inversely related to photosynthetic activity of the zooxanthellae symbionts, unicellular algae that support skeletal growth of their coral host. In the Berau area, in particular in near-shore corals, this proxy was found inversely related to local rainfall (~river discharge) records, suggesting that during the wet season, photosynthetic activity decreases. The Ba/Ca ratio and luminescence on the other hand, were found positively related to rainfall. This correspondence is

better developed in the near-shore samples from relatively turbid waters. During dry El Niño years, when river run-off is limited, luminescence peaks are clearly weaker developed than during non El Niño years (Fig. 2). The δO^{18} is inversely related to SST, but shows poor correlation with other SST proxies and air temperature records, because of strong fluctuations in salinity. The Sr/Ca ratio on the other hand, shows a strong correlation with the Southern Oscillation Index (SOI) and local air temperature records (Fig. 3).

The study has shown that *Porites* spp. colonies from the Berau area are excellent monitors of environmental and climatic change. Moreover, *in situ* time-

series measurements of environmental parameters (SST, turbidity, salinity) and meteorological data, in combination with dyeing of living coral surfaces, could allow for calibration of the various proxy signals. Cores obtained from large *Porites* spp colonies present in the area, will enable the reconstruction of fluctuations in frequency and intensity of ENSO cycles and local environmental trends over hundreds of years. Quantification of the luminescence records can provide a tool for establishing temporal changes in sediment supply to the Berau reef setting, which constitutes important information for environmental studies and CZM purposes.

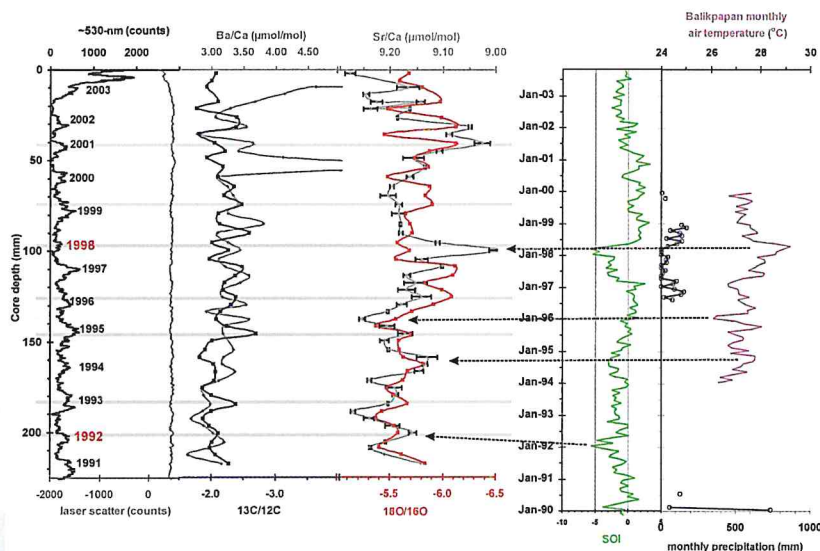


Fig. 3. Correlation of various proxy records from locality SL-13 (Fig. 1) and correspondence with the Southern Oscillation Index (SOI) and local climatic record (incomplete) to the right. Disproportional values at the top are caused by the presence of coral tissue. During dry El Niño years (in red) luminescence peaks are weaker developed. The Sr/Ca ratio, shows an excellent match with the Balikpapan monthly air temperature data.

PHOTO-INDUCED REDOX-CYCLING OF IRON IN SOUTHERN OCEAN WATERS

Micha Rijkenberg, Loes Gerringa, Klaas Timmermans & Hein de Baar*

Iron (Fe) is a biological active element. The bio-availability of Fe is not simply a matter of concentration, but is especially depending on its chemical form. In order to better understand the limitation of iron on phytoplankton growth in high-nutrient-low-chlorophyll regions such as the Southern Ocean we investigated the effect of solar radiation on the chemistry and bioavailability of Fe. The project shows that light in concert with the chemical form of Fe plays an important role in the photoreduction and subsequent bio-availability of Fe. Moreover, the results suggest that diatoms can increase the photo-reduction of Fe(III).

The redox-cycling of iron (i.e. the interconversion of Fe^{3+} (Fe(III)) and Fe^{2+} (Fe(II))) is supported by photochemical processes which potentially increases the bio-availability of Fe. To investigate the impact of enhanced ultraviolet B (UVB: 280-315 nm) on the photo-production of Fe(II) we determined the effect of the wavelength of light

(nm^{-1}). On board of the Polarstern (Fig. 1), deck-incubations already showed that UVB was the most effective wavelength region responsible for initiating the Fe redox-cycle (Fig. 2). Our results show that throughout the year, and even under ozone depleted conditions, the role of UVB in the photo induced redox-cycle of Fe is of

minor importance for the improvement of the bio-availability of Fe for phytoplankton in the Southern Ocean (Fig. 3).

Up to 99% of the dissolved Fe in the oceans is bound by dissolved organic molecules (ligands). Three of these naturally occurring molecules were found to influence the photo-production of Fe(II) (Fig. 4). Desferrioxamine B (a marine Fe binding molecule) decreased the photo-production of Fe(II). Moreover, it binds re-oxidized Fe(III) thus prevents the precipitation and transformation of Fe into a more reactive biological available fraction. In contrast, phytic acid (a metal complexing storage compound in terrestrial plants found in river run off) increased the photo-



Fig. 1. Research vessel "Polarstern".

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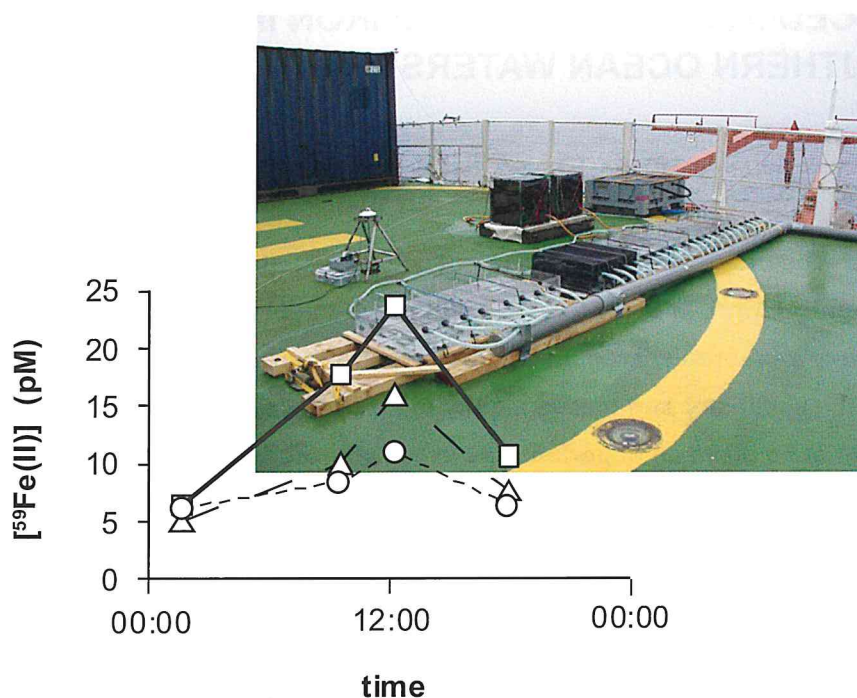


Fig. 2 The daily cycle of the concentration Fe(II) (pM) under three different light conditions, UVB+UVA+VIS ($\square$), UVA+VIS ($\triangle$) and VIS ($\circ$) (UVA: 315–400 nm, VIS: 400–700 nm) as measured with deck-incubations in the Southern Ocean. The background shows the incubator on the helicopter deck of the German research vessel Polarstern.

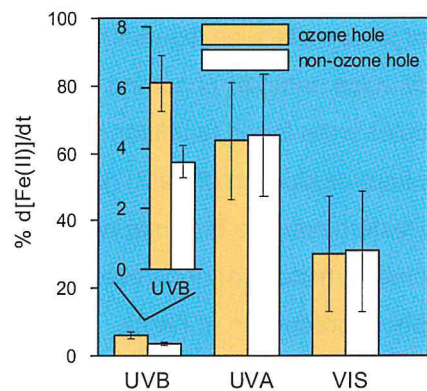


Fig. 3 The wavelength band dependent Fe(II) photo-production as percentage of the photo-production due to the total spectrum under ozone hole conditions (23 Sept. 2000) and under non-ozone hole conditions (9 Nov. 2000) at Palmer station.

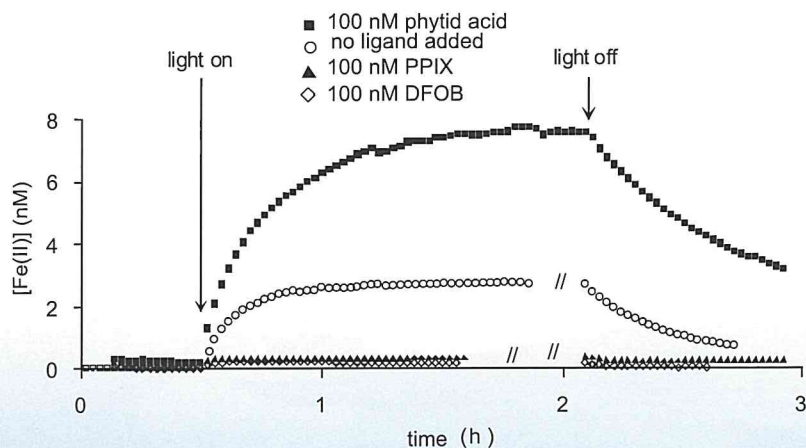


Fig. 4 The photo-production of Fe(II) without ligands added, and with 100 nM phytid acid, 100 nM protoporphyrin IX (PPIX) and 100 nM desferrioxamine B (DFOB) added. The Fe(III) (100 nM) was added to the Southern Ocean seawater before the experiments.

production of Fe(II) . It increased the Fe fraction available for photo-reduction by influencing the precipitation of Fe. Protoporphyrin IX (PPIX) (representing ligands derived from the breakdown of phytoplankton photopigments, e.g. chlorophyll *a*) decreased the Fe(II) concentration by the binding of Fe(II) . Yet, in a light driven catalytic process Fe(II)PPIX produced superoxide (O_2^-) and free radical ligand species which reduced Fe(III) to Fe(II) , even in the dark. The findings with PPIX are most relevant, because in open oceanic waters Fe is present bound to porphyrin-related molecules.

The natural organic Fe binding molecules in Dutch coastal seawater were insensitive for degradation due to UVA (315–400 nm) and

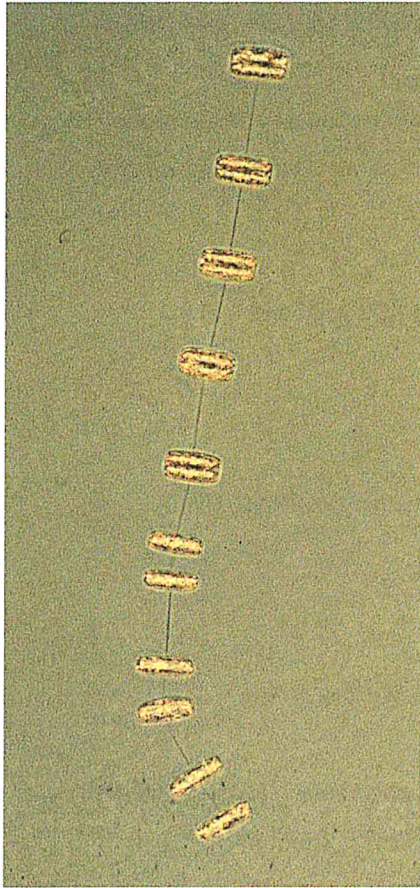


Fig. 5 *Thalassiosira* sp., an Antarctic open ocean and chain forming diatom with a cell length of $\sim 70 \mu\text{m}$.

UVB. Although the organically complexed Fe concentration was high (24.4 nM), the Fe(II) concentrations upon irradiance stayed very low ($< 240 \text{ pM Fe(II)}$). The Fe(II) production showed a similar pattern as the Fe(II) production from inorganic Fe colloids. These observations suggest that the Fe(II) originates mainly from the inorganic colloidal Fe fraction.

Photo-production of Fe(II) was also studied in the presence of two Southern Ocean diatoms, *Thalassiosira* sp. (Fig. 5) and *Chaetoceros brevis*. Both diatoms species increased the amount of photo-reducible Fe by releasing organic substances and thus

increasing the Fe(II) concentration. Moreover, *Chaetoceros brevis* transformed strong Fe binding molecules to weaker Fe binding molecules, thus also increasing the potential biological availability of Fe. Thus phytoplankton themselves influence the Fe chemistry. They can do that even with the use of light.

EXTERNAL PROJECTS OF THE DEPARTMENT OF MARINE CHEMISTRY AND GEOLOGY

- Positive feedback of enhanced UV-B via iron chemistry of sea water on phytoplankton growth and CO₂ fixation in the Southern Ocean. Project code: 851.20.004.

Prof. Dr. Ir. H.J.W. de Baar.

- Strataformation on the European margin (STRATAFORM, EU).

H. de Stigter, T.C.E. van Weering.

- Canyons (NEBROC, NWO, EU).

T.C.E. van Weering, H. de Stigter.

- Paleooceanography of the N.E. Atlantic margin (NEBROC, NWO).

T.C.E. van Weering, T. Richter.

- Past Climate Variability (PACLIVA, EU).

T. Richter, T.C.E. van Weering.

- European Seafloor Observatory Network (ESONET, EU).

T.C.E. van Weering, H. de Haas.

- Forcing of carbonate mounds and deep water coral reefs along the NW European continental margin (MOUNDFORCE, ESF/NWO).

T.C.E. van Weering, H. de Haas, F. Mienis.

- Mixing of Agulhas Rings Experiment: Palaeoceanographic observations of the Agulhas Ring Corridor (NWO-CLIVAR).

G.-J.A. Brummer, J.H.F. Jansen.

- Carbonate Chemistry, Carbon Cycle and Climate Change: a multidisciplinary view (6C, 5th FWP of EU).

G.-J.A. Brummer, S. Schouten.

- Divalent cations: development and validation of proxies, from empirism towards a mechanistic understanding (NWO-DFG Bilateral Cooperation Programme).

G.-J.A. Brummer, R.P.M. Bak.

- Rockall Channel Studies (ROCS; NWO).

H. van Haren, G.-J.A. Brummer (W. van Raaphorst).

- East Kalimantan Programme for Coastal Zone Research Netherlands-Indonesia, Pilot Phase (WOTRO/KNAW/ICOMAR).

G. van den Bergh, G.-J.A. Brummer, T.C.E. van Weering.

- Variability of Atlantic Meridional Overturning Circulation (VAMOC, NERC-NWO-RCN trilateral programme RAPID).

G.-J.A. Brummer, T.C.E. van Weering, H. van Aken.

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

- * Which organic compounds are present in the different compartments (biota, water, sediments) of the marine environment and what is their origin?
- * What is their biochemical role in marine organisms, or, in case of anthropogenic components, what are their toxic effects?
- * Which reactions (e.g. biotransformation and diagenesis) affect these components during transport in the marine environment? How are these reactions affected by environmental conditions and on which time scales? What can these components tell us on the biogeochemical cycling of carbon, nitrogen and sulfur in the ocean?
- * What can be learned from organic matter deposited in marine sediments with respect to marine evolution, the functioning of past marine ecosystems, climate variability and organic carbon burial?

The research of MBT is divided into two departmental themes; Marine Biogeochemistry and Marine Toxicology.

In 2004, the advanced equipment for the determination of polar lipids in the marine water column and sediments, the LC-triple-quadrupole MS, acquired in 2003 through the ALW "Middelgroot" program, became operational and generated the first scientific results. Cruises to the North Sea for the LOICZ "Archaeal carbon fixation" project (April and August 2004) and the Euromargin MIMES (Multiscale Investigations of Eastern Mediterranean Seep Systems) expedition (June/July 2004), to investigate seafloor seeps and mud volcanoes in the Nile Deep Sea Fan (eastern Mediterranean Sea), turned out to be successful. Our most outstanding scientific achievement in 2004 was the Spinoza price, 1.5 million Euro for research and a bronze statue of the Dutch philosopher Spinoza, awarded by the Dutch Organization for Scientific Research (NWO) to our department head, Jaap Sinninghe Damsté. The NWO-Spinoza prize, which some regard as the 'Dutch Nobel Prize', is awarded to Dutch scientists who are at the very top of the research profession. The laureates are internationally renowned and are an inspiration to young scientists. Every year, 3 to 4 scientists are selected from all

fields of sciences. Another substantial achievement was that Marco Coolen obtained a VENI grant from NWO for his work on fossil DNA in marine sediments. The VENI grant is a personal grant for young scientist with a great potential. Other outstanding scientific results of 2004 were the publication of a Science and a Nature with strong involvement of MBT. The Science paper was a direct product of the STW funded project on lipids of marine diatoms, which ended in 2003. It showed how a combination of molecular phylogeny, lipid biochemistry and molecular palaeontology can aid in much more accurate molecular clock calibrations. The Nature paper was a direct product from the recent MBT research in the development of a new palaeotemperature proxy for sea surface temperatures based on archaeal lipids, the so-called TEX86 index. In the Nature paper this method was used, in collaboration with researchers from the University of Oxford, to determine palaeotemperatures of the Arctic Ocean 70 million year ago. An astoundingly high temperature of ca. 15°C was found, an apparent consequence of the severe greenhouse conditions at that time.

In the Environmental Chemistry and Toxicology branch of the department, the emphasis lay on the development of the analysis of chlorofluorocarbons (CFCs) and the brominated flame retardant HexaBromoCycloDodecane (HBCD). Our future major aim is to use CFCs and other halogenated hydrocarbons as tracers for different water masses in the open ocean in co-operation with the department of Physical Oceanography. Efforts were extended to measure concentrations of dissolved hydrophobic chemicals in the femtomolar concentration range, using passive sampling devices in remote areas. To this aim, several of these samplers were mounted on moorings that were deployed in the Atlantic Ocean and Strait Mozambique within the LOCO project. Of the brominated flame retardants, we concentrated on the bioaccumulation of HBCD in marine mammals and fish. Of the three diastereomers in the commercial mixture, only α -HBCD bioaccumulates at the top of the food web (EU project BIOCET). We could show with in vitro assays with liver microsomes of mammals and fish, that enzyme-mediated biotransformation by the cytochrome P450 system is a major factor in this behaviour (EU project FIRE).

A more detailed account of the results of the projects that ended in 2004 is given on the following pages.

BLACK SHALE DEPOSITION DURING OCEANIC ANOXIC EVENTS IN THE CRETACEOUS:

a feed-back mechanism of the global carbon cycle to reduce extremely high levels of atmospheric CO₂?

Astrid Forster, Marianne Baas & Jaap S. Sinninghe Damsté.*

The mid-Cretaceous represents a time in Earth-history that is in a strong contrast to the present-day situation. Globally, temperatures were much higher and the sea-level was elevated to a maximum of about 250 m above today's level. At the same time, intensified volcanism and oceanic crust production occurred. These geologic processes released large amounts of "Greenhouse" gases, such as carbon dioxide (CO₂). The warm Cretaceous climate has been linked to high levels of atmospheric CO₂. Presently, it becomes more and more evident that the Earth's climate is warming and that this phenomenon of "global change" is paralleled by an increase in atmospheric CO₂-concentrations. Little is still known about the relation between both processes and how fast and strong the Earth's climate system is responding. Mid-Cretaceous marine sedimentary deposits offer an excellent archive of the conditions during this ancient "Greenhouse" and the possible feedback-mechanisms that could have compensated for high CO₂-levels in the atmosphere. We think that "Oceanic Anoxic Events" represent such counter-balancing processes that could have cooled the planet during the Cretaceous "Greenhouse".

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The international scientific network program C/T-NET chose to investigate one of the most prominent Cretaceous events reflecting a

massive perturbation of the global carbon cycle. World-wide, this event became evident by the deposition of sediments that are

extraordinarily rich in organic matter (Fig. 1). The deposition of this specific black shale layer took place in a wide range of marine settings about 93.5 million years ago at the Cenomanian/Turonian boundary (Fig. 2). The C/T-boundary event is one of several globally traceable events of marine black shale deposition that occurred during the mid-Cretaceous. They were termed "Oceanic Anoxic Events" (OAEs) because these events represent periods of oxygen-crises in extraordinary warm oceans and shallow seas. This is in strong contrast to today's generally well

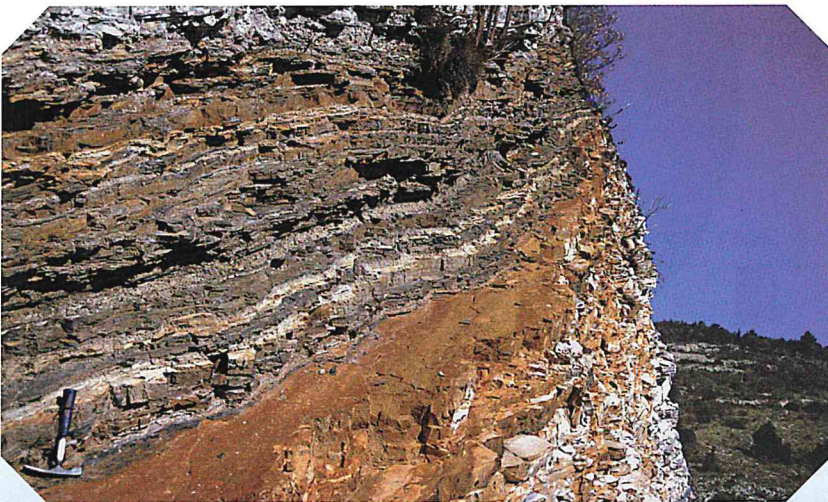


Fig. 1. Outcrop section of the Livello Bonarelli sediment near Furlo. This 1-m-thick interval consists of organic-rich and carbonate-free marine black shales, intercalated with light coloured layers of radiolarian sands.

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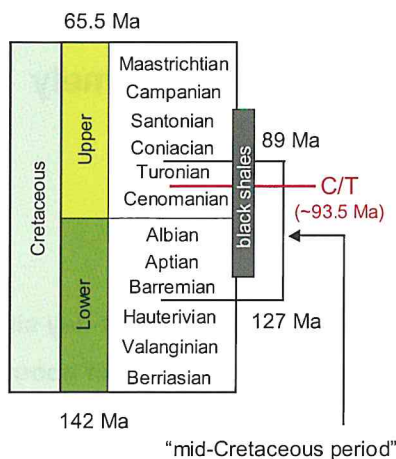


Fig. 2. Stratigraphic setting of the Cenomanian/Turonian Oceanic Anoxic Event (OAE 2).

mixed and oxygenated oceans and shelf seas, where almost all organic matter produced by phytoplankton is recycled and oxidized. An essential condition for the formation of organic matter-rich sediments such as black shales, is the long-term depletion of oxygen in the marine bottom waters and the sediment itself. Such "anoxic" conditions can be either established by a widely restricted water circulation or extremely high rates of phytoplankton production in the surface waters – or a combination of both. The Cenomanian/Turonian "Oceanic Anoxic Event" (OAE 2) had a strong impact on the Earth's oceans and atmosphere. Firstly, the event caused a severe biotic crisis so that numerous species of marine organisms became extinct. Secondly, the massive deposition of organic matter in black shales

during the OAE 2 (Fig 3) caused a depletion of the global atmospheric carbon reservoir in the light (^{12}C) versus the heavy (^{13}C) stable carbon isotope, which is documented by a pronounced carbon-isotope anomaly in these sediments. We investigated this characteristic geochemical "fingerprint" of the OAE 2 in high resolution by generating so called compound specific $\delta^{13}\text{C}$ -records*. These records are based on stable carbon isotope analysis of selected geochemical molecular fossils (biomarkers) preserved in the anoxic black shales. In combination with other C/T-NET datasets these isotopic records enabled us to precisely define and

compare the event at different key-locations in the world (Fig. 3.). Furthermore, we used indicative fossil molecular compounds to reconstruct the local environmental conditions that favored the deposition of black shales at these sites. The framework established by the C/T-NET has led to two follow-up research projects at NIOZ on the reduction in atmospheric CO_2 concentrations and the timing and magnitude of the global cooling during the OAE 2.

This work was supported by the European Community's Improving Human Potential Program under contract HPRN-CT-1999-00055, C/T-NET.

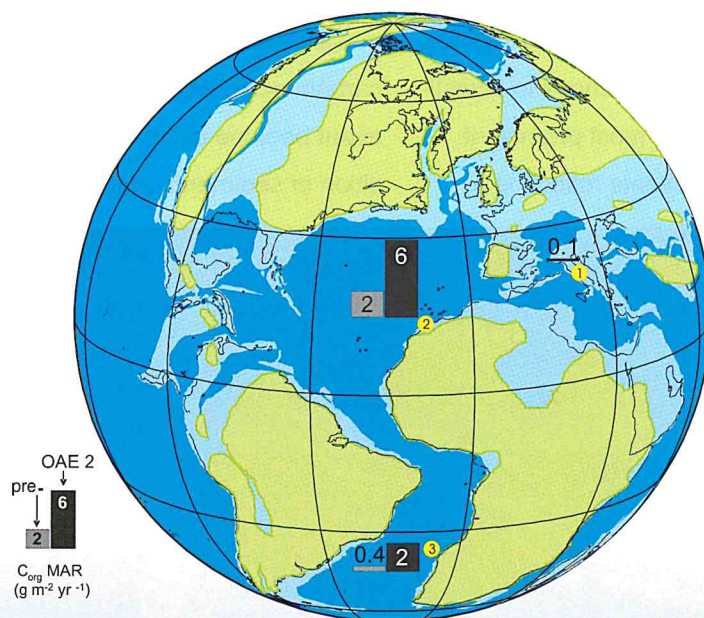


Fig. 3. Paleogeographic setting of the Cenomanian/Turonian Oceanic Anoxic Event (OAE 2) 93.5Ma. Green=Land, Light blue=shallow sea, dark blue= deep sea. We have investigated sections of Livello Bonarelli, Italy ①, the Tarfaya Coastal Basin, Morocco ②, and Site 530 of the Deep Sea Drilling Programme ③. The bar diagrams indicate the difference in organic carbon sedimentation rates (in $\text{g m}^{-2} \text{ yr}^{-1}$) before (grey bars) and during the OAE 2 (black bars).

*an explanation of the $\delta^{13}\text{C}$ concept is given in the contribution of Y. van Breughel et al.

LEVELS OF PERSISTENT ORGANIC POLLUTANTS IN EUROPEAN SEAS: A THREAT FOR HARBOUR PORPOISE AND COMMON DOLPHIN POPULATIONS?

Jan Boon*, Bart Zegers, Annelique Mets & Ronald van Bommel

The European project BIO CET¹ has discovered that by far the highest levels of the relatively 'new' flame retardant hexabromocyclododecane (HBCD) were found in harbour porpoises from the Irish Sea and the Northwest coast of Scotland. However, only the α -isomer of HBCD bioaccumulated in blubber of common dolphin and harbour porpoise. High levels of PCBs occurred in harbour porpoises from Dutch waters and in common dolphins from the English Channel. These levels were above threshold concentrations reported to cause effects on reproduction in marine mammals.

Research groups from Scotland, Ireland, France, the Netherlands, Belgium and Spain were involved in this study funded by the Energy, Environment and Sustainable Development programme of the European Commission. The work was based on analysis of samples from harbour porpoise (*Phocoena phocoena*) and common dolphin (*Delphinus delphis*; fig.1) found dead on the coast, and also looked at the possible causes and consequences of the pollutant levels.

The three-year study aimed at quantifying levels of persistent organic pollutants (POPs) and heavy metals in harbour porpoises and common dolphins stranded on the coasts of different European seas (fig. 2). NIOZ was responsible for the analysis of all POPs in this project.

The most interesting results were obtained on the occurrence of a

particular class of brominated flame retardants (BFRs) in porpoises. This is hexabromocyclododecane (HBCD), which has a high production volume within the EU; 9500 tons was produced in 2001. This BFR is often used in insulation material for the building industry. By far the highest HBCD levels occurred in harbour porpoises

stranded on the coasts of the Irish Sea (median value 2.9 microgram per (μg) gram lipid) and on the Northwest coast of Scotland (5.1 $\mu\text{g g}^{-1}$ lipid).

Commercial HBCD consists of three very similar compounds, called isomers. In all commercial mixtures one of them, the γ -isomer, makes up 70% of the total and

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Fig. 1. Common dolphin (*Delphinus delphis*) Photo: Alfredo López, CEMMA, Spain.

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¹ BIO CET: Bioaccumulation of persistent organic pollutants in small cetaceans in European waters: Transport pathways and impact on reproduction. Project coordinated by the university of Aberdeen. More information at www.abdn.ac.uk/biocet/.

dominates over the other two (α - and β -HBCD). To our surprise, all residues in harbour porpoise and common dolphin contained exclusively α -HBCD. Probably, biotransformation of the β - and γ -isomers by the cytochrome P450 enzyme system plays a role in their removal. We will investigate this in the current EU project FIRE, which is entirely devoted to the environmental fate and endocrine effects of brominated flame retardants.

The contribution of HBCD to adverse effects is still uncertain, since much less is known about these emerging chemicals than about the classical organochlorines such as PCBs and DDT.

The highest levels of PCBs were found in harbour porpoises from Dutch waters and common dolphins from the English Channel. These levels were above $15 \mu\text{g g}^{-1}$ lipid and thereby high enough to have an impact on reproduction via disruption of hormonal processes. Evidence collected on pregnancy rates suggests that the reproductive rate in Dutch porpoises is considerably lower than elsewhere in Europe. Although this fits with their high PCB levels, Dutch porpoises also carry the *Brucella* bacterium. Although its effects in cetaceans are unknown, *Brucella* can cause

the first pregnancy to end in an abortion in cattle.

Polybrominated diphenyl ethers (PBDEs) represent another class of brominated flame retardants. Five PBDE congeners were found in all samples (BDEs 47, 99, 100, 153, 154); they were all tetra- to hexa brominated compounds that are also major constituents of the commercial penta-BDE mixture, which has just been banned for further use in the EU after 2008. Of the commercial mixtures, penta-BDE is the mixture with the lowest degree of bromination, but also the most toxic one. The currently most

often used commercial PBDE mixture is deca-BDE, which consists for more than 98% of one compound, the fully brominated deca-BDE congener (BDE209). This bulky molecule was never detected in the set of BIOCET samples, although it often dominated over the penta-BDE compounds in sediments from the area. The differences in levels between different seas for the PBDEs and the DDT metabolite DDE were smaller than for the PCBs and HBCD, and regional differences in the toxic effects of these compounds are therefore unlikely.

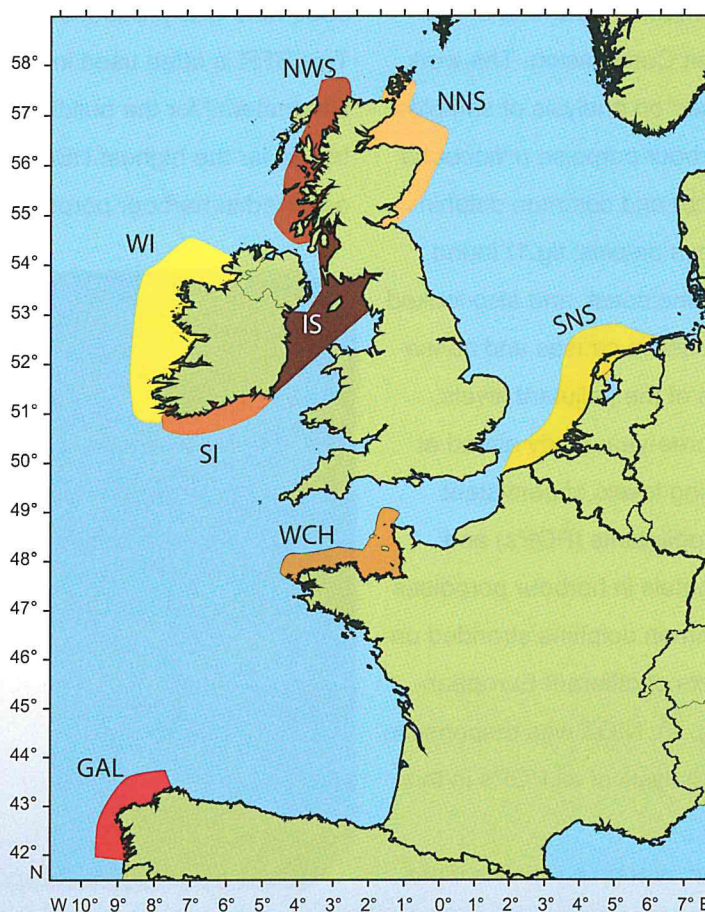


Fig. 2. Sampling areas for stranded cetaceans in the BIOCET project.

THE TEX₈₆ INDEX IS A NEW TOOL TO RECONSTRUCT ANCIENT SEA SURFACE TEMPERATURES

Cornelia Wuchter, Stefan Schouten & Jaap S. Sinninghe Damsté*

When we want to understand better what to expect in the future, we have to learn from the past. This is also true for the present change in our climate. To do this, we use organic compounds preserved in sediments from ancient microbial communities. The structures of the compounds give information about the environment in which the organisms possessing these compounds lived. One of the most crucial factors is the reconstruction of past sea surface temperatures (SST). Some groups of compounds that are part of the cell membranes of organisms adapt their molecular structure in order to maintain similar membrane properties over a range of water temperatures. When these changes can be calibrated experimentally with cultivated living organisms, it becomes possible to reconstruct records of palaeotemperatures from dated sediment cores. Here we present our newly developed TEX₈₆ index (TEX₈₆=Tetra Ether Index of lipids with 86 carbon atoms), which is based on the tetra-ether lipids from the cell membranes of a particular branch of Archaea: the marine Crenarchaeota.

Marine Crenarchaeota are Prokaryotes that belong to the domain of Archaea. Recent molecular biological work showed that the group of the marine Crenarchaeota is ubiquitously distributed and comprises ca. 20% of the picoplankton in the world's oceans. The membrane lipids of marine Crenarchaeota consist of a unique group of compounds: the glycerol dibiphytanyl glycerol tetraethers (GDGTs, Fig 1). Culture experiments have shown that the hyperthermophilic Crenarchaeota, which live at temperatures of 60–100°C, change their relative distribution of the (5 carbon) cyclopentane rings in their membrane lipids as a function to temperature. With

this mechanism, they keep the properties of their cell-membrane constant over a range of temperatures. For the adaptation of the marine Crenarchaeota to temperate seas such as the North Sea and the Wadden Sea, another structural adaptation to the GDGT molecules has occurred in the form of an extra cyclohexane ring (with six carbon atoms) This compound was named crenarchaeol and its structure is drawn as no. V in fig 1.

Archaeal lipids in sediments

The distribution of GDGTs from marine Crenarchaeota in core top sediments derived from different geographic locations correlates well with SST. In cold areas the

GDGT distribution is dominated by GDGT (I) (Fig. 1) and crenarchaeol (V). In warmer regions the GDGT distributions differ substantially, as crenarchaeol becomes the most

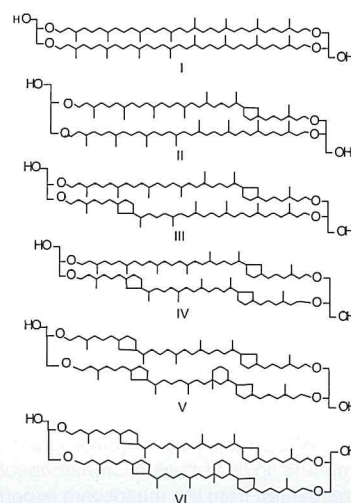


Fig. 1. Molecular structures of membrane lipids of marine Crenarchaeota. The compounds I–VI are GDGTs with 0–4 cyclopentane rings. Compound V is crenarchaeol and VI is a regio-isomer of crenarchaeol.

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Fig. 2. Set-up of the experiment (carried out in darkness).

abundant GDGT. Moreover, the GDGTs with 1-3 cyclopentane rings (II-IV) increase, and a regio-isomer of crenarchaeol (VI) is also detected. The relative GDGT distribution can be expressed as an

index of the concentrations of the GDGTs II, III, IV and VI. We named this the TEX_{86} index, which is defined as follows:

$$TEX_{86} = \frac{III+IV+VI}{II+III+IV+VI}$$

Thus, only GDGT II occurs exclusively in the denominator of the index! The correlation of the TEX_{86} index to the annual mean SST resulted in the following linear equation for a number of core-top sediments from different areas:

$$TEX_{86} = 0.015 \cdot T + 0.28, \quad (r^2 = 0.92) \text{ with } T = \text{annual mean SST (in } ^\circ\text{C)}.$$

However, an observed high correlation of the GDGT distribution in sediments with SST can never provide direct causal evidence that marine Crenarchaeota adapt their physiology exclusively to the

temperature of the ambient seawater. For instance, variations in salinity may also play a role.

Calibration of the TEX_{86} in laboratory cultures

Crenarchaeota cannot yet be grown in pure cultures. Therefore North Sea water was incubated in 20L mesocosm tanks (Fig. 2.) over a range of temperatures (5-35°C) and salinities (27-35‰) (Fig. 3).

The experiments were carried out in the dark to prevent the growth of algae. As expected, an increase in the number of cyclopentane moieties in the crenarchaeotal membrane lipids with increasing water temperature could be observed (Fig.3). In contrast, the differences in salinity did not show any effect on the membrane lipid distribution (Fig.3) and thus salinity does not disturb the temperature signal. The TEX_{86} values from our incubations

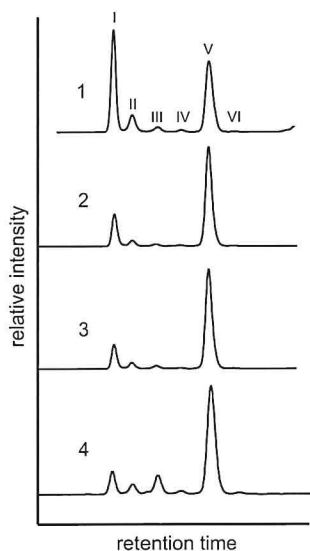


Fig. 3. HPLC-base peak chromatogram of membrane lipids of marine Crenarchaeota as recovered from the mesocosm experiments. The roman numbers correspond to the structures in Fig. 1. Mesocosm tanks were incubated at different temperature and salinities (1) 10°C and 27‰, (2) 25°C and 27‰ (3) 25°C and 35‰ and (4) 35°C and 27‰.

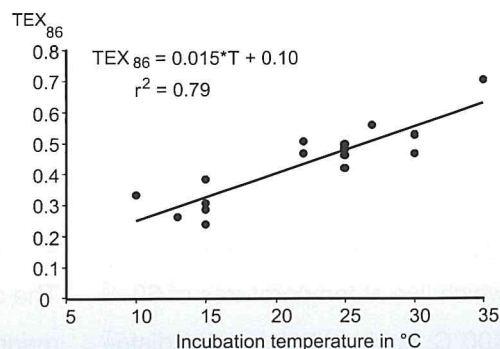


Fig. 4. Correlation of the TEX_{86} index with seawater temperature in the mesocosm experiments.

showed a significant linear correlation to incubation temperature (Fig.4) with the same slope of 0.015 as obtained from the sediment core tops, but with a difference in the intercept with the Y-axis. This difference seems mainly determined by the low amount of crenarchaeol isomer VI (Fig. 1) in the incubation series. Recent ^{13}C

NMR analysis of this compound indicates that compound VI is a regio-isomer of crenarchaeol. Interestingly, regio-isomers of GDGTs II-V have also been observed in increasing amounts with increasing temperature in the samples from sediment cores. It seems however, that this regio-isomer adaptation for membrane fluid-

ity is less strong in the species present in our North Sea incubations than in tropical Crenarchaeota.

Thus, the calibrations carried out in our culture experiments have confirmed the usefulness of the TEX_{86} as a new proxy for the reconstruction of sea-surface temperatures of the earth's history.

WHAT CAN A FJORD IN NORWAY TELL US ABOUT CARBON CYCLE CHANGES DURING NATURAL GREEN-HOUSE CONDITIONS IN THE EARTH HISTORY?

*Yvonne van Breugel, Mathias Paetzel, Stefan Schouten & Jaap Sinninghe Damsté**

Massive combustion of fossil fuel by man since the industrial revolution has increased the atmospheric CO₂ levels from 280 ppmv (parts per million by volume) in 1800 to about 376 ppmv in 2004. To understand what might be ahead of us, we have to look back in the earth history to earlier periods with natural green house conditions. These occurred 180 million years ago in the Jurassic and 120 million years ago in the Cretaceous during so called “oceanic anoxic events” (OAE’s). A striking feature of both periods is the extent of oxygen depletion in the world’s oceans. Since the present day situation in some Norwegian fjords presents similar environmental conditions, we investigated the carbon cycle in the Kyllaren fjord. This fjord has a stratified water column year round with a very shallow chemocline at 3.5 m depth. Our results show that respired CO₂ from re-mineralized cellular material accumulates below the chemocline and is used as a ‘second-hand’ carbon-source by the green sulphur bacteria, living at 4 m depth in Kyllaren fjord. We think that the recycling of respired CO₂ was also a very important process in the ancient (shallow) oceans during both pre-historical ocean anoxic events.

The OAE's in the Jurassic (180 Ma) and in the Cretaceous (120 Ma) are characterized by large volcanic activities, causing elevated atmospheric CO₂ levels and high temperatures. Another striking feature during both periods was the lack of oxygen in the bottom water of the oceans, sometimes even up into the photic zone (where light penetrates in the water). In our present day oceans, all bottom water is oxygenated. The Kyllaren fjord (Fig. 1), however, is anoxic below 3.5 m depth. The 29-meter deep fjord is located on the west coast of Norway and is connected with the Norwegian Sea by a nar-

row, 1-2 m deep channel.

Precipitation and river run-off establish a low salinity surface layer, causing a permanent salinity stratification in the fjord. Only in the

surface water oxygen and CO₂ are exchanged with the atmosphere, but in the denser bottom water oxygen is absent (anoxic) and the hydrogen sulphide concentration is

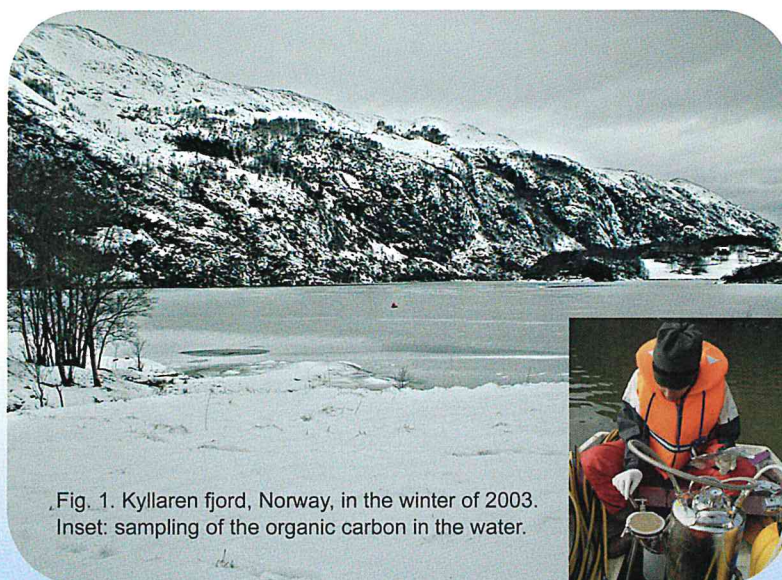


Fig. 1. Kyllaren fjord, Norway, in the winter of 2003. Inset: sampling of the organic carbon in the water.

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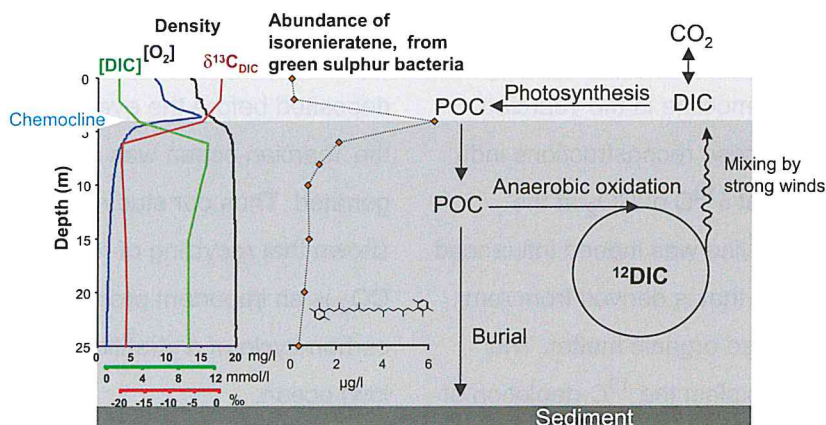


Fig. 2. Increasing DIC concentrations with a concurrent decrease of its ¹³C content (δ¹³C) indicates the accumulation of 'second-hand' DIC derived from remineralization of cellular material (POC) in the bottom water layer of the Kyllaren fjord, as depicted in the model on the right. Isorenieratene is a carotenoid compound only found in green sulphur bacteria living near the chemocline in anoxic water.

high (Fig. 2). The interface between these two layers is referred to as the 'chemocline'.

Unlike the upper water layer, a high concentration of substantially ¹³C-depleted dissolved inorganic carbon (DIC) of ca. -19 ‰ was observed below the chemocline in the Kyllaren fjord, throughout the year. This indicates a notable accumulation of 'second-hand' DIC derived from mineralized organic matter (respired DIC). Just below the chemocline, high abundances of the compound isorenieratene were detected. This is a biomarker for the occurrence of photosynthetic green sulphur bacteria (GSB). These organisms flourish when sunlight penetrates to anoxic waters containing hydrogen sulphide (H₂S). GSB use the reductive tricarboxylic acid cycle for CO₂

fixation. The key enzyme of this biochemical pathway, pyruvate synthase, has a much lower discrimination against ¹³C compared to the enzyme used by most algae (Rubisco). Indeed, the biological carbon isotope fractionation by GSB of isorenieratene, ε_p versus CO₂, displays an annual average of 4 ‰ in the Kyllaren fjord, and is independent of CO₂ concentration and growth rate of the GSB. Thus, the ¹³C-depleted isorenieratene

What is δ¹³C ?

Stable carbon exists in two atomic forms with masses 12 (¹²C; 99 %) and 13 (¹³C; only 1 %). Autotrophic organisms, which use dissolved inorganic carbon (DIC) as their primary carbon source, prefer the light ¹²C form for uptake in their cells. As a result, the ¹³C form of carbon is depleted in the cell material of algae and autotrophic bacteria compared to DIC in the water column. The average degree of this ¹³C-depletion is about 25·10⁻³. (The notation δ¹³C (pronounce delta 13C) against a standard of Vienna Pee Dee Belemnite (VPDB) is in parts per thousand, e.g. δ¹³C_{organic carbon} ~ -25 ‰). The ¹³C-depletion in the cell material is expressed as the biological carbon isotope fractionation, ε_p versus CO₂.

In formula:

$$\delta^{13}C = \left(\left(\frac{{}^{13}C / {}^{12}C_{\text{sample}}}{{}^{13}C / {}^{12}C_{\text{standard}}} \right) - 1 \right) \times 1000 (\text{‰})$$

the δ¹³C_{VPDB} = 0 ‰ by definition.

The CO₂ in the present-day oceans is in equilibrium with CO₂ level in the atmosphere and consequently δ¹³C_{DIC} ~ 0 ‰.

(-25 to -32 ‰) in the Kyllaren fjord gives evidence of assimilation of the respired CO_2 by photosynthetic GSB.

Fossil isorenieratene was also detected in sediments deposited in ancient oceans during the Toarcian OAE, indicating anoxia in the photic zone. The constant ε_p of isorenieratene in the Kyllaren fjord

was subsequently used in the reconstruction of $\delta^{13}\text{C}$ of CO_2 at the chemocline in the Toarcian time. These reconstructions indicate that $\delta^{13}\text{C}$ of CO_2 at the chemocline was indeed influenced by CO_2 that is derived from remineralized organic matter. This could explain the ^{13}C -depletion of sedimentary organic carbon

deposited during the OAE compared to the organic carbon deposited before the event, when the Toarcian ocean was oxygenated. Thus our study has shown that recycling of respired CO_2 is an important process in the carbon-cycle of a stratified (shallow) ocean.

EXTERNAL PROJECTS OF THE DEPARTMENT OF MARINE BIOGEOCHEMISTRY AND TOXICOLOGY

- Chemical fossils of diatoms for age determination of petroleum: Improved tools for solving exploration and production problems (STW).
B. Abbas, S. Rampen, G. Muyzer, S. Schouten, J.S. Sinninghe Damsté.
- Environmental controls on present and past microbial diversity as revealed by extant and fossil DNA from Antarctic Ace Lake and Ellis Fjord (NAAP/NWO-ALW)
B. Abbas, J.S. Sinninghe Damsté, J.K. Volkman, M. Coolen.
- Bioavailability of surfactants in marine sediments. In cooperation with IRAS (UU) and Aquasense. (ERASM)
K. Booi, J.P. Boon
- Project FIRE: Risk assessment of brominated flame retardants (BFRs) as suspected endocrine disrupters for human and wildlife health. Project granted by DG XII of the European Union, 2002-2006.
J.P. Boon, B.N. Zegers (guest scientist).
- Project ballastwater treatment Hamann. Land-based testing of a pilot installation built to remove organisms and suspended particulate matter from ballast water on ships. Project granted by the German company 'Hamann AG'.
J.P. Boon, M.J.W. Veldhuis.
- Project Ballastwater-DGG. The group consisted of NIOZ, Royal Haskoning, 3 manufacturers of ballast water treatment equipment, 4 shipowners. Project granted by the Ministry of Transport, Public Affairs and Water Management, 2003-2004.
J.P. Boon, M.J.W. Veldhuis, C. Brussaard, C.C. Ten Hallers-Tjabbes.
- Project Whale-Farøer: Biochemical and *in vitro* biotransformation analyses on hepatic microsomes of pilot whales. Project granted by 'Denmarks og Grønlands Geologiske Undersøgelse', Copenhagen, DK. Together with the toxicology department of the University of Wageningen, 2003-2005.
J.P. Boon.
- Two Marine Environmental Awareness Courses for the Dutch Maritime Universities of professional education, 2004. Project granted by the 'ProSea' foundation.
J.P. Boon, (together with EcoMare).
- The biophysical properties of newly-discovered membrane lipids: Insights into the functioning of cell membranes of marine microorganisms (NWO-ALW).

H. Boumann, S. Schouten, E.C. Hopmans, J.S. Sinninghe Damsté, P. Stroeve, M. Longo, A.C.T. Van Duin.

- The nitrogen cycle: foraminifera, bacteria and molecular paleontology of the marine deeper redox zone (NWO-ALW).

J. Brandsma, M.S.M. Jetten, B. Van Der Zwaan, S. Schouten, J.S. Sinninghe Damsté.

- Environmental controls on ancient microbial diversity and metabolic processes as revealed by stratigraphic analysis of fossil and extant functional genes.

M.J.L. Coolen (VENI grant).

- Fossil DNA as recorder of global change and ancient biodiversity in Quaternary marine settings (NWO-ALW).

M. Coolen, J.S. Sinninghe Damsté.

- Palaeothermometry of the mid-Cretaceous greenhouse world using a new sea surface temperature proxy based on crenarchaeal membrane lipids (NWO-ALW).

A. Forster, E.C. Hopmans, S. Schouten, J.S. Sinninghe Damsté.

- Archaeal carbon fixation and burial and terrestrial organic matter input in the coastal system as revealed by tetraether membrane lipids (NWO-ALW and LOICZ)

L. Herfort, E.C. Hopmans, S. Schouten, J.S. Sinninghe Damsté.

- A new sea surface temperature proxy based on planktonic archaeal membrane lipids, the TEX86 (NWO-ALW).

C. Huguet, E.C. Hopmans, S. Schouten, J.S. Sinninghe Damsté.

- The impact of Anammox on the present-day and past oceanic nitrogen cycle (NWO-ALW).

A. Jaeschke, M. Strous, M.S.M. Jetten, S.G. Wakeham, S. Schouten, J.S. Sinninghe Damsté.

- Molecular and geochemical analysis of hot spring cyanobacterial and *Chloroflexus* mats as stromatolite analogs.

M.T.J. Van Der Meer, D.M. Ward, F. Cohan, J. Eisen, J. Heidelberg, M. Madigan, S. Schouten.

- 6C: Climate change, carbon cycle and carbonate chemistry (EU).

J. Ossebaar, G.-J. Brummer, S. Schouten.

- Long-chain diols as palaeoproductivity proxies (NWO-ALW).

S. Rampen, K. Timmermans, G.-J. Brummer, S.G. Wakeham, S. Schouten, J.S. Sinninghe Damsté.

- Tropical environmental change and its teleconnections during the last deglaciation: a lipid biomarker study dated with ^{14}C wiggle-matching (NWO-ALW).
M. Rietkerk, G.J.M. Versteegh, F.H.J. Jansen, J.S. Sinninghe Damsté.
- MEDIFLUX: An integrated study of seepage through the seabed of the Nile deep sea fan (ESF/NWO-ALW).
A. Stadnitskaia, J. Woodside, G.J. De Lange, J.S. Sinninghe Damsté.
- Recycling of respired CO_2 in stratified marine systems: Consequences for the interpretation of the stable carbon isotope record (NWO-ALW).
Y. Van Breugel, S. Schouten, J.S. Sinninghe Damsté.
- Climate history of the South East Atlantic Ocean (NEBROC).
G.J.M. Versteegh, F.J.H. Jansen, J.S. Sinninghe Damsté, J.W. De Leeuw.
- Land-ocean interaction and oceanic response in the Mid-Cretaceous western tropical Atlantic (DFG).
T. Wagner, P. Hofmann, J.S. Sinninghe Damsté.
- Development, evaluation and application of organic geochemical tracers for terrestrial carbon input into the marine environment (NWO-ALW).
J.W.H. Weijers, E.C. Hopmans, S. Schouten, J.S. Sinninghe Damsté.
- Tetraether membrane lipids in the water column and sediments: Insights into the evolution and ecology of marine pelagic archaea.
C. Wuchter, S. Schouten, J.S. Sinninghe Damsté.
- Biomarker and isotope studies of organic matter cycling in the Black Sea: A focus on bacteria and archaea (NSF).
S.G. Wakeham, S. Schouten, J.S. Sinninghe Damsté.



BIOLOGICAL OCEANOGRAPHY

The goal of the ongoing research of BIO is to obtain insight into the behavior and life strategies of the components of the lower food web, to elucidate intra- and interspecific interactions and, to identify key species for specific ecological conditions and ecosystem functioning. These new avenues of research are embedded in the major recent projects of the BIO and in the different themes of the newly formulated Science Plan. Research performed in the BIO ranges therefore from autecological studies of key species to food web studies including a modelling component.

In the year 2004, members of the BIO participated in two cruises in the North Sea and the Atlantic and in a nine-weeks mesoscale iron fertilization experiment in the Atlantic sector of the Southern Ocean. Also, the second cruise of the ALW-funded BADE project was conducted in the subtropical Atlantic. During this BADE-2 cruise, the dynamics of the microbial community in the surface layers including the air-sea interface were studied along a trophic gradient from the Mauritanian upwelling into the subtropical Atlantic gyre. Particular attention was paid to the role of ultraviolet radiation influencing the carbon and energy flow between the different compartments of the microbial community. Moreover, the prototypes of the high pressure sampling and incubation device were tested successfully during this cruise, a description of this new sampling device and about its role in future NIOZ research is given in the Marine Technology report. First trials for the newly-funded ALW-project BIOSYS, dealing with the feeding ecology of cold water corals in the Atlantic and Mediterranean were performed. A six months field campaign was carried out at the coral reefs of Curaçao to study the nutrition and mineralization of encrusting sponges and the interactions between sponges and prokaryotes. The efficiency of large scale removal of potentially invasive (micro)organisms from ballast water of ships was tested in the NIOZ harbor in cooperation with a commercial company.

MODELLING OF COMPETITION AMONG MUSSELS

Daisuke Kitazawa & Piet Ruardij*

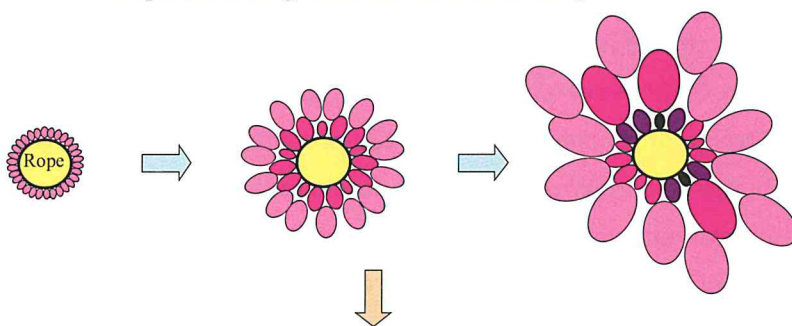
An artificial structure built in the sea provides space for settlement of sessile organisms in banks. Mussels are the dominant species and their activities may change the water quality around them. In order to assess the environmental impact of the mussel bank, a mathematical model was constructed which describes the dynamics controlled by competition for space and food. The competition model can predict the food ingestion, the oxygen consumption, and the growth of the mussels as controlled by competition for space and food.

A new runway will be built in Tokyo Bay of Japan as an international airport. A mega-floating platform is one of the three possibilities proposed as the method of construction. To realize this Mega-Float, a prototype model has been anchored in the southern area of Tokyo Bay. In this project, the resulting changes in water current, water quality and benthic ecosystem were examined to assess the environmental impacts. It

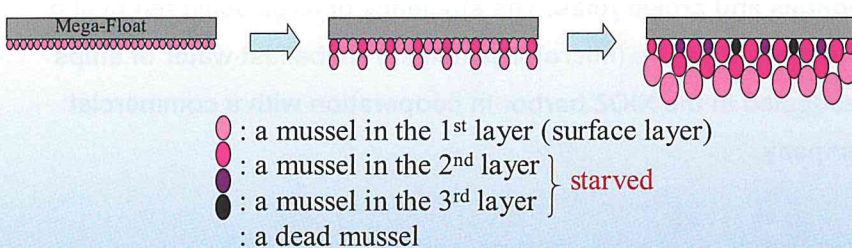


A prototype model of the Mega-Float

Competition among mussels at the cultivation rope



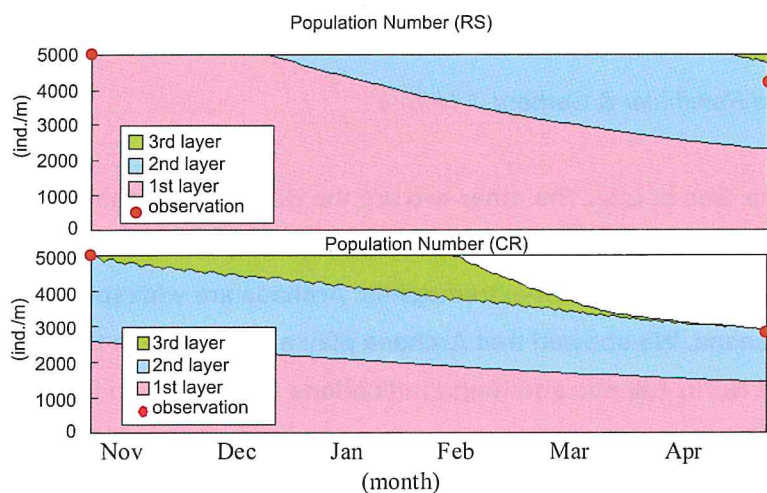
Competition among mussels at the bottom surface of Mega-Float



appeared that the water quality just below the under-surface of the prototype model changed due to activities of the sessile organisms, about 80 percent of which were blue mussels (*Mytilus galloprovincialis*). For the quantitative environmental impact assessment a mathematical model was developed to describe the dynamics of mussels on an artificial structure as con-

The competition model was developed for mussels on the cultivation rope, and applied to mussels at the under-surface of the Mega-Float.

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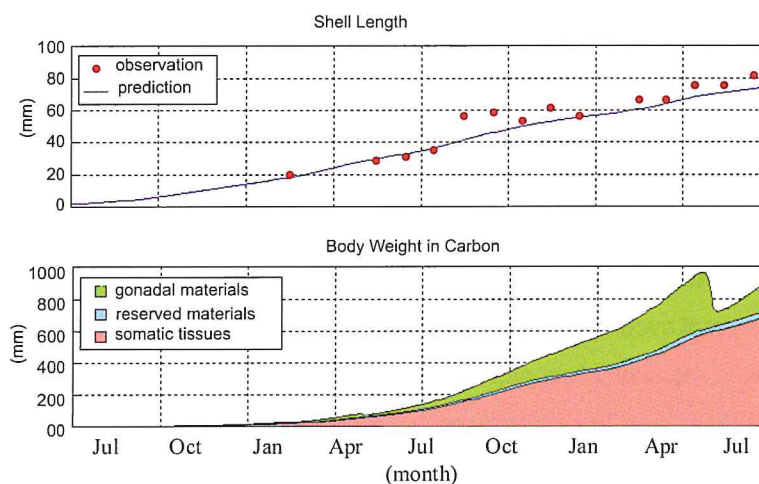
Time variations in population number of mussels, the seeds of which are collected from rocky shores (RS) and collector ropes (CR).

trolled by competition for space and food availability. With the model the impact of the dynamics of the mussels on the environment such as changes in the suspended matter and oxygen concentration can be estimated. The model consists of a physiological growth model based on the Dynamic Energy Budget model (DEB) of Kooyman and a competition model for space. In the latter the formation of new layers of mussels is described as a function of the mussel density on the artificial structure. In this way a multilayer structure of a mussel bank can be described, in which competition for food between mussels in different layers takes place. For the mussel in the basic layers the formation of new layers will undoubtedly lead to food shortage and starvation due to their unfavorable position. This

starvation will depend on the physiological status of the mussel as described with the DEB model. The competition model is developed by using observations of mussels growing on cultivation ropes at the northwest coast of Spain. The parameter values of the physiological submodel are calibrated with observed growth curves. The parameters of the space competition submodel are

calibrated with data of growth experiments on a cultivation rope. On such a rope the population number starts with 5000 individuals per meter, which are collected from rocky shores and collector ropes. As mussels grow, the population number decreases due to death of starved mussels, and about half of the living mussels are inactive in the inner layer of the mussel bank.

The competition model will be



Time variations in shell length and body weight in carbon in 2 years.

applied to competition among mussels on the under- surface of the Mega-Float, and is connected to the three dimensional marine ecosystem model. The food ingestion, the oxygen consumption, and the growth of the mussels can be estimated according to temperature and suspended matter in the ambient water, and the impacts of the mussel bank on the surrounding environment are predicted.

MAJOR ROLE OF ARCHAEA IN THE DEEP NORTH ATLANTIC OCEAN

*Eva Teira, Thomas Reinthaler & Gerhard J. Herndl**

Archaea form one of the three branches of the Tree of Life. The other two are the Bacteria and the Eukarya; the latter include all plants and animals. Archaea have been traditionally considered as "extremophiles," although recent studies have shown that non-extremophilic Archaea are widespread in marine plankton of virtually all seas and oceans. We showed that Archaea play a major role in the ecosystems of the deep and dark parts of the North Atlantic and found indications for growth on inorganic as well as organic carbon. Thus they might have an autotrophic and/or a heterotrophic mode of growth.

Despite the general occurrence of Archaea, virtually nothing is known yet about their basic physiology.

Questions as: "What are their sources for carbon and energy?"

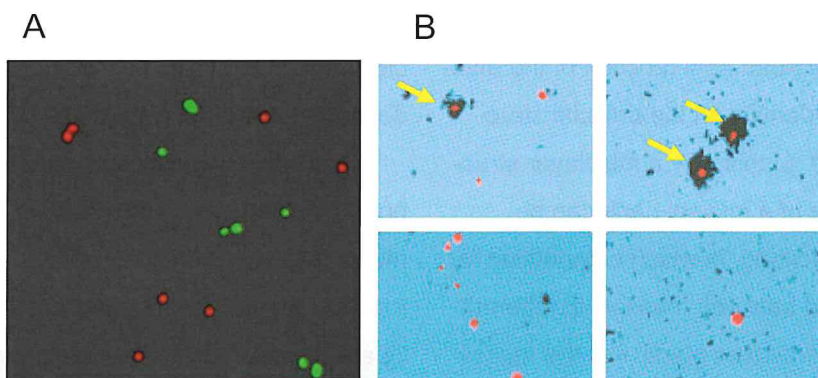
need to be answered to assess the role of Archaea in the global biogeochemical cycles. We have adapted a molecular technique (CARD-FISH, see the intermezzo for a more detailed explanation) to detect marine Archaea more efficiently. This technique was applied

to samples collected during 2 research cruises in the North Atlantic where the two main branches of the North Atlantic Deep Water were followed over more than 4000 km. Water samples were collected from 100 to 4000 m depth. By using MICRO-CARD-FISH, we determined the substrate uptake on a single cell level for Bacteria, Eury- and Crenarchaeota separately. As sub-

strate we used radiolabeled bicarbonate to indicate potential autotrophy of Archaea and Bacteria and enantiomeric amino acids. Our results indicate that Archaea are not only more abundant than Bacteria but provide also direct evidence that Archaea are, at least partially, living in an autotrophic mode utilizing inorganic carbon in a similar manner as plants do, but without sunlight

as energy source. However, Archaea are also taking up organic molecules like amino acids, indicating heterotrophic growth.

Whether individual archaeal species are capable to grow on both inorganic and organic carbon sources and the source they use for energy, are both very important research questions for the near future. NIOZ is very well equipped to play a leading role in this field.



Examples of applying CARD-FISH and MICRO-CARD-FISH to North Atlantic deep water prokaryotic communities (2700 m). (A) Confocal laser scanning micrograph of a double CARD-FISH hybridisation. Bacteria fluoresce green and Archaea fluoresce red. (B) Micrograph of Archaea assayed by MICRO-CARD-FISH using radio-labelled Aspartic acid. Active cells surrounded by black halos are indicated by yellow arrows.

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What is 'FISH'?

The combination of Fluorescence In Situ Hybridisation (FISH) techniques with microautoradiography allows us to determine the uptake potential of a given substrate by specific prokaryotic groups (Bacteria or Archaea).

The recently developed Catalyzed Reporter Deposition (CARD)-FISH uses horseradish peroxidase (HRP)-labelled oligonucleotide probes and is based on the deposition of a large number of fluorescent molecules by peroxidase activity, resulting in the amplification of the fluorescence signal. The critical step of this method is the penetration of the HRP-labelled oligonucleotide probes into the cells, due to the large size of the enzyme. The original protocol included a lysozyme permeabilisation treatment. However, Archaea cell walls do not contain murein, and thus, they are insensitive to lysozyme treatment. We therefore modified the existing protocol to more efficiently detect marine Archaea, substituting lysozyme by proteinase-K treatment to make the cell wall permeable for the probe. The adapted method with proteinase-K resulted in detection rates of Archaea which were twice as high as with lysozyme pre-treatment. We successfully combined micro-autoradiography and the refined CARD-FISH (MICRO-CARD-FISH) method for the study of the uptake of specific substrates by Bacteria and Archaea in the deep waters of the North Atlantic (from 100 down to 4000 m depth).

EXTERNAL PROJECTS OF THE DEPARTMENT OF BIOLOGICAL OCEANOGRAPHY

- Mortality of marine phytoplankton in ecosystems with contrasting trophic status (oligotrophic versus eutrophic) (NWO-ALW).

C.P.D. Brussaard

- Application of capillary electrophoresis for isolating bacteria and assessing ectoenzyme diversity and kinetics (ACE, Marie Curie Host Fellowship of EU).

G.J. Herndl

- Capillary electrophoretic separation of dissolved carbohydrates of the aquatic realm (CAESAR, Marie Curie Fellowship).

G.J. Herndl

- Bacterial-derived dissolved organic matter production and transformation in the North Atlantic Deep Water (Marie Curie Fellowship). (Until June).

G.J. Herndl

- Bacterial single-cell approaches to the relationship between diversity and function in the sea (BASICS, 5th FWP of EU).

G.J. Herndl

- Dynamics in bacterioplankton activity in relation of dissolved organic matter quality assessed by a combination of bulk measurements and single cell analysis (ALW-NWO).

G.J. Herndl

- Transformation of dissolved organic matter (DOM) in the North Atlantic Deep Water and intermediate waters: assessing the functional and phylogenetic variability of marine bacterioplankton communities in relation to the quality of DOM (TRANSAT, ALW-NWO).

G.J. Herndl

- Bacterioplankton cell death: competition between flagellate grazing and viral lysis and the role of bacterioplankton cell wall-derived dissolved organic matter in the ocean (BADE, ALW-NWO).

G.J. Herndl

- Activity, rates, carbon use and high-pressure microbial ecology of the deep sea (ARCHIMEDES, ALW-NWO).

G.J. Herndl

- MFSTEP: Mediterranean Forecasting System Toward Environmental Prediction. (MFSTEP FWP of EU Energy, Environment and Sustainable Development)

P. Ruardy

- Project: Seedcorn DP177: Rapid development of an ecosystem/ecological modelling capacity at CEFAS (funded by English government)

P. Ruardy

- Biodiversity and ecosystem functioning of deep water coral reefs in the Mediterranean Sea and the NE Atlantic (NWO-ALW).

F.C. Van Duyl

- Dissolved organic matter cycling on coral reefs: Are coral cavities sinks of DOM? (NWO-WOTRO)

F.C. Van Duyl

- Removal of pico-and nanoplankton by coral reef benthos along the east coast of Kalimantan (Indonesia): coupling pelagic benthic heterotrophy to coral reef status (NWO-WOTRO)

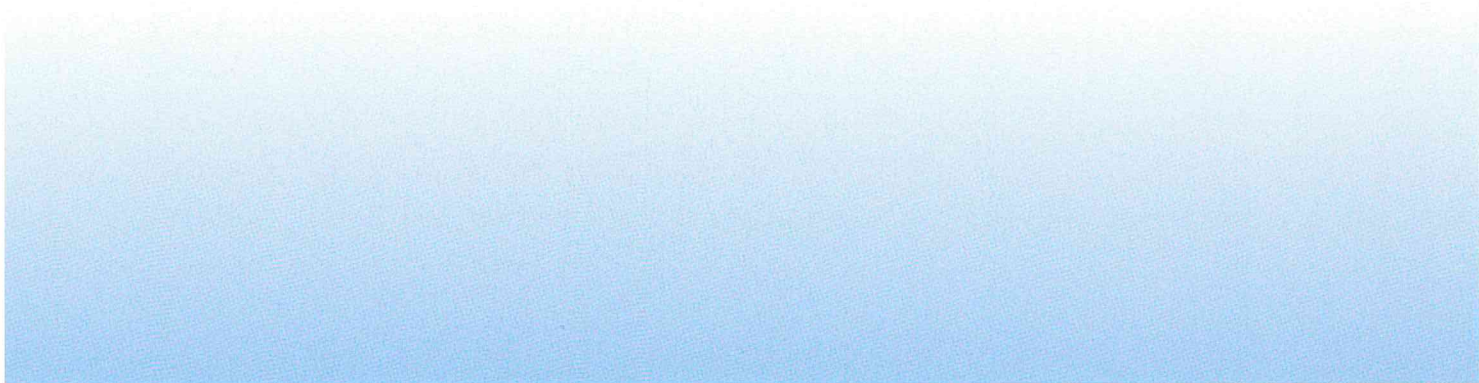
F.C. Van Duyl

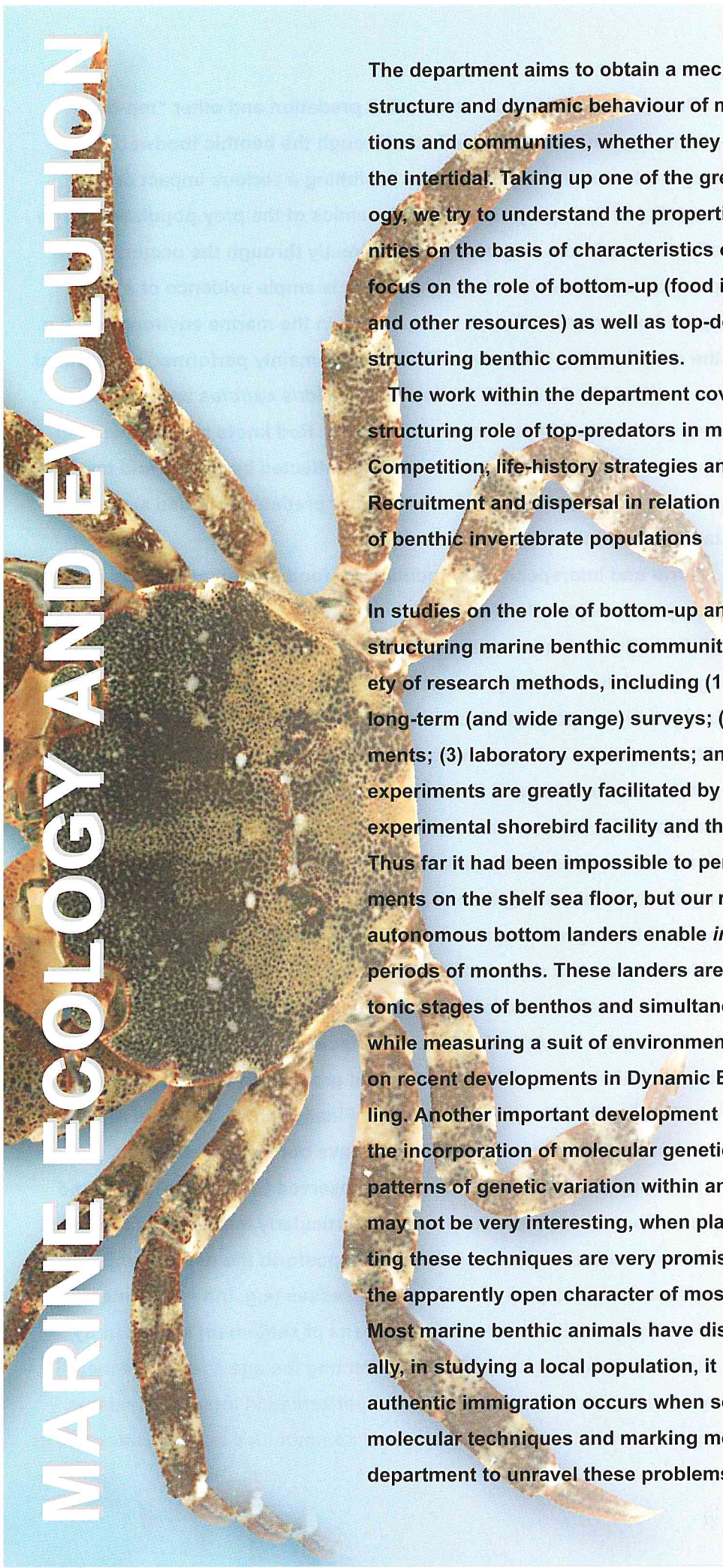
- Competition between a non- and a N₂-fixing coccoid *Synechococcus* under different nitrogen conditions (EU-5FWP, Marie Curie Host Fellowship)

M.J.W. Veldhuis

- HAMANN Ballast Water Project (HAMANN A.G. and Dutch Ministry of Public Works and Transport (DGG))

M.J.W. Veldhuis, J.P. Boon





MARINE ECOLOGY AND EVOLUTION

The department aims to obtain a mechanistic understanding of the structure and dynamic behaviour of marine macrobenthos populations and communities, whether they occur on the shelf margin or the intertidal. Taking up one of the great challenges in modern ecology, we try to understand the properties of populations and communities on the basis of characteristics of individual organisms. We focus on the role of bottom-up (food input and competition for food and other resources) as well as top-down (predation) processes in structuring benthic communities.

The work within the department covers three major themes: The structuring role of top-predators in marine ecosystems, Competition, life-history strategies and dynamic energy budgets, Recruitment and dispersal in relation to spatial and genetic structure of benthic invertebrate populations

In studies on the role of bottom-up and top-down processes in structuring marine benthic communities, the department uses a variety of research methods, including (1) field observations, along with long-term (and wide range) surveys; (2) manipulative field experiments; (3) laboratory experiments; and (4) modelling. Laboratory experiments are greatly facilitated by the possibilities within the experimental shorebird facility and the renovated aquarium building. Thus far it had been impossible to perform manipulative field experiments on the shelf sea floor, but our recently developed autonomous bottom landers enable *in situ* experiments lasting for periods of months. These landers are capable of sampling planktonic stages of benthos and simultaneously exposing substrates, while measuring a suit of environmental variables. Modelling builds on recent developments in Dynamic Energy Budgets (DEB) modelling. Another important development in marine benthic ecology is the incorporation of molecular genetics. Although the description of patterns of genetic variation within and among populations *per se* may not be very interesting, when placed in a general ecological setting these techniques are very promising. One example concerns the apparently open character of most marine benthic populations. Most marine benthic animals have dispersive propagules and usually, in studying a local population, it remains unclear how much authentic immigration occurs when settlement takes place. Both molecular techniques and marking methods are used within the department to unravel these problems of open marine systems.

One of our main hypotheses is that predation and other “top-down” processes have cascading effects through the benthic foodweb. This may work directly, with predators exhibiting a serious impact on the mortality of their prey and on the dynamics of the prey populations. The effect of predators may also work indirectly through the occurrence of predator-avoidance mechanisms. There is ample evidence of a widespread occurrence of such mechanisms in the marine environment, e.g. the deep-burying of bivalves. This work is mainly performed in intertidal areas (Wadden Sea), with the red knot *Calidris canutus* and its bivalve prey as the most important model system. Red knots mainly eat small bivalves and they are therefore strongly affected by spatial and temporal variation in bivalve recruitment. Other predators studied are crustaceans, juvenile flatfish and seabirds.

Intra- and interspecific competition for food and other resources may also play a major role in determining community processes. At the level of the individual, interest is directed towards performance (e.g. growth, age and size at maturity, fecundity, survival or, more generally, energy budgets) in response to food availability and other environmental conditions, and the consequences of choosing a specific strategy for competitive interactions and fitness. A phenomenon of increasing concern and potential (both as an adaptive trait and a tool to understand selection pressures) is phenotypic flexibility, which is studied in filter-feeding bivalves (sizes of gills and palps), in their avian predators (various parts of the digestive system) and in reef corals. At the level of communities, research is done in the Wadden Sea and in the North Sea, in both of which the effect of climate variability on macrobenthic communities is studied. On the Atlantic slope the effects of food pulses on metabolism and life history of key species and groups are studied in deep-sea coral and soft sediment communities. Finally, in tropical coral reefs the mechanisms determining dominance have our special attention.

At the population level, it has been observed that the period around the settlement of the recruits may be particularly important in the regulation of marine benthic populations. Henceforth the department focuses intensively on recruitment processes (e.g. intra- and interspecific adult-juvenile competition by means of settlement inhibition by adults, or the competition for food affecting the age and size at metamorphosis). Recruitment studies are performed in intertidal systems, shallow coastal seas and in coral reef communities in deep water and in the tropics.

PREDATOR – PREY INTERACTIONS IN A MARINE ECOSYSTEM IMPACTED BY INDUSTRIAL FISHERIES

Cees Camphuysen* & Jaap van der Meer

The industrial fishery for sandeels is currently, by quantity, the largest fishery in the North Sea. The top predator community in the North Sea consists of about 50 species of seabirds and mammals, most of which eat fish. Sandeels are important prey for many species, and reduced sandeel abundance has had detectable consequences for breeding success, most notably in surface-feeding seabirds. The IMPRESS project set out to investigate the complex predator-prey relationships as an aid in understanding the fisheries effects on prey availability.

Sandeels are major prey for top predators in the North Sea such as seabirds, whales, dolphins and seals. Severe effects of sandeel stock collapses on some species have been reported, but the relationship between prey density and availability to predators remains poorly understood. Some seabirds fail to reproduce in years when sandeel stocks are low, while other species adjust their foraging successfully or change prey. Recent investigations of the potential impact of the industrial sandeel fishery on seabirds were prompted by the knowledge that breeding success of seabirds depended on sandeel availability and the assumption that the industrial fishery may have reduced sandeel availability to levels at which avian reproductive output is affected.

Effects of reduced prey availability on breeding success were often more pronounced in surface-feeding seabirds such as black-legged kittiwakes *Rissa tridactyla* and arctic terns *Sterna paradisaea*. These findings have led to suggestions that these species are most sensitive to changes in prey availability, particularly sandeels.

Although severe ecosystem effects of sandeel stock collapses have occurred, the fishing industry contests the view that its activities negatively affect top-predators. In the IMPRESS project predator-prey relationships in marine ecosystems have been studied in unprecedented detail

IMPRESS (Interactions between the Marine environment, PREDators, and prey: implications for Sustainable Sandeel fisheries) was a partnership of Royal NIOZ, Natural Environmental Research Council (UK), DHI Water and Environment (Denmark), Fisheries Research Services (UK), Aberdeen University (UK), Leeds University (UK), Centre National de la Recherche Scientifique (France), University of Hamburg (FRG), and the Netherlands Institute for Fisheries Research (RIVO, NL), with the Federal Research Centre for Fisheries (FRG) and the Southampton Oceanography Centre (UK) as subcontractors.

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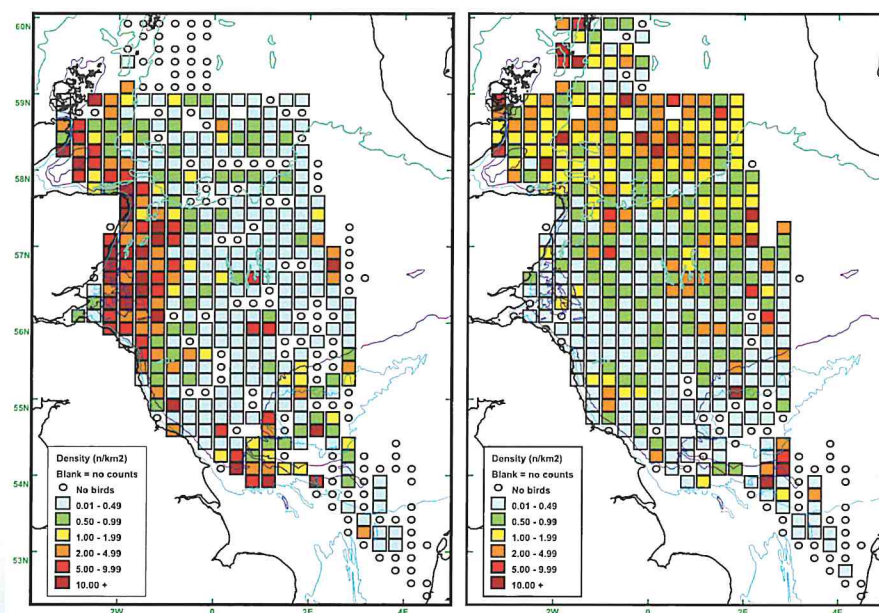
The Pelagia research team: June 2003, "mission completed" (left to right: Nicole Sonntag, Santiago Gonzalez, Philipp Schwemmer, Damien Nixon, Luc Meuwisse, Oliver Ross, Martin Laan, Jackie Smith, Dennis de Boo, Suzan van Lieshout, Beth Scott en Kees Camphuysen).

Previous studies on the impact of industrial sandeel fisheries on seabirds have focussed particularly on sandeel abundance. However, major factors governing the availability to seabirds were not considered. Availability is related to the interaction between the spatial patterns in the abundance of specific size classes of sandeels and the feeding behaviour of seabirds. The overall objective of the project was to determine the relationship between hydrography, relevant sandeel population characteristics, *i.e.* the temporal and spatial patterns in abundance and age- and size distributions, and the foraging performance of groups of seabirds and marine mammals.

The problem was 'attacked' by all available means and tools, using a combination of data loggers on individual birds (foraging performance), observations at the

colonies (breeding performance and diet), ship-based surveys (inter-specific interactions and at-sea distribution, hydrography, fish distribution), and modelling work. To examine the complicated interplay between predators, a large-scale study of the at-sea distribu-

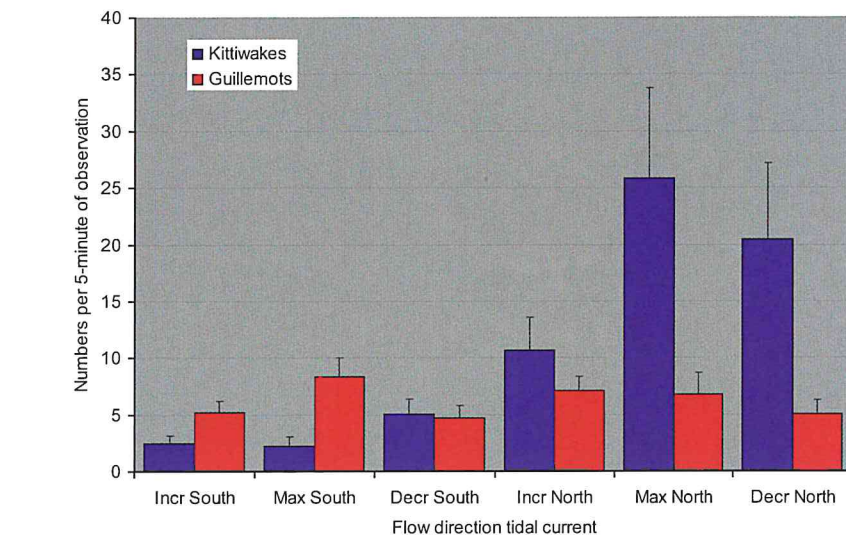
tion, foraging behaviour, feeding interactions and hydrographical characteristics of the feeding areas of all avian and mammalian top-predators was conducted, utilizing long-term data gathered in previous projects in similar ways. New GPS loggers, developed during this project and attached to northern gannets *Morus bassanus* (birds large enough to carry such devices seemingly undisturbed), provided unique insights in the whereabouts and specific activities of individual birds of known (breeding) status and performance. These birds had also dive depth recorders at their feet and a temperature sensor in their stomach, so that diving depth and prey



Contrasting distribution patterns: coastal orientation of black-legged kittiwakes (left), with high densities near the colonies along the Scottish east coast, and the offshore orientation and northerly distribution of northern fulmars (right), mainly inhabiting the deeper North Sea waters that are thermally stratified in summer.

ingestion were recorded real time with highly accurate location fixes. Radio telemetry techniques were used and compass loggers were deployed for smaller predators, such as black-legged kittiwakes, European shags *Phalacrocorax aristotelis* and common guillemots *Uria aalge*.

The survey work under IMPRESS has emphasized the importance of shallow sea fronts for foraging seabirds and indicated that these form an outer barrier for birds breeding down the east coast of Britain. In addition, combining information on at-sea distribution and activity with oceanographic data has highlighted the potentially complex interplay between seabird breeding success, feeding location and inter-specific competition. Water depth throughout most of the study area (the NW North Sea off the Firth of Forth) is less than 60 m and thus all diving seabirds and all the marine mammals potentially have access to the entire water column within their respective foraging ranges. Surface feeders, as their name implies, such as terns, gulls, northern fulmars *Fulmarus glacialis* and storm-petrels *Hydrobatidae* rely on the presence of prey near the water surface, while northern gannets are unlikely to dive deeper



Foraging black-legged kittiwakes and common guillemots (number $\pm$ SE per 5-minutes of observation) with changing tide during continuous surveys in the Wee Bankie area (the full tidal cycle was surveyed twice, 12-13 June 2003; 56°15'N, 01°30'W). On the x-axis, indications of currents running south (ebb; increasing, maximum and decreasing) and north (flood) during six tidal stages.

than 20-25m. These differences in foraging capabilities have implications as to how prey stocks can be utilised by each predator. A dedicated cruise in 2003 with RV Pelagia, revealed that foraging activity varied during the day in relation to changes in tidal currents, suggesting that physical processes may help drive prey towards the surface. Inactive periods were recorded more frequently in surface feeding black-legged kittiwakes than (potentially) deep diving common guillemots, with the latter continuing to feed at certain phases of the tide when black-legged kittiwakes had stopped entirely. Clearly more surveys are needed to investigate these inter-specific differences further. Surface

feeders were found to commonly profit from small flocks of auks *Alca torda* driving sandeels and other fish in balls to the surface in Multi-species foraging associations (MSFAs). Seabirds used complementary tactics when feeding together (e.g. pursuit-diving, plunge-diving, dipping, scooping, surface-pecking and aerial-pursuit), but some of the large aerial species tended to exclude smaller species thereby preventing further access to the fish. For at least eight surface-feeding species, MSFAs must have contributed significantly to their daily prey intake.

Given the increasing pressure on the North Sea ecosystem from both fisheries and climate change, the use of top predators to monitor



Seabirds used complementary tactics when feeding together (e.g. pursuit-diving, plunge-diving, dipping, scooping, surface-pecking and aerial-pursuit), but some of the large aerial species tended to exclude smaller species thereby preventing further access to the fish.

ecosystem health is an attractive concept. However, as the results from the IMPRESS project indicate, we are still a long way from having all the background knowledge required for such an approach. Only through multi-disciplinary projects, we can begin to understand the functional links between marine predators, their prey and the marine climate, allowing us to move towards ecosystem-based fisheries management.

CORALS: VICTIMS OF ALGAL OVERGROWTH, BUT CAN THEY FIGHT BACK?

Maggy M. Nugues & Rolf P.M. Bak*

Coral reefs are threatened in their existence by algal overgrowth and coral disease. In studying the mechanism of coral defense against algal overgrowth, we discovered that algae are transmitting a pathogenic bacterium.

Algal invasions and overgrowth are considered as serious threats to marine ecosystems. Proliferating algae can out-compete other benthic organisms and reduce biodiversity. We used the Caribbean coral reef system to develop vital conceptual understanding of algal-coral habitat interactions. Within 30 years, sudden and large-scale increases in the abundance of macroalgae have led to widespread and dramatic shifts from coral to macroalgal abundance on Caribbean coral reefs. Since increases in macroalgal cover and biomass have generally occurred simultaneously with losses in coral cover, it is widely assumed that there has been a shift in the competitive environment, due to reduced herbivory or increased nutrient availability, so that macroalgae have been overgrowing and killing corals. However, there has been no experimental demonstration that macroalgae

could actively overgrow and kill corals and that this process alone could explain coral reef degradation.

We surveyed coral-algal interactions on six reefs in Curaçao (Netherlands Antilles). 30 to 60 % of coral colonies were in contact with, or

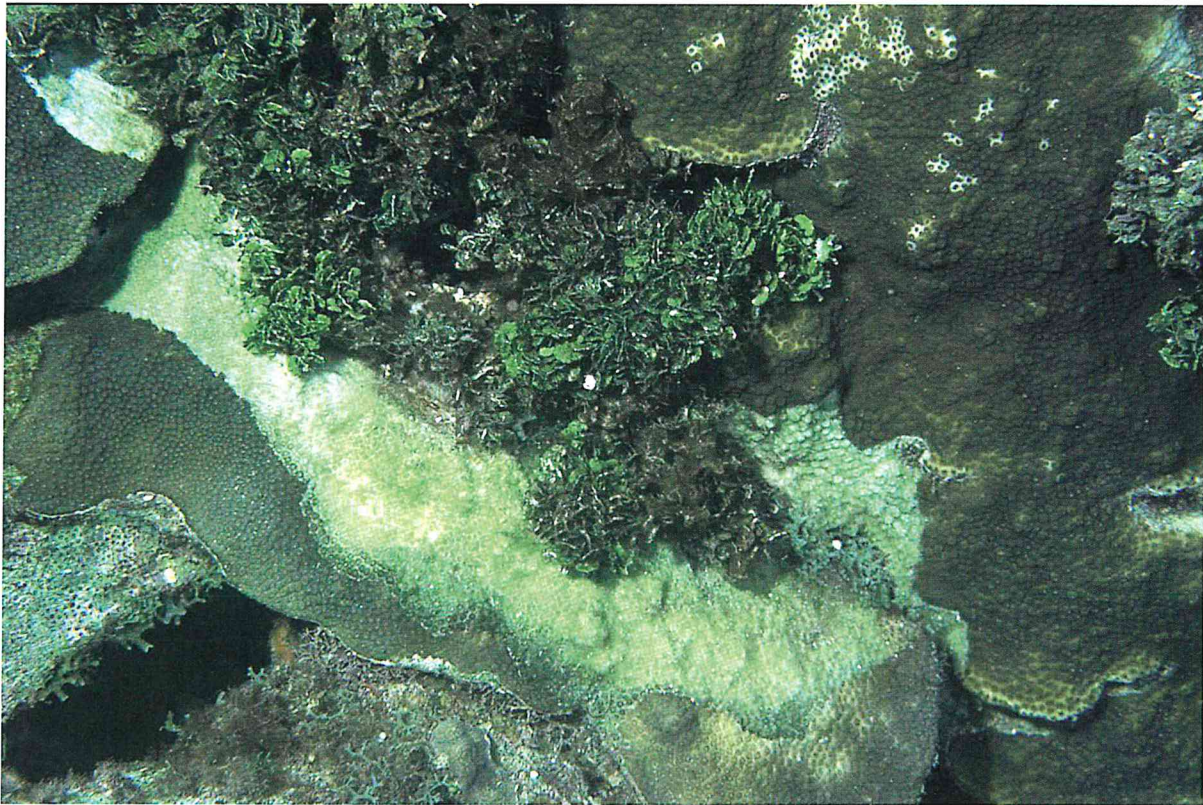


Overgrowth of the coral *Meandrina meandrites* by the brown alga *Lobophora variegata*. 20 m depth, Vaersenbaai, Curaçao.

overgrown by macroalgae, demonstrating the importance of coral-algal interactions on reefs. Using a series of experiments involving coral and algal transplantations, we demonstrated that macroalgae

in general cannot kill corals through competitive overgrowth. Coral margins onto which the brown alga *Lobophora variegata* was transplanted did not experience greater coral mortality than margins kept free of the alga in 5 out of 6 coral species studied. We showed that most coral species were able to extrude arrow-like killing threads ('mesenterial filaments') over a number of algal species. This extrusion was followed by a persistent discoloration due to the movement of chloroplasts in the green alga *Halimeda opuntia*, providing the first ever-reported coral defensive mechanism against macroalgae. The great abundance and wide distribution of the species of corals and macroalgae used in our study, together with observations of mesenterial filaments in natural interactions, suggest that this mechanism could be commonly involved in interaction between

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White plague on a colony of the reef-building coral *Montastraea faveolata* with the green alga *Halimeda opuntia* (top) growing at the point of origin of the disease. The bleached area of the colony has been killed by the disease. 8 m depth, Carmabi Buoy Zero, Curaçao.

corals and macroalgae and explain coral resistance against algal overgrowth.

However, we also found that *H. opuntia* was able to spread a virulent coral disease known as white plague that has caused severe and widespread mortality in most Caribbean coral species. Colonies of the dominant coral *Montastraea faveolata* exposed to algal transplants developed the disease

whereas unexposed colonies did not. Furthermore, the bacterium *Aurantimonas corallicida*, causative agent of the disease, was present on *H. opuntia* sampled close to, and away from diseased corals, indicating that the alga serves as a carrier for this bacterium.

These results suggest that the spread of macroalgae on coral reefs could account for the elevated incidence of coral diseases

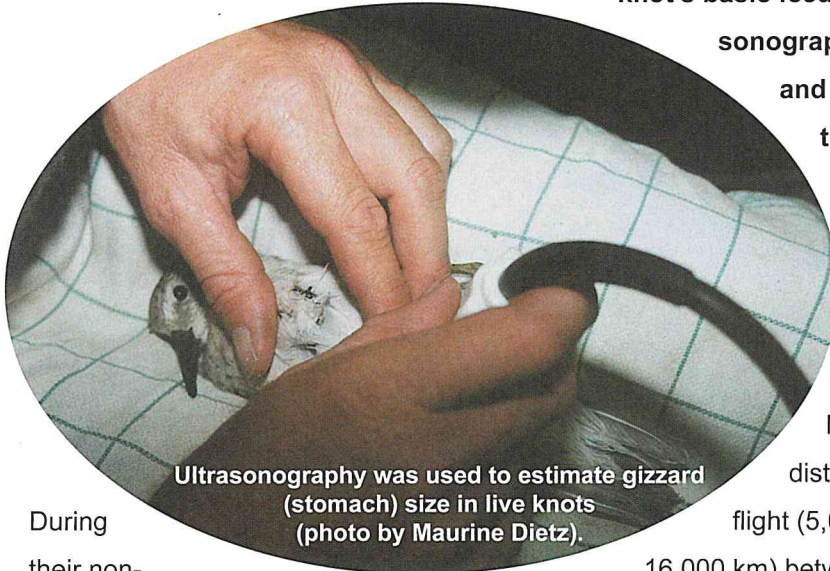
over past decades. We propose a new alternative explanation to coral-algal phase shifts in which macroalgae cause coral mortality, not by direct competitive overgrowth, but by promoting mortality from other processes, such as coral disease. In order to save reefs from destructive diseases, it may be necessary to solve the problem of algal overgrowth.

FORAGING DECISIONS IN A MARINE TOP-PREDATOR, THE RED KNOT (*CALIDRIS CANUTUS*)

Jan van Gils, Theunis Piersma*, Anne Dekinga & Bernard Spaans.

In our department, the red knot (*Calidris canutus*) is used as a model organism to investigate the role of top-predators in marine ecosystems. In this context, the present study aimed at understanding the

knot's basic feeding habits. The application of ultrasonography enabled us to estimate stomach size and revealed that knots adjusted the size of their digestive system to the quality of their intertidal prey. However, at times with only poor quality prey around, knots with the smallest stomachs were the ones most likely to die.



Ultrasonography was used to estimate gizzard (stomach) size in live knots (photo by Maurine Dietz).

During their non-breeding season, red knots are typically found at intertidal mud-flats, where they mainly feed on bivalved shellfish like cockles, which they swallow whole! Knots possess a relatively large muscular stomach or 'gizzard', which allows them to crush their hard-shelled prey internally. This way of feeding comes at a price as a large gizzard requires large transport and maintenance costs. However, knots seem to have found a way out by flexibly reducing the size of their gizzard (and other nutritional organs) at times when feeding is impossible, such as during their

their arctic breeding grounds and their coastal wintering grounds in temperate and tropical zones. However, such reductions (before departure) and

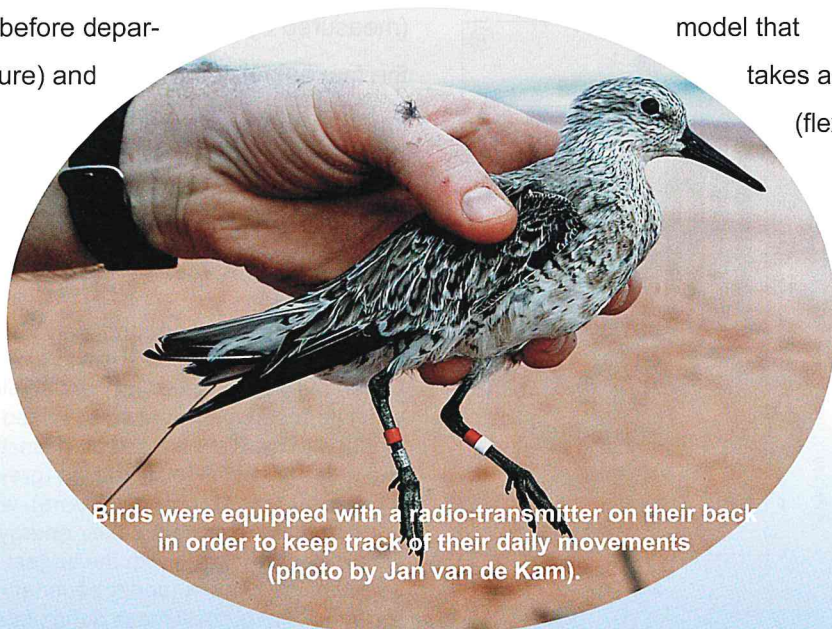
long-distance flight (5,000-16,000 km) between

enlargements (upon arrival) of the digestive system take time and therefore knots in their migratory period often have too small gizzards to (re)fuel at full speed. How red knots cope with this problem is the main theme of this work.

By applying a diet

model that

takes a (flex-



Birds were equipped with a radio-transmitter on their back in order to keep track of their daily movements (photo by Jan van de Kam).

ible) digestive constraint into account, we predicted knots with relatively small gizzards to feed on easy-to-digest, soft-bodied prey (crustaceans) and knots with larger gizzards to feed on more abundant but harder-to-digest, hard-shelled prey (bivalves). As the model predicted birds with the smallest gizzards to obtain the lowest intake rates, we expected those birds to make the longest working days. The use of ultrasonography enabled us to estimate gizzard mass in live knots and to test these gizzard-size dependent diet-predictions.

Indeed, knots lived up to our expectations. Radio-marked, free-living knots that had relatively small gizzards (i.e. those that were about to depart or had just arrived) were found in soft-bodied food

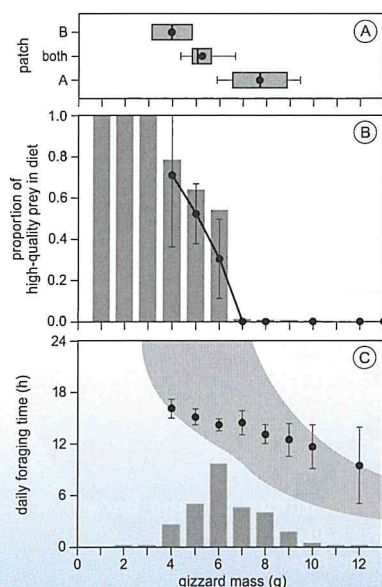


Individual colour-marking was used to estimate annual survival rates. This particular bird was banded near Texel in spring 2002 and was resighted in the UK in winter 2003/2004 (photo by Chris Kelly).

patches, while birds with the largest gizzards were found in hard-shelled food patches. Diet composition varied accordingly (measured by detailed analysis of the faeces), with the softest diets found in knots with the tiniest gizzards. Finally, length of the foraging day declined with gizzard mass, with birds possessing the

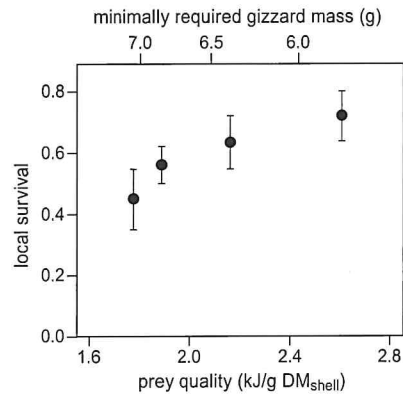
smallest gizzards stretching their working day to almost 17-h (by moving along with the tide in an eastward direction).

By reversing the equations of the diet model we expected and indeed found that knots fine-tuned the size of their gizzard to the local quality of the prey (both within and between years and between sites).



(A). Birds with small gizzards only visited the patch containing the soft-bodied prey (patch B containing shrimps and crabs), while birds with large gizzards only visited the patch containing hard-shelled prey (patch A containing cockles). Birds with intermediate gizzard sizes visited both patches. (B). Proportion of soft-bodied food in the diet declined as a function of gizzard mass (dots $\pm$ SE-bars), in line with theoretical expectations (grey bars). (C). Daily foraging time declined with gizzard mass (dots $\pm$ SE-bars), with birds possessing the smallest gizzards just being able to balance their energy budget (lower boundary of grey surface). On the contrary, birds with the largest gizzards hit the upper limit to daily metabolizable energy intake (upper boundary of grey surface). Grey bars give frequency distribution of gizzard mass during late summers.

Knots possessed large gizzards when their bivalve prey contained little amounts of flesh relative to the amount of shell material, while they possessed smaller gizzards when prey contained relatively good amounts of flesh. However, we observed limits to these flexible adjustments of gizzard size. We calculated that in years with low prey quality the required size adjustments would be too large for some birds to be able to cope. In



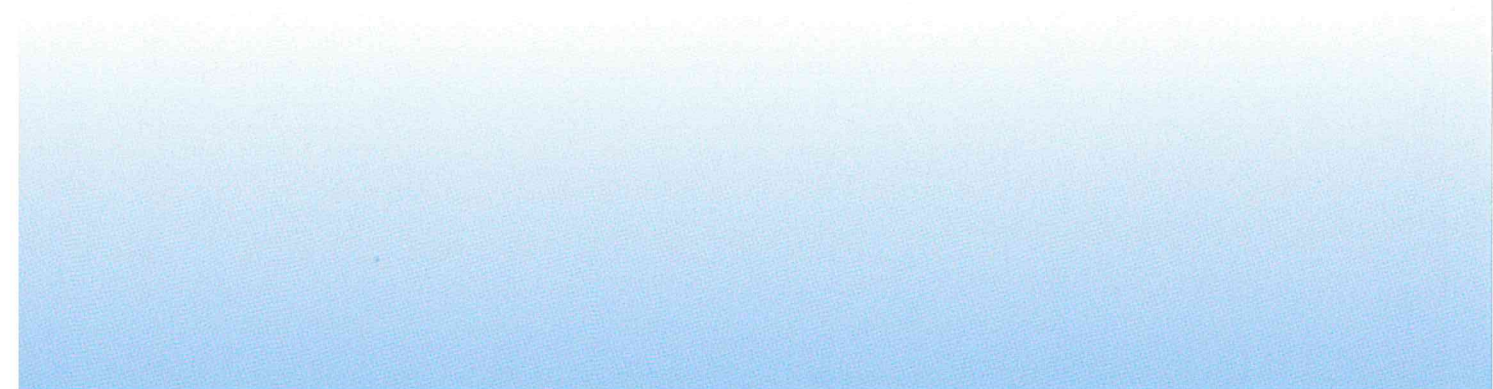
The local survival rate (year-1) of colour-banded red knots increased with prey quality (defined as the amount of metabolizable energy per gram shell mass). Bars give SE.

accordance with this prediction, our colour-marking programme revealed (i) that birds with too small gizzards disappeared and likely died after such years, and (ii) that the proportion of birds that did not disappear (i.e. those that survived) increased with local prey quality. We were able to show that mechanical cockle-fisheries were the direct cause of the observed decline in prey quality in the western Dutch Wadden Sea.

EXTERNAL PROJECTS OF THE DEPARTMENT OF MARINE ECOLOGY AND EVOLUTION

- Biological monitoring programme North sea and Outer Delta (MON*BIOLOGIE, RWS-RIKZ)
R. Daan, M. Mulder
- Biological monitoring macrozoobenthos in Wadden Sea and Ems-Dollard in 2004 (MON*BIOLOGIE, RWS-RIKZ)
R. Dekker
- Pan-European Gradients in Propagation and Settlement Events (EU Network of Excellence on Marine Biodiversity and Ecosystem Functioning)
C.J.M. Philippart
- Effects of variation in nutrient loading on the trophic state of the western Wadden Sea (RIKZ, Kader Richtlijn Water)
C.J.M. Philippart
- Noordzee en Kust: naar duurzame vormen van visserij (LNV)
G.C.A. Duineveld
- Beschermde Gebieden Noordzee (RIKZ)
G.C.A. Duineveld
- Reproductive strategies of high latitude invertebrates AWI-ANTXXII/2
G.C.A. Duineveld, M.S.S. Lavaleye
- Biodiversity and Ecosystem functioning of deep water coral reefs in the Mediterranean Sea and NE Atlantic (BIOSYS, NWO/ALW)
G.C.A. Duineveld
- Development of recruitment landers for North Sea and NE Atlantic shelf edge (NWO/ALW)
G.C.A. Duineveld
- Monitoring marine oil pollution (RWS)
C.J. Camphuysen
- Critical interactions between species and their implications for a precautionary fisheries management (BECAUSE)
C.J. Camphuysen
- Interactions between the marine environment, predators and prey: implications for sustainable sandeel fisheries (IMPRESS)
J. van der Meer, C.J. Camphuysen
- Interference and the spatial distribution of shorecrabs (ALW)
J. van der Meer, I Smallegange

- Functional ecology of preen-gland waxes (ALW)
T. Piersma, J. Reneerkens
- Interference in waders (RUG)
J. van der Meer, T. Piersma, W. Vahl
- East Kalimantan project (coral reefs) (WOTRO)
R. Bak
- Comparison of tropical and temperate bivalves on mud flats (RUG)
T. Compton, T. Piersma
- Analysis of benthos sampling data western Wadden Sea (Natuurmonumenten)
T. Piersma
- Dynamic energy budgets in Atlantic bivalves, 'Van Gogh' (NWO)
H. van der Veer
- Energy budgets in bivalves (EU)
J. Cardoso, H. van der Veer



THE NETHERLANDS MARINE RESEARCH FACILITIES (MRF)

Marieke J. Rietveld

MRF advises the Earth and Life Sciences Board (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 ALW, MRF helps the chief scientists in the planning, preparation and execution of the cruises. MRF also advises ALW on long-term investments, in consultation with the financial department and marine technical services of NIOZ and advisory committees on CTD systems, Auto-analyser systems, Moored instrumentation systems, Bottom sampling and seismic systems and Biological sampling systems. In these advisory committees scientists and technicians from all Dutch scientific groups involved in sea-going research participate.

In June 2004 the updated Long Term Plan on seagoing Marine Facilities 2004 – 2008 was submitted to the NWO advisory Committee for Marine Facilities (CMF). Every year the Long Term Plan will be updated.

In 2004 the National Programme consisted of:

1 PASS-2 2004, Palaeoceanographic, Palaeoclimatic, Palaeo-environmental and diagenetic Aspects of Sapropel formation in the Eastern Mediterranean with emphasis on the most recent S1 (PASS-2). Project manager and cruise leader Dr. G.J. de Lange, Institute of Earth Sciences, Utrecht University. The project is the sea-going contribution to the EU-programme Sapropels and Paleoceanography (SAP). The overall aim is a better understanding of the (paleo)-functioning of the Eastern

Mediterranean and to determine the role in the global environment by studying the characteristic biogeochemical processes.

The Project is a co-operation with Italian research groups. A 20 day cruise was performed on board RV PELAGIA.

2 BADE-2 (competition between flagellate grazing and viral lysis and the role of bacterioplankton cell wall-derived dissolved organic matter in the ocean; project manager Prof. Dr. G. Herndl, NIOZ) a cruise of 33 days was performed on board RV PELAGIA in the North Atlantic off Mauritania in the upwelling area towards the open Atlantic.

3 For the EUROCORES project MOUNDFORCE 2004 (The distribution, morphology and sedimentology of mud mounds in the Gulf of Cadiz and at the South West Rockall Trough Margin; project leader Prof. Dr. T.C.E. van Weering, NIOZ, chief scientist Dr. H. de Haas, NIOZ) a 35 day cruise was performed on RV PELAGIA in both areas.

4 For the EUROCORES project MEDIFLUX/MIMES (An integrated study of seepage through the seabed of the Nile deep-sea fan; chief scientist Dr. J. Woodside, VUA, co-chiefs Dr. J.P. Foucher, IFREMER, and Dr. G. de Lange, UU) a 35 day cruise was performed on RV PELAGIA in the Eastern



Lander preparation during MOUNDFORCE.

Mediterranean and Nile Delta. Through participation of German scientists and technicians the deep tow sonar system of GEOMAR, DTS-1, could be successfully operated together with the Posidonia system from IFREMER.



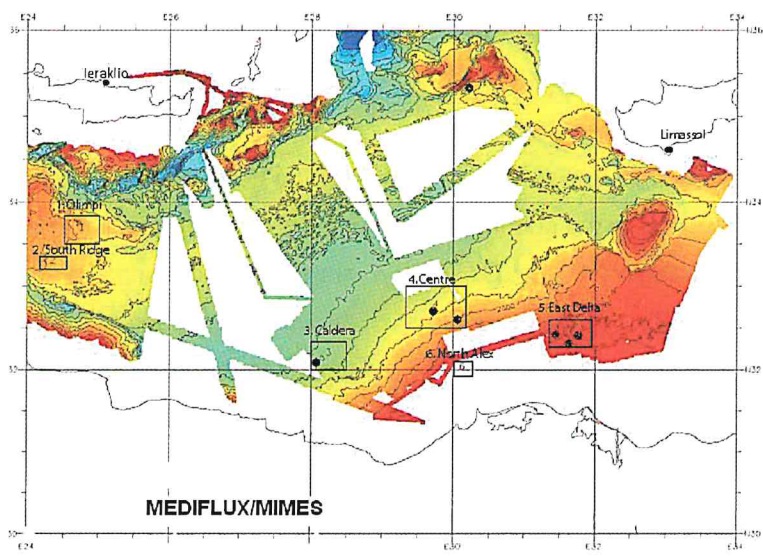
The logo for the site survey IODP549.

5 IODP 549 Site Survey (Recovery of 900 km multi-channel seismic (MCS) lines and 1 million years history of the Indian monsoon to support the IODP proposal 549-Full2; project leader Dr. J.W. Zachariasse, UU, chief scientist Dr. H. de Haas, NIOZ); six science days were chartered on the French RV MARION

DUFRESNE of the Polar Institute (Institut Polaire Emile Victor (IPEV)) during a combined 18 day cruise with the French CHAMAK programme in the Arabian Sea, using the NIOZ 6- and 18-channel seismic system.

For the NWO big-investment grant for the LOCO project (Long-Term Ocean Climate Observations) two cruises were performed.

- 6 LOCO/IW (Long-Term Ocean Climate Observations – Internal Waves; project managers Dr. H. van Haren and Dr. L. Maas, NIOZ); a 26 day cruise was performed in the Atlantic Ocean Canary Basin on board RV PELAGIA.
- 7 LOCO/North Atlantic (Long-Term Ocean Climate Observations – North Atlantic;



The MEDIFLUX/MIMES research area with stations and ports of call in the East Mediterranean Sea.

project manager Dr. H. van Aken, NIOZ): a 10 day barter cruise together with a German group was performed on RRS CHARLES DARWIN in the Irminger Sea for the recovery and redeployment of the 4 LOCO moorings.

Advice to ALW for the National Programme 2005:

For the new project ARCHIMEDES (Activity, Rates, Carbon use and High-pressure Microbial Ecology of the DEap Sea); project manager Prof.dr. G. Herndl, NIOZ, a 28 day cruise was advised in the Atlantic Ocean in the Canary Basin on board RV PELAGIA

For the new project BIOSYS (BIOdiversity and EcoSYStem Functioning of Deep Water Coral Reefs in the Mediterranean and N.E.Atlantic); chief scientist Dr. F. van Duyl, NIOZ, a 21 day cruise was advised in the North Atlantic Ocean West of Ireland (Rockall Trough margin) on board RV PELAGIA.

For the NWO big-investment grant for the LOCO project (Long-Term Ocean Climate Observations) two ongoing cruises were advised. One cruise for LOCO/North Atlantic (project manager Dr. H. van Aken, NIOZ) for a 24 day cruise in combination with the



LOCO/IW preparing the towed ADCP for testing.

NIOZ CLIVAR cruise CAMP and the turn-around of the German CIS moorings, in the Irminger Sea in the North Atlantic on RV PELAGIA and for LOCO/Mozambique (project manager Dr. Ir. H.

Ridderinkhof, NIOZ) in March 2005 for a 20 day cruise on board the UK research vessel RRS DISCOVERY in the Mozambique Strait.

Ocean Facilities Exchange Group (OFEG)

In this framework a number of cruises were performed. A 20 day cruise for the SAGA project of the University of Hamburg (Chief Scientist Dr. M. Hübscher) on board RV PELAGIA in the East Mediterranean Sea off Israel; A 10 day cruise for the

LOCO/Irmingersea cruise on the UK RRS CHARLES DARWIN in the North Atlantic Ocean, and a 7 day cruise for the LOICZ cruise CRENS on board the German RV ALKOR in the North Sea.

In the framework of the Tripartite Agreement, the Ocean Facilities Exchange Group (OFEG), met two times in 2004, in April in London, and in November in Barcelona.

Participants are: NERC and SOC (UK), IFREMER (Fr), BMBF (De) and NIOZ (NL). UTM-CMIMA of the Spanish research council CSIC attended the meetings as an observer.

M.J. Rietveld participated in the 18th meeting of the International research Ship Operators Meeting (ISOM), hosted by the Biological Station of the Hellenic Centre for Marine Research (HCMR) on Rhodes, Greece, in October 2004. After she served the ISOM as Secretary for six years she was nominated Chair of ISOM for a two year term. M.J. Rietveld also took part in the Ocean Fleets Working Group (OFWG) of the ESF Marine Board. In 2004 the OFWG met twice in Paris.

been archived on CD-ROM or DVD and are stored in a safe, for use in case of permanent loss of data by the scientist. Following technical developments and due to the increased size of the collected datasets, the DMG is migrating from the use of CD-ROMs to DVDs.

Besides this archive on CD-ROM/DVD the DMG also maintains a series of databases and project web sites and pages. Part of these are dynamically linked.

One of the highlights of 2004 has been the development of COREBASE (<http://www.nioz.nl/corebase>) in close cooperation with the Department of Marine Chemistry and Geology. COREBASE is an online archive of stored cores which was developed to give a detailed inventory of the cores, their status and the analyses, performed on those cores. COREBASE also

contains high resolution images of cores obtained from the XRF-CoreScanner.

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

The DMG databases residing in Sybase have been queried through the DMG web pages by an average of more than 15000 times per month.

The success of the newly developed CoreBase is shown by the fact that currently 30% of these queries are directed to this database.

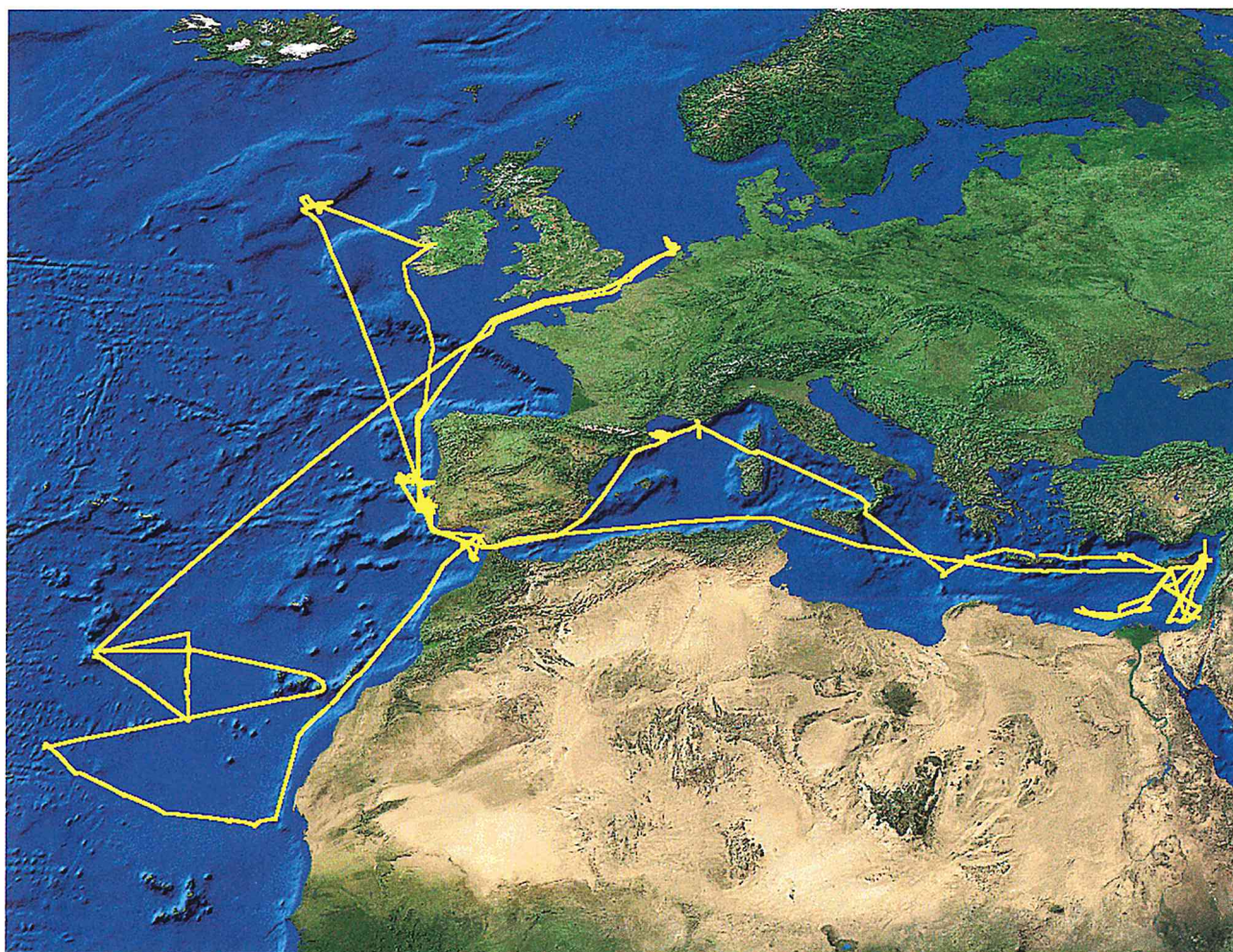
The DMG represents NIOZ and the Dutch academic oceanographic community within the National Oceanographic Data Committee

(NODC). The DMG representative is the NODC Chairman.

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

An additional task of the DMG is the development and maintenance of the Netherlands Antarctic Data Inventory (NADI, <http://www.nadi.nl>) for the Antarctic research projects in the Netherlands. One member of the staff represents the Netherlands in the Joint Committee on Antarctic Data Management (JCADM), which currently has representation from 26 countries. He was elected as JCADM Chief Officer during the meeting in Bremen in July.

Cruise number	Project	Departure	Arrival	Specific area	Chief scientist
64PE222	COMAREC	Feb. 9, Texel	Feb. 13, Texel	North Sea	Ir. M. Bergman
64PE223	COMAREC	Apr. 3, Texel	Apr. 7, Texel	North Sea	Ir. M. Bergman
64PE224	CRENS	Apr. 16, Texel	Apr. 20, Texel	North Sea	Dr. L. Herfort
64PE225	CANYONS-2	Apr. 24, Texel	May 24, Toulon	NW Atl. Oc. / Med. Sea	Dr. H. de Stigter
64PE226	PASS-2	May 27, Toulon	Jun. 13, Iraklion	Mediterranean Sea	Prof. Dr. G. de Lange
64PE227	MEDIFLUX	Jun. 16, Iraklion	Jul. 11, Limassol	Mediterranean Sea	Dr. J. Woodside
64PE228	SAGA-Charter	Jul. 15, Limassol	Aug. 12, Cadiz	Mediterranean Sea	Hamburg University
64PE229	MOUNDFORCE-2004	Aug. 15, Cadiz	Sep. 15, Cadiz	NW Atl. Oc.	Dr. H. de Haas
64PE230	BADE-2	Sep. 17, Cadiz	Oct. 12, Las Palmas	NW Atl. Oc.	Prof. Dr. G. Herndl
64PE231	LOCO-IW	Oct. 15, Las Palmas	Nov. 13, Texel	NW Atl. Oc.	Dr. H. van Haren
64PE232	COMAREC	Nov. 22, Texel	Nov. 26, Texel	North Sea	Ir. M. Bergman



R.V. Pelagia cruises 2004



JOURNAL OF SEA RESEARCH

Background of the Journal

The Netherlands Journal of Sea Research was introduced in April 1961 to publish the investigations of the Netherlands Institute for Sea Research (formerly the Zoological Station of the Netherlands Zoological Society). Although the authors of the first publications were employed as scientists and director of the institute, the Journal became an international platform within a few years. The first special issue was published in August 1973, and comprised the Proceedings of the 7th European Symposium on Marine Biology. To reflect the broadening of the geographical origin of the authors, the name of the journal was changed in 1996 into the Journal of Sea Research. The Journal is published by Elsevier since 1997. The scientific responsibilities and the editorial office have always been within NIOZ.

Publications in 2004

In 2004, the Journal published volumes 51 and 52, each consisting of four issues and together comprising 47 research papers and 4 short communications. A Special Issue, viz. 51(3-4) comprised Part II of the Proceedings of the International Scientific Symposium on "Proceedings of the Fifth International Symposium on Flatfish Ecology".

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Most downloaded articles

Between April 2003 and March 2004, the following articles were downloaded most frequently from the web (the number of downloads are given between brackets).

1. Karsten Reise (n=509)

Sediment mediated species interactions in coastal waters
Journal of Sea Research, 48 (2002) 127-141

2. J. Timothy Wootton (n=426)

Indirect effects in complex ecosystems: recent progress and future challenges
Journal of Sea Research, 48 (2002) 157-172

3. John Widdows and Mary Brinsley (n=389)
Impact of biotic and abiotic processes on sediment dynamics and the consequences to the structure and functioning of the intertidal zone
Journal of Sea Research, 48 (2002) 143-156
4. G. Claireaux and J.-P. Lagardere (n=371)
Influence of temperature, oxygen and salinity on the metabolism of the European sea bass
Journal of Sea Research, 42 (1999) 157-168
5. Anna Lucea, Carlos M. Duarte, Susana Agusti and Morten Sondergaard (n=309)
Nutrient (N, P and Si) and carbon partitioning in the stratified NW Mediterranean
Journal of Sea Research, 49 (2003) 157-170
6. W. F. de Boer and H. H. T. Prins (n=263)
Human exploitation and benthic community structure on a tropical intertidal flat
Journal of Sea Research, 48 (2002) 225-240
7. Gerhard C. Cadée and Jan Hegeman (n=253)
Phytoplankton in the Marsdiep at the end of the 20th century; 30 years monitoring biomass, primary production, and Phaeocystis blooms
Journal of Sea Research, 48 (2002) 97-110
8. Stefan G. Bolam and Teresa F. Fernandes (n=226)
Dense aggregations of *Pygospio elegans* (Claparede): effect on macrofaunal community structure and sediments
Journal of Sea Research, 49 (2003) 171-185
9. S. Dittmann (n=208)
Zonation of benthic communities in a tropical tidal flat of north-east Australia
Journal of Sea Research, 43 (2000) 33-51
10. Margene E. Goecker and Sara E. Kall (n=205)
Grazing preferences of marine isopods and amphipods on three prominent algal species of the Baltic Sea
Journal of Sea Research, 50 (2003) 309-314

Note that the top-3, and number 7 on the list are articles that were part of the Proceedings of the Symposium "Structuring Factors of Shallow

Marine Coastal Communities". This symposium was organised by the Journal in November 2001 to celebrate the 40th anniversary of the Journal and the 125th anniversary of the institute. Compared to September 2003, the online usage of the Journal of Sea Research in September 2004 has increased by 33% to approximately 3000 downloaded articles in one month.

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

Obituary

JACQUES W. DE BLOK 1923-2004

On the 24th of December 2004 our former colleague biologist Jacques de Blok passed away after several years of a debilitating illness. De Blok started studying biology at Leiden University just after the war in 1946. Under Prof. C.J. van de Klaauw he studied the architecture of the asymmetrical head of the plaice (published in four parts in the Proceedings of the Dutch Royal Academy in 1955-'57). In 1952 he worked as a student at the Zoological Station in Den Helder (later NIOZ) on settlement of mussel larvae, together with Hanny Geelen. They found that larvae first settled on thread-like material, to move later on by byssus-drifting to mussel banks. With the renewed interest in byssus-drifting in later years, he published a note on his early work for *Nature* in 1977 (267: 558). In 1953, he started work on lunar and tidal influences on timing of reproduction in marine invertebrates, first as ZWO-financed research. From 1958, Jacques continued as a staff member of the Zoological Station. This work was supervised by dr. P. Korringa (Netherlands Institute for Fishery Investigations) and dr J. Verwey, director of the Zoological Station. In his well known annual reports of the Zoological Station, J. Verwey, mentioned the progress and the difficulties encountered every year. In cooperation with mr. Duk, instrument maker at the Zoological Laboratory of the University of Leiden, an apparatus was constructed to test separately the action of the different factors that change during tidal and lunar cycles. Although the apparatus worked finally, the various species tested proved

very uncooperative in production of clear results and the number of experiments that could be done, working with artificial periodicity cycles of 17 and 34 days, could yield only few data within the reproductive season of each year. However, this study made Jacques an expert in aquarium facilities. NIOZ very much profited by this experience during the planning and construction of the Aquarium building of the new Institute on Texel (1971). The building was fully restored in 2004, but its basic construction concept was kept as it had been for more than 30 years.

Jacques' punctuality made him also a good editor of the Netherlands Journal of Sea Research founded in 1961. He became an editor in 1969, executive editor in 1970 and remained so till his retirement in 1984, when his task was taken over by dr. J.J. Beukema. Jacques was very helpful in guiding NIOZ scientists with their first papers in the Journal. In Jacques' editorial period special volumes were published for the first time, such as Proceedings of EMBS symposia held on Texel (1973 and 1982); and authors were invited to publish together on topics such as Chemistry of the Wadden Sea (1974), *Arenicola* (1979), the Zaire river and deep-sea fan (1984), the Oyster Ground (1984) and the brackish Lake Grevelingen (1984). In Jacques period 'our' NIOZ Journal gradually developed to the high standard international journal as we know it today. Its size changed; no longer are all figures redrawn by the reprographic department at NIOZ, and Dutch authors have become a minority. To indicate this truly international character we have changed the name to Journal of Sea Research in 1996. Since 1997 the journal is published by Elsevier, but its editors are still based at the Royal NIOZ and continue in Jacques de Blok's spirit, publishing papers for an international readership.

G.C. Cadée

QUANTIFYING THE UPTAKE OF FOSSIL FUEL CARBON DIOXIDE BY THE OCEANS

40 Years of Research 1964-2004

In 1957 Dave (Charles David) Keeling from Scripps Institute of Oceanography started the now world-famous time series of atmospheric CO₂ measurements at Mauna Loa, Hawaii (Figure 1). After a few years a rise in CO₂ was apparent, at first controversial due to suggested measurement errors, but already in the early 1960's it was recognized the steady increase was real and attributable to the burning of fossil fuels.

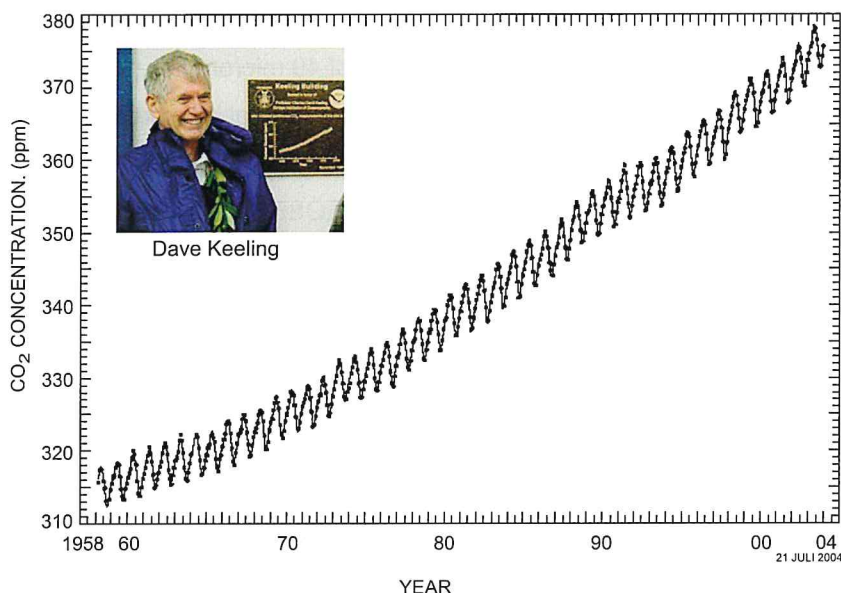


Fig. 1. Dave Keeling and his famous curve of increasing atmospheric carbon dioxide at Mauna Loa over the 1957-2004 period, to be continued. Taken from: <http://cdiac.esd.ornl.gov/trends/co2/sio-mlo.htm>

Henk Postma of the Netherlands Institute for Sea Research, while staying for a while at Scripps, in 1964 wrote an article in the two years young Netherlands Journal of Sea Research in which the fundamentals of the exchange of oxygen and carbon dioxide between ocean and atmosphere were established. This procedure was worked out for the case of the Pacific Ocean. While realizing the poor quality of some of the data he used, the procedure gave a tentative geographical pattern of exchange of carbon dioxide between the Pacific Ocean and the

atmosphere (Figure 2). The shaded areas are the regions where carbon dioxide is outgassing from the ocean to the atmosphere. Immediately Henk Postma recognized that the pattern which existed before the addition of carbon dioxide from fossil fuels can in principle be determined by the same procedure. It was evident that the same procedure would show larger outgassing regions before fossil fuel burning started. In other words, owing to the combustion of fossil fuel, the escape areas have slightly decreased in size. In view of the limited accuracy of the data, Henk Postma did not further quantify this, but speculated that a future 25% increase of atmospheric CO₂ would already cause the high latitude outgassing belts to vanish completely, while the broad equatorial outgassing region would persist much longer. The increase of CO₂ in the oceans due to uptake of excess CO₂ from fossil fuel burning was, in principle, directly measurable (Postma,

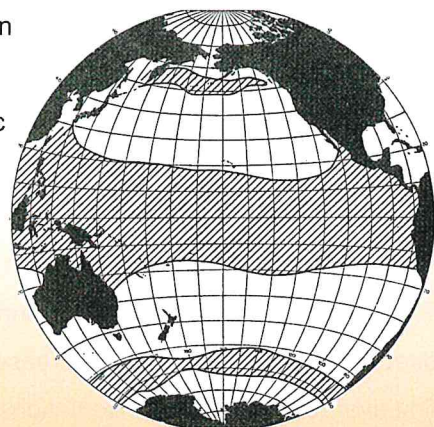


Fig. 2. Tentative geographical pattern of exchange of carbon dioxide between the Pacific Ocean and the atmosphere. Areas where carbon dioxide is transferred from the ocean to the atmosphere are shaded. Taken from Postma (1964).



Henk Postma in about early 1960's.

1964). The basic principles required for such an approach were also well understood at that time (e.g., correction of *in situ* Dissolved Inorganic Carbon (DIC) measurements for changes due to remineralization of soft tissue and dissolution of CaCO_3 , comparison with "initial" or "preformed" concentrations at the sea surface).

However, it was not until an extensive and reasonably high-quality data set for DIC and alkalinity was collected during the GEOSECS expeditions of the 1970's, that the full potential of such an approach was recognized and formalized. Brewer [1978] and Chen and Millero [1979] independently published formal approaches to extract the small excess (anthropogenic) component (order of 40 micromoles per kg seawater) from the large and strongly varying natural background DIC concentration (order 2000 micromol kg^{-1}). They demonstrated the approach using data collected during the GEOSECS Atlantic Survey.

As Brewer [1978] noted, "the oceanic CO_2 concentration is indeed

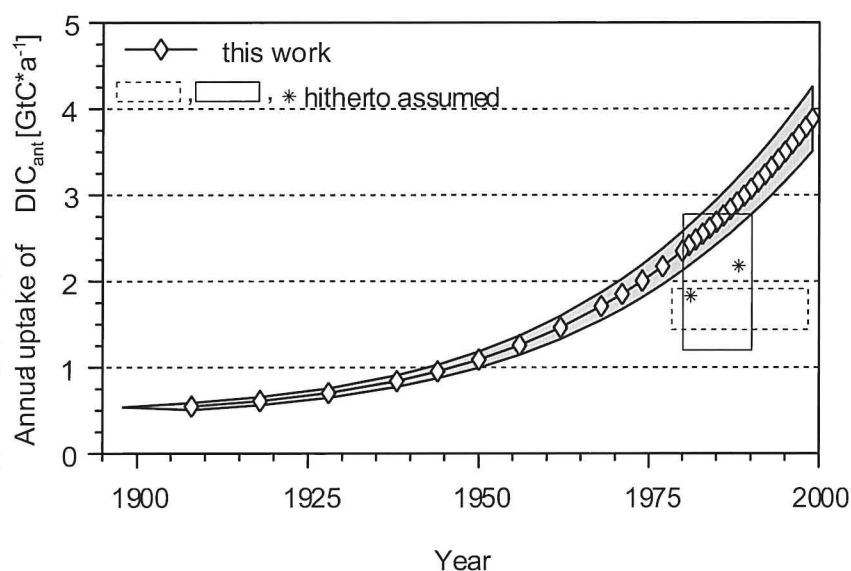
increasing with time..... this increase can be measured directly, and the record of this increase is written in the interleaved structure of oceanic water masses."

Immediately the approach was criticized by sceptical scientists submitting comment articles to various journals. At that time (1978) the undersigned had just started the PhD research in the laboratory of Peter Brewer at Woods Hole, after having become enthusiastic for sea research during the Oceanography course of Henk Postma in 1974. The negative comments by others led to much discussion in our laboratory, and rapid writing of rebuttal statements by Peter Brewer. Eventually due to these criticisms the method fell out of use, except for Arthur Chen who continued to use it in various ocean regions, culminating in a review [Chen, 1993] which included an estimate of the global ocean inventory of excess (i.e. due to fossil fuel) CO_2 for the year 1980.

If we were ever going to have an accurate estimate of excess CO_2 in the oceans, we first should make major improvements in the accuracy of DIC measurements. With painstaking efforts Andy Dickson of Scripps realized the production and distribution of certified standards of CO_2 in seawater, as well as detailed measurement protocols. At the time Andy was visiting us at NIOZ and after a more and more cheerful dinner was amazed by the novel VacuVin rubber cork we used to seal off the final bottle of wine. The next day I gave him one of these Dutch inventions, which he gratefully accepted but at same time said he did not need it, as standard bottles always have to be completely emptied right away. Ever since the early 1990's, his methods and standards have been applied rigorously on all our cruises, and as a result the accuracy of the DIC global dataset has improved greatly.

Mario Hoppema graduated in 1991 under supervision of Henk Postma and he is now working at the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven. Mario realized that this accuracy would allow direct observation of the DIC increase. By comparing several repeat cruises in the Weddell Sea, we were the first ever to report direct observations of increasing DIC in the deep ocean [Hoppema *et al.*, 1998].

Fig. 3. Annual uptake of anthropogenic CO_2 by the world oceans. The shaded area depicts the range between the upper and lower bound due to over- and underestimation of the ocean ventilation rates, respectively. The uptake rates hitherto assumed by common wisdom are indicated by the solid box, by stars and by the dashed box for various work by others, see further Thomas et al., 2001.



Meanwhile the same accuracy was applied in the JGOFS/WOCE Global CO_2 ocean survey in the middle of the 1990's. Simultaneously there was a renaissance of the indirect approach by calculation procedures as pioneered by Postma, Brewer, Chen and Millero, but now more comfortably relying on high accuracy ocean data. Nicki Gruber introduced major refinements of the calculation procedure, and his so-called ΔC^* method was widely accepted as a solid method to calculate the ocean inventory of excess CO_2 from the global oceans dataset [Gruber et al., 1996]. Soon others developed significantly different approaches with the same goal of estimating the excess CO_2 in the oceans [e.g. Goyet et al., 1999].

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Helmuth Thomas having previously worked at Kiel, Warnemuende and Hamburg, came to NIOZ in 1998 in the context of the Netherlands Bremen Oceanography program. While preparing for a major North Sea cruise program to validate the "continental shelf pump hypothesis" he also found the time to visit Australia to collaborate with Matthew England. Together they developed yet another approach to estimate the excess CO_2 in the oceans. The manuscript was heavily criticized by the reviewers because over the years 1980-1989 their annual ocean CO_2 uptake at 2.4-3.1 PgC per year was far too high compared to common 'wisdom' (Figure 3). However the paper was eventually published in 2001 [Thomas et al, 2001]. Some years later such higher ocean CO_2 uptake for the era 1980-1989 has appeared to be evident, and common wisdom has been corrected upwards (Sabine et al., 2004). Nowadays, combining the JGOFS/WOCE survey with the Gruber approach, it is shown that the oceans have taken up 48% of fossil fuel emission over the 1800-1990 era, and 32% over the 1980-1999 era (Table 1). Meanwhile the North Sea program of four cruises in four seasons in 2001-2002 was underway, and resulted in an article published in Science in May 2004 [Thomas et al., 2004]. We had proven that, yes indeed, continental shelf seas are a major sink of excess CO_2 ; when extrapolating to all coastal seas worldwide perhaps as much as 20% of the overall ocean uptake of fossil fuel CO_2 is via coastal seas. The inevitable comment by some others, and our response, were a *déjà-vu* of the early days with Brewer in Woods Hole. Other colleagues however really appreciated the work. This led to an offer Helmuth Thomas could not refuse, and at new year 2005 it is quiet in the CO_2 laboratory at NIOZ, but we will start again, with new staff and new projects continuing the 40 years strong tradition.

Table 1. Anthropogenic CO₂ budget for the anthropocene (1800 to 1994) and for the decades 1980-1999.

See further Sabine et al (2004).

CO₂ Sources and Sinks			
[Pg C] = [Petagram C] = [10 ¹⁵ gram Carbon]			
	1800 to 1994	1980 to 1999	
	[Pg C]	[Pg C]	
<i>Constrained sources and sinks</i>			
(1)	Emissions from fossil fuel and cement production	244 + 20	117 + 5
(2)	Storage in the atmosphere	-165 + 4	-65 + 1
(3)	Uptake and storage in the oceans	-118 + 19	-37 + 8
Inferred net terrestrial balance			
(4)	Net terrestrial balance = [-(1) - (2) - (3)]	39 + 28	-15 + 9

After all some lessons are obvious: never underestimate the pioneer Henk Postma; good concepts often exist already before the data are accurate enough to verify and develop them further; accurate data leads to refined concepts; science is more than Nature or Science, so keep an eye on Geophysical Research Letters; and whenever you publish something original, be prepared for some by-standers to submit comment papers as their cheap route to fame.

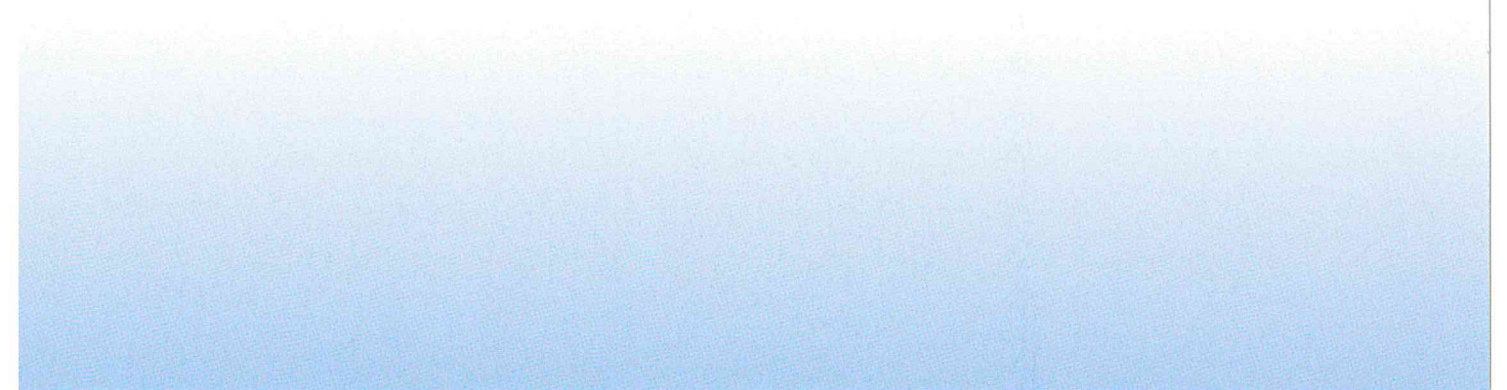
Acknowledgements.

The pioneering contribution of Henk Postma was mentioned to me by Doug Wallace, and this text is largely based on Postma (1964) and Wallace (2001), including verbatim citations. Henk Postma was much indebted to Dave Keeling for valuable comments, while Dave Keeling also plays a key role in the certified standards program of Andy Dickson. His son Ralph Keeling very well understood the same relationships of oxygen and carbondioxide as used by Henk Postma, and pioneered the very accurate detection of decreasing O₂ in the atmosphere due to fossil fuel burning as a sophisticated tool to constrain the fate of fossil fuel CO₂ in the oceans. Texel, 19 January 2005, Hein de Baar.

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Ecological Role of Planktonic Bacteriophages in the North Sea and the Tropical Atlantic Ocean

A geochemical study of lacustrine sediments: towards palaeo-climatic reconstructions of high Andean biomes in Colombia



Life history variation of a marine bivalve (*Macoma balthica*) in a changing world

Jan Drent



Denis L. Volkov

Monitoring the variability of sea level and surface circulation with satellite altimetry

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Jérôme BONNIN

PUBLICATIONS AND PRESENTATIONS

Dissertations

- Bonnin, J. Short-term sediment resuspension on the continental slope and geochemical implications: the Faeroe-Shetland Channel. Utrecht University, 152 pp.
- Boom, A. A geochemical study of lacustrine sediments: towards palaeo-climatic reconstructions of high Andean biomes in Colombia. University of Amsterdam, 125 pp.
- Drent, J. Life history variation of a marine bivalve (*Macoma balthica*) in a changing world. University of Groningen, 192 pp.
- Maier, C. Exploring stable isotopic variation in scleractinian coral tissue and skeleton. Proxies for climate, ecological plasticity and coral functioning. University of Amsterdam, 120 pp.
- Van Gils, J.A. Foraging decisions in a digestively constrained long-distance migrant, the red knot (*Calidris canutus*). University of Groningen, 352 pp.
- Volkov, D. Monitoring the variability of sea level and surface circulation with satellite altimetry. University of Utrecht, 152 pp.
- Winter, C. Ecological role of planktonic bacteriophages in the North Sea and the tropical Atlantic Ocean. University of Groningen, 71 pp.

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- Verbeek, S.A. Reconstruction of climatic events of local, regional or global character archived in *Porites lutea* coral colonies, Berau Delta, East-Kalimantan, Indonesia. East Kalimantan Research Programme.
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- Zegers, B.N., A. Mets, R. Van Bommel, C. Minkenberg, T. Hamers, J.H. Kamstra, J.A. Learmont, M.B. Santos Vazquez, G.J. Pierce, R.J. Reid, I.A.P. Patterson, E. Rogan, S. Murphy, M. Addink, W. Dabin, V. Ridoux, A.F. González, A. López & J.P. Boon. Stereo-isomer specific bioaccumulation of hexabromocyclododecane (HBCD) in marine mammals. Proc. extended abstract 3rd Int. BFR workshop, Toronto, 6-9 June.

Posters

- Bak, R.P.M., M.M. Nugues, G. Nieuwland, Suharsono & D. Kushnida. The health status of the coral reefs of East Kalimantan. Indonesian- Dutch symposium on the East Kalimantan Pilot Phase, Jakarta, Indonesia, 24 - 26 May
- Ballini, M., C. Kissel, C. Colin, T. Richter, T. Dokken, D. Blamart, M. Pagel & L. Labeyrie. Deep hydrological changes in Northern North Atlantic during Heinrich 4 and Interstadials 7 and 8 based on a multi-proxy analysis. 8th International Conference on Paleoceanography, Biarritz, France, 5-10 September.

- Baudoux, A-C. & C.P.D. Brussaard. Characterization of viruses infecting *Phaeocystis globosa* and their occurrence in the field. NECOV symposium "Ecology of Aquatic micro-organisms, University of Amsterdam, May. Poster award.
- Baudoux, A-C. & C.P.D. Brussaard. Different viruses infecting the nanophytoplankton *Phaeocystis globosa*. International Symposium on Microbial Ecology, ISME-10, Cancun, Mexico, 22-27 August.
- Bayon, G., B. Dennielou, N. Vigier, K.W. Burton, J. Etoubleau, J.H.F. Jansen, A. Brenot & J. Carignan. Hafnium isotopes as a probe of silicate weathering processes. European Geosciences Union, 1st General Assembly, Nice, France, 25 - 30 April.
- Bijma, J., H.F. Arlinghaus, G.-J.A. Brummer, H. Elderfield, A. Mackensen, G. Munhoven, M.R. Palmer, G.-J. Reichart, S. Schouten & D. Wolf-Gladrow. Carbonate Chemistry, Carbon Cycle and Climate Change: a multidisciplinary view ("6C"). ICP8, Biarritz, France, 5-10 September.
- Brussaard, C.P.D. & A-C. Baudoux. Phytoplankton virus type diversity. Gordon Research Conference series: Marine microbes – picophytoplankton, from ecology to genomics. Roscoff, Brittany, France, 6-10 June.
- Buijsman, M.C. Evaluating the variability of secondary currents in a tidal inlet with weak curvature. Physics of Estuaries and Coastal Seas (PECS), Merida, Mexico, October.
- Cadée, G.C. Mass mortality of *Corbicula* (Mollusca Bivalvia) in the Rhine in 2003. Conference Dutch Malacological Society Eindhoven NL, 30-31 October.
- Camphuysen, C.J. & M.F. Leopold. Dutch Great Cormorants invade an offshore area. 8th Intern. Seabird Group Conference "North Atlantic Seabird Populations", King's College Conference Centre, University of Aberdeen (UK), 2-4 April
- Cardoso, J.F., J.I.J. Witte & H.W. van der Veer. Seasonal and temporal variability in growth and reproduction in bivalves: the Baltic clam *Macoma balthica* (L.) as an example species. ICES Annual Science Symposium, Vigo, Spain, 22-25 September.
- Casamayor, E.O., C.M Borrego, C. Wuchter, S. Schouten & J.S. Sinninghe Damsté. Microbial dark carbon fixation in oxic-anoxic interfaces and anoxic water masses: Implications for the global carbon budgets under new climatic scenarios. 10th International symposium on Microbial Ecology, Cancun, Mexico, 13-18 September.

- Data Management within the Netherlands Polar Programme – A report from the Netherlands National Antarctic Data Centre. SCAR Open Science Conference at XXVIII SCAR & COMNAP XVI meeting. 25-31 July, Bremen, Germany.
- De Bruin, T.F. & W.T.B. Van Der Lee. The Netherlands National Oceanographic Data Committee – A model for nationwide oceanographic data management. Oceanology International 2004. London, UK, 16-19 March.
- De Goeij, J.M. & F.C. Van Duyl. Are coral cavities sinks of dissolved organic matter? Verwey dagen, 26-28 January.
- De Haas, H., T.C.E. Van Weering, F. Mienis & H.C. De Stigter. Morphology and sedimentology of carbonate mounds at the South Rockall Trough margins. Euromargins Conference, Barcelona, Spain, 11-13 November.
- De Stigter, H.C. & T.C.E. Van Weering. Sediment dynamics of the Nazaré Canyon, Portuguese Atlantic margin. 7th Netherlands Earth Sciences Congress, Veldhoven, 5-6 April.
- Drijfhout, S. & L.R.M. Maas. Impact of rotation and channel geometry on the trapping of internal tides. Symposium on ocean mixing, Victoria, BC Canada, 12 October.
- Esparza, M., J.O. Grimalt, T. Richter & T.C.E. Van Weering. Bidecadal sea surface temperature changes in Feni Drift during the Holocene. 8th International Conference on Paleoceanography, Biarritz, France, 5-10 September.
- Forster, A., S. Schouten & J.S. Sinninghe Damsté. Applying the TEX₈₆ proxy to Cretaceous black shales: Sea-surface temperature reconstruction in a greenhouse world. Gordon Research Conference on Organic Geochemistry, Gordon Research Conference on Organic Geochemistry, Holderness, NH, USA, 8-14 August.
- Groot, M.A.M., H. Hooghiemstra, J.H.F. Jansen & J.C. Berrio Mogollon. Last glacial decadal-to-centennial multi-proxy record of climate variability from Colombian Lake Fuquene: presentation of a next-generation project. 7de Nederlands Aardwetenschappelijk Congres, Veldhoven, 5-6 April.
- Hagelin, J., L.E.L. Rasmussen & J. Reneerkens. Preen gland secretions of a scented and unscented seabird. 26th Annual Meeting of the Association for Chemoreception Sciences, Sarasota, Florida, USA, 23 April.
- Huckins, J.N., K. Booij, W.L. Cranor, D.A. Alvarez, M. Bartkow, J.A. Lebo, C.E. Orazio, R.C. Clark, J.D. Petty, G.L. Robertson & J. Mueller. Status of

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SETAC World Congress, Portland, Oregon, USA, 14-18 November.

Huguet, C., A. Schimmelmann, C. Wuchter & S. Schouten. Application of a new
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occurrence from Santa Barbara Basin. 8th International Conference on
Paleoceanography, Biarritz, France, 5-10 September.

Ivanochko, T.S., R. Ganeshram, D. Kroon, M.R. Fontugne, G. Ganssen, G.J.A.
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Kissel, C., C. Laj, T. Richter, H. Flesche-Kleiven, J. Duprat, J.-L. Turon & L.
Labeyrie. Holocene variations in the strength of the North Atlantic Deep
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Maas, L.R.M. & U. Harlander. Equatorial wave attractors and inertial oscillations.
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August 15-21.

Maier, C., M.G. Weinbauer, J. Pätzold & R.P.M. Bak. Nitrogen and carbon utiliza-
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records in the eastern equatorial Atlantic: Late Pleistocene and Holocene
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Mienis, F., T. Van Weering, H. De Haas, H. De Stigter, A. Wheeler & V. Huvenne.
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Geophysical Research Abstracts, Vol. 6, Nice, France, 25 - 30 April.

Mienis, F., T. Van Weering, H. De Stigter, H. De Haas & T. Richter. Watermass
properties over mounds in the Gulf of Cadiz and the SW Rockall Trough
margin, Euromargins conference, Barcelona, Spain, 17 – 21 November.

Pancost, R.D., S. Pressley, L. Benning, B. Mountain, H.M. Talbot, P. Farrimond,
S. Schouten & J.S. Sinninghe Damsté. A plethora of unusual compounds
in hydrothermal sinters: Reflections of microbial adaptation to extreme

environments and high temperature diagenesis, Gordon Research Conference on Organic Geochemistry, Holderness, NH, USA, 8-14 August.

Parada, V., E. Sintes & G.J. Herndl. Diel dynamics in virioplankton activity. CIESM congress, Barcelona, Spain, June.

Peeters, F.J.C., R. Acheson, G.J.A. Brummer, W.P.M. De Ruijter, G.M. Ganssen, R.R. Schneider, E. Ufkes & D. Kroon. Vigorous exchange between the Indian and Atlantic Ocean at the end of the last five glacial periods. ICP8, Biarritz, France, 5-10 September.

Philippart K., P. Van 't Hof, F. Van Der Meer, J. Van Bleijswijk & A. Bol. Identificatie van schelpdierlarven. Open Dag Koninklijk NIOZ, 23 October.

Powers, L.A., J.P. Werne, T.C. Johnson, I.S. Castañeda, E.C. Hopmans, J.S. Sinninghe Damsté & S. Schouten. An independent paleotemperature reconstruction through the Last Glacial Maximum in Lake Malawi, East Africa. PAGES meeting, Nairobi, 28-30 July.

Powers, L.A., J.P. Werne, T.C. Johnson, I.S. Castañeda, E.C. Hopmans, J.S. Sinninghe Damsté & S. Schouten. An independent paleotemperature proxy for continental paleoclimate reconstruction: Development and application of TEX86 in lakes. Gordon Research Conference on Organic Geochemistry, Holderness, New Hampshire, USA, 8-14 August.

Powers, L.A., T.C. Johnson, J.P. Werne, I.S. Castañeda, E.C. Hopmans, J.S. Sinninghe Damsté & S. Schouten. Large temperature variability in a southern tropical continental setting through the last glacial maximum. AGU Fall Meeting, San Francisco, USA, 13-17 December.

Ramos A., M. Dopico, R. Bao, M. Heubeck, D. Humple, C.J. Camphuysen & Antonio Sandoval Rey. The Prestige incident: assessing the impact of a major oil spill. 8th Intern. Seabird Group Conference "North Atlantic Seabird Populations". King's College Conference Centre, University of Aberdeen, UK, 2-4 April

Rampen, S.W., B.A. Abbas, G. Muyzer, S. Schouten & J.S. Sinninghe Damsté. Reconstruction of the evolution of diatoms using molecular fossils. Gordon Research Conference on Organic Geochemistry, Gordon Research Conference on Organic Geochemistry, Holderness, NH, USA, 8-14 August.

Reneerkens, J., T. Piersma & J. Sinninghe Damsté. Functional aspects of shifts in preen wax composition in shorebirds. Course on Life History Theory, Graduate School Functional Ecology, Schiermonnikoog, 11-15 October

- Richter, T.O., C. Kissel & C. Laj. Holocene terrigenous input patterns and bottom current variability in the NW Atlantic Ocean: Preliminary results. 8th International Conference on Paleoceanography, Biarritz, France, 5-10 September.
- Ridderinkhof, H. The LOCO (Long-term Ocean Climate Observations) programme in the Netherlands. CLIVAR conference. Baltimore, USA, 21-25 June.
- Schefuß, E., S. Schouten, P.M. Grootes, J. Rullkötter & R.R. Schneider. Multi-isotopic analyses of terrigenous lipid biomarkers reveal ocean-climate-vegetation linkages in tropical Africa. 8th International Conference on Paleoceanography, Biarritz, France, 5-10 September.
- Schefuß, E., J.-B. Stuut, J.H.F. Jansen & J.S. Sinninghe Damsté. Stable carbon isotopes of plant-wax lipids in dust and sediments from the central east-Atlantic. EUG General Assembly, Nice, France, 26-30 April.
- Stadnitskaia, A., G. Muyzer, B. Abbas, M.J.L. Coolen, E.C. Hopmans, M. Baas, T.C.E. Van Weering, M.K. Ivanov, E. Poludetkina & J.S. Sinninghe Damsté. Biomarker and 16S rRNA evidence for anaerobic oxidation of methane and related carbonate precipitation in deep sea mud volcanoes of the Sorokin Trough, Black Sea. 10th International Symposium on microbial ecology ISME-10: Microbial Planet: sub-surface to space, Cancun, Mexico, 22-27 August.
- Stadnitskaia, A., H. Niemann, A. Boetius, C. Pierre, I. Bouloubassi & the NAUTINIL Scientific Party. Lithological characteristics of seep-related sediments recovered during Nautille dives on the Nile deep-sea fan, Eastern Mediterranean. European Geosciences Union 1st General Assembly, Nice, France, 25 - 30 April.
- Terra, G.M., W.J. Van de Berg, L.R.M. Maas & A. Doelman. Experiments on an idealized nonlinear tidal resonator. Symposium on Nonlinear Systems, Enschede, 10 & 11 June.
- Terra, G.M., W.J. Van de Berg, L.R.M. Maas & A. Doelman. Experiments on an idealized nonlinear tidal resonator. FOM-Congres Stroming en Warmte, Veldhoven, 8 & 9 November.
- Timmermans, K.R., B. Van Der Wagt & H.J.W. De Baar. Growth rates, half saturation constants, and nitrate, silicate and phosphate uptake in relation to iron availability in 4 large open Southern Ocean diatoms. NECOV symposium "Ecology of aquatic micro-organisms", UvA Amsterdam, 19 May.
- Timmermans, K.R., L. Van Opstal, E. Van Tellingen, C.P.D. Brussaard & M.J.W. Veldhuis. Growth and mortality of Antarctic diatoms in relation to environ-

- mental factors. Nederlands Polair Programma symposium, Teylers Museum, Haarlem, 10–11 May.
- Ufkes, E., J.H.F. Jansen, R.R. Schneider & D. Kroon. The whereabouts of *Globorotalia truncatulinoides sinistral* in the South Atlantic during the last million years. 8th International Conference on Paleoceanography, Biarritz, France, 5 - 10 September.
- Van Den Bergh, G.D., G-J. Brummer, S.A. Verbeek, J.H. Kneepkens, D. Kusnida, S. Lubis, Y. Noviad, K. Budiono, W. Boer, F. Ariese & G. Ganssen. Porites coral as monitor of seasonal rainfall fluctuations and climatic change (ENSO). Workshop on East Kalimantan Research Programme, Pilot phase, Jakarta, Indonesia, 24-26 May.
- Van Dongen, B.E., P.N. Pearson, S. Schouten & R.D. Pancost. An insight into tropical Cretaceous and Paleogene depositional environments using unusually pristine sediments in Tanzania. Gordon Research Conference on Organic Geochemistry, Gordon Research Conference on Organic Geochemistry, Holderness, NH, USA, 8-14 August.
- Van Duyl, F.C. & J.M. De Goeij. Nano- and picoplankton abundance and its depletion by coral reef benthos off East Kalimantan. WOTRO 40 Year Symposium, Amsterdam, 10 November
- Van Duyl, F.C. & J.M. De Goeij. Picoplankton abundance and its depletion by coral reef benthos off East Kalimantan. The joint Indonesia-the Netherlands Symp. on the results of East Kalimantan Pilot Phase Program, Jakarta, Indonesia. 24-26 May.
- Van Haren, H., R. Groenewegen, M. Laan & B. Koster. A fast thermistor string (v. 2) for monitoring (sloping) bottom boundary layer processes and internal waves. 1st EGU General Assembly, Nice, France, 26-30 April.
- Volkov, D.L. Complex singular value decomposition analysis of eddy kinetic energy field in the North Atlantic Current, EGU general assembly, Nice, France, 26-30 April.
- Weijers, J.W.H., S. Schouten, E.C. Hopmans, E. Schefuß & J.S. Sinninghe Damsté. Branched tetraether lipids: A new tool for palaeoclimate studies? Gordon Research Conference on Organic Geochemistry, Gordon Research Conference on Organic Geochemistry, Holderness, NH, USA, 8-14 August.
- Wernand, M. The Arcane Colouring of Natural Waters; from Bacon to Raman. Ocean Optics XVII, Fremantle, Australia, 25-29 October

Wilke, I., F.J.C. Peeters & G.J.A. Brummer. Identification of the Agulhas leakage planktic foraminiferal assemblage. ICP8, Biarritz, France, 5-10 September.

Oral presentations

Amaro, T., S. Schulting & G. Duineveld. Possible causes of shifts in the Frisian Front macrofauna? The 33rd Annual Marine Benthic Ecology Meeting, Mobile, Alabama, USA, 25-28 March.

Amaro, T., S. Schulting & G. Duineveld. Possible causes of shifts in the Frisian Front macrofauna? CIMAR, Porto, Portugal, December.

Amaro, T. Changes in the benthic community in the southern North Sea. Environment Research in context, Apeldoorn, 1-4 March.

Amaro, T., P. Tyler & G. Duineveld. Does the northern bivalve species *Mya truncata* reproduce at its southern distribution limit? Preliminary results. Verweij-PhD meeting, Texel, January.

Arrieta, J.M., E. Sintes, T. Reinthaler & G.J. Herndl. Ectoenzymatic hydrolytic activities in the sea surface microlayer. CIESM congress, Barcelona, Spain, June.

Bak, R.P.M. & G. Nieuwland, Constancy and change in deep reef environments. 10th Int. Coral Reef Symp. Okinawa, Japan, 28 June - 2 July.

Bak, R.P.M. Coral Reef Ecosystems (Master Course Limnology and Oceanography) Lecture series, University of Amsterdam, November

Bak, R.P.M. Coral reefs and sea floor morphology. KNAW/TNO Symposium geo-hazards and resources of the Netherlands Antilles. Utrecht, 23 September.

Bak, R.P.M. The role of urchins as bio-eroders. Diadema Workshop. University of Miami, RSMAS Miami, USA, 19 - 20 March.

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

Ballini, M., C. Kissel, C. Colin, T. Richter, M. Pagel, D. Blamart & L. Labeyrie. Deep hydrological changes in Northern North Atlantic during Heinrich 4 and Interstadials 7 and 8 based on a multi-proxy analysis. European Geophysical Society, Nice, France, 25-30 April.

Booij, K. Chemical and toxicological background of the MARPOL treaty. Marine Environmental Awareness Course, NIOZ, 17 March.

Booij, K. Chemical and toxicological background of the MARPOL treaty. Marine Environmental Awareness Course, NIOZ, 26 October.

Booij, K. Passieve bemonstering: methodes en onmogelijkheden. Seminar "Metten wat los en vast zit". Den Haag, 23 June.

- Booij, K., J.N. Huckins & J.D. Petty. Calculating aqueous concentrations from SPMD-absorbed amounts. 1st International Passive Sampling Workshop and Symposium, Ceske Budejovice, CZ, 15-17 April.
- Boon, J.P., B.N. Zegers, A., Mets, R. Van Bommel, C. Minkenberg & T. Hamers. Stereo-isomer selective bioaccumulation of hexabromocyclododecane (HBCD) isomers in marine mammals from European seas. 3rd International Workshop on Brominated Flame Retardants, Toronto, Canada, 6-9 June.
- Boon, J.P., C.C. Ten Hallers-Tjabbes & M.J.W. Veldhuis. The use of natural seawater and automated analytical methods for testing of ballast water treatment units. Conference on ballast water and waste water treatment aboard ships and in ports, Bremen, 8-10 September. This presentation was also given at the 3rd inter-sessional meeting of the ballast water working group of the Marine Environmental Protection Committee (MEPC) of IMO, London, 4-8 October.
- Bos, O.G. Recruitment variation of *Macoma balthica*(L.): the role of larval food limitation. Recruitment Workshop, Royal NIOZ, Texel, 27 October.
- Brummer, G.J.A., F. Peeters, R. Acheson, I. Wilke, N. Loncaric & D. Kroon. The Holocene - Late Pleistocene history of Agulhas leakage. Atlantic-Indian Ocean exchange workshop, IMAU, Utrecht, 3 June.
- Brummer, G.J.A. Monsoonal upwelling and nitrogen cycling: fluxes and isotopes off Somalia. Cambridge University, U.K., 28 January.
- Brummer, G.J.A., S. Schouten & J. Ossebaar. Stable carbon and nitrogen characterisation of the Somali margin. 6C Annual Meeting, Blagnac, France, 10-12 September.
- Brussaard, C.P.D. & P. Ruardij. Viral role in phytoplankton population dynamics in relation to different environmental variables. International Symposium on Microbial Ecology, ISME-10, Cancun, Mexico, 22-27 August.
- Buehler, D.M. & T. Piersma. Phylogeographic reconstruction of the flyways of red knots within the last 20,000 years. Workshop of the European Science Foundation within the Bird Migration programme, Kalø, Denmark, 20-23 November.
- Buijsman, M.C. Lateral Current Structure in the Marsdiep Tidal Inlet. Nederlands Centrum voor Kustonderzoek (NCK), Ierseke, March.
- Buijsman, M.C. ADCP observations of secondary circulation in the Marsdiep tidal inlet, the Netherlands. 1st EGU General Assembly, Nice, France, 26-30 April.

- Cadée, G.C. Drifting seeds and fruits. Nationaal Herbarium Leiden, 21 January
- Cadée, G.C. Fragmented shells more interesting than entire? Annual conference KNNV, Arnhem, 17 April.
- Cadée, G.C. History of Royal NIOZ. Friends of Teylers Museum, Texel, 6 April
- Cadée, G.C. Research and facilities Royal NIOZ at Texel. Visit KNNV Den Helder, Texel, 12 June.
- Cadée, G.C. Tropical drift seeds from the Dutch coast. KNNV Den Helder, 29 October.
- Camphuysen, C.J. Area-specific feeding behaviour of central place foraging Northern Gannets *Morus bassanus* from the Bass Rock (North Sea). 8th Intern. Seabird Group Conference "North Atlantic Seabird Populations". King's College Conference Centre, University of Aberdeen, UK, 2-4 April.
- Camphuysen, C.J. Census techniques for seabirds at sea: towards the identification of key foraging areas from ship-based surveys. Congresso Internacional Aves do Atlantico, Sao Vicente, Madeira, Portugal 29, October.
- Camphuysen, C.J. Seabird distribution and oceanic upwelling off northwest Africa. Congresso Internacional Aves do Atlantico, Sao Vicente, Madeira, Portugal, 1 November.
- Camphuysen, C.J., B. Scott. & S. Wanless. The distribution and inter- and intra-specific foraging interactions of seabirds and marine mammals of the north-western North Sea: long-term and large-scale patterns reflecting shifts in prey availability and species-specific responses to predictable foraging opportunities. Conference "Management of Marine Ecosystems: monitoring change in upper trophic levels", Zoological Society of London, UK, 22-23 April.
- Cardoso, J.F.M.F., D. Langlet, J.F. Loff, A.R. Martins, J.I.J. Witte & H.W. Van Der Veer. Spatial and temporal variability in growth and reproduction of the Japanese cupped oyster *Crassostrea gigas* (Thunberg, 1793): are they adapting to northern European waters? ICES Annual Science Symposium, Vigo, Spain, 22-25 September.
- Cardoso, J.F.M.F., D. Langlet, J.F. Loff, A.R. Martins, J.I.J. Witte, J. Van Bleijswijk, A. Bol & H.W. Van Der Veer. Reproductive output of the Japanese cupped oyster *Crassostrea gigas* (Thunberg, 1793) along a latitudinal gradient. Recruitment Workshop, Royal NIOZ, Texel, 27 October.
- Cardoso, J.F.M.F., D. Langlet, J.F. Loff, A.R. Martins, J.I.J. Witte, & H.W. Van Der Veer. Is the Japanese cupped oyster *Crassostrea gigas* (Thunberg, 1793)

- Forster, A., M. Baas & J.S. Sinninghe Damsté. Black shale deposition during the Cenomanian/Turonian anoxic event: compound specific $d^{13}C$ -isotope records from different key-locations. 7th Nederlands Aardwetenschappelijk Congres (NAC 7), Veldhoven, 5-6 April.
- Garcia, A.C., H. Coelho, P.C. Leitão, H.C. De Stigter, T.C.E. Van Weering & R. Neves. Internal tide influence on sediment resuspension in Nazaré Canyon and adjacent areas. Joint Eurodelta – Eurostrataform Annual Meeting, Venice, Italy, 20-23 October.
- Gerkema, T. Internal waves: the inner unrest in the ocean. BBOS Autumn Symposium, Schoorl, 5 November.
- Gerkema, T. Near-inertial waves: a "non-traditional" view. University of Waterloo, Belgium, 19 October.
- Harlander, U. A high latitude quasigeostrophic delta plane model derived from spherical geometry. 1st EGU General Assembly, Nice, France, 26-30 April.
- Harlander, U. & A. Will. Eigenschaften extrem wachsender Rossbywellenzuege im Zeitraum 1959-99. DACH Meteorologen Tagung, Karlsruhe, Germany, 7-10 September.
- Herfort, L., S. Schouten & J. S. Sinninghe Damsté. Marine Archaea: missing in the Carbon Cycle? 7th Nederlands Aardwetenschappelijk Congres (NAC 7), Veldhoven, 5-6 April.
- Hosegood, P. & H. Van Haren. Observations of boundary mixing in the pycnocline in the Faeroe-Shetland Channel -- Internal tides versus atmospheric forcing. AGU-Ocean Sciences meeting, Portland, OR, USA, 26-30 January.
- Hosegood, P. & H. Van Haren. The evolution of strong near-bed density fronts in the Faeroe-Shetland Channel. 1st EGU General Assembly, Nice, France, 26-30 April.
- Huguet, C., C. Wuchter, A. Van Vos Avezathe, J.H. Kim, J.S. Sinninghe Damsté & S. Schouten. Validation and application of a new organic paleothermometer, the TEX86: A multiproxy-study of the Last Glacial Maximum in the Arabian Sea. 7th Nederlands Aardwetenschappelijk Congres (NAC 7), Veldhoven, 5-6 April.
- Jansen, J.H.F. Paleoceanography, General circulation. NEBROC-ECOLMAS Introductory Course in Marine Sciences. NIOZ, 24 November.
- Jansen, J.H.F. Paleoceanography, Terrigenous proxies. NEBROC-ECOLMAS Introductory Course in Marine Sciences. NIOZ, 24 November.

- Jansen, J.H.F. Why ice ages, and what does the ocean floor tell about them?
Openbare Scholengemeenschap De Hogeberg, Den Burg, 28 September,
22 November.
- Jukema, J., T. Piersma, C. Both, Y. Verkuil & N. Karlionova. Small male ruffs with
feminine plumages: evidence for a third reproductive strategy, the faeder?
Wader Study Group Annual Conference, Papenburg, Germany, 4-7
November.
- Kissel, C., C. Laj, T. Richter, H. Flesche-Kleiven, J. Duprat, J.-L. Turon & L.
Labeyrie. Holocene variations in the strength of the North Atlantic Deep
Water, a magnetic approach. American Geophysical Union Fall Meeting,
San Francisco, USA, 13-17 December.
- Koning, E. Early diagenesis of biogenic silica. NEBROC course, NIOZ, 18
November.
- Koning, E. The preservation potential of biogenic silica. Proper 2 course,
Barcelona, Spain, 9 November.
- Kuypers, M.M.M., G. Lavik, D. Wöbken, M. Schmid, B.M. Fuchs, M. Strous, S.
Schouten, C. Schubert, R. Amann, B. Barker Jørgensen & M.S.M. Jetten.
Anaerobic ammonium oxidation, a new sink in the marine N-cycle. Gordon
Research Conference on Organic Geochemistry, Gordon Research
Conference on Organic Geochemistry, Holderness, NH, USA, 8-14
August.
- Lavaleye, M.S.S. & J.I.J. Witte. Veertien programma's over diverse onderwerpen
uit het natuurleven in zee, uitgezonden tijdens Natuurwijzer, een radiopro-
gramma over de natuur en het milieu op Texel, Radio Texel.
- Lavaleye, M.S.S. & S. Thatje. First results of the four ALTRAP-lander deploy-
ments in the Weddell Sea, Antarctica. ANT XXI/2 expedition, Polarstern,
Antarctica, 10 January.
- Maas, L.R.M. A mechanical model of convection: first experimental results
obtained with the upward-driven pendulum. 1st EGU General Assembly,
Nice, France, 26-30 April.
- Maas, L.R.M. & H. Van Haren, Dead water.... as possible explanation for fair-
weather drowning. IMAU, Utrecht University, 2 December.
- Maas, L.R.M. & H. Van Haren. Near-inertial internal wave passage through a
deep mixed layer. 1st EGU General Assembly, Nice, France, 26-30 April.
- Maas, L.R.M. Modelling convection in terms of the dynamics of the centre-of-
mass. Symposium on nonlinear systems, University of Twente, 10 June.

- Piersma, T. Protecting the inspirational shorebirds worldwide. Wetlands International 50th Anniversary Executive meeting, Bangkok, Thailand, 25 November.
- Piersma, T. Rapid evolutionary changes in the migrations of red knots: does the passerine model apply? Workshop of the European Science Foundation on the evolution of bird migration, Papenburg, Germany, 10-12 March.
- Piersma, T. Series of 6 lectures in Topmaster course 'Adaptation, Biodiversity and Conservation', University of Groningen, November.
- Piersma, T. Series of four lectures on vertebrate morphology, physiology and evolution. First year course on Biodiversity, University of Groningen, October.
- Piersma, T. Tales of four shorebirds of the open Frisian countryside. Annual meeting Fryske Akademy, Leeuwarden, 20 November.
- Piersma, T. The value of finding out – past, present and future of research in and around Roebuck Bay. Summary statement at Day of the Bay, Broome, Australia, 3 July.
- Piersma, T. Wadden Sea, red knots and beyond, with a brief review of the mudwork in Roebuck Bay. Lecture at Department of Conservation and Land Management, Perth, Australia, 12 July.
- Piersma, T., C. Kraan, A. Dekinga & J.J. Beukema. Long-term research on sediments and the macrozoobenthic communities of intertidal flats in relation to mechanical dredging for shellfish. Symposium on the effects of mechanical shellfishing organized by the Centre for Ecological and Evolutionary Studies (CEES), University of Groningen, 29 January.
- Poole, I., P.F. Van Bergen, J. Kool, S. Schouten & D.J. Cantrill. Can isotopic heterogeneity of fossil woods help determine palaeoclimate? International Association of Wood Anatomists International Symposium on Wood Sciences, Montpellier, France, 24-29 October.
- Poole, I., P.F. Van Bergen, J. Kool, S. Schouten & D.J. Cantrill. Reconstructing palaeoclimate from fossil wood: do carbon isotopes help or hinder? Swedish Museum of Natural History, Stockholm, Sweden, 5 March.
- Reneerkens, J. Schelpdiervisserij en kanoeten in de Waddenzee. Avifauna Groningen, Groningen, 11 February
- Reneerkens, J. Kokkelvisserij. Themamiddag "Milieu de moeite waard" Socialistische Partij, Den Helder, 21 February
- Reneerkens, J., T. Piersma & J. Sinninghe Damsté. Functional aspects of shifts in preen wax composition in shorebirds. Annual Conference International Wader Study Group, Papenburg, Duitsland, 6 November

Rampen, S.W., G. Muyzer, B. Abbas, G. Massé, W.G. Allard, S.T. Belt, J.-M.

Robert, S.T. Rowland, J.M. Moldowan, S.M. Barbanti, F.J. Fago, P.

Denisevich, J. Dahl, L.A.F. Trindade, S. Schouten & J.S. Sinninghe

Damsté. Molecular fossils as time indicators for the evolution of diatoms.

7th Nederlands Aardwetenschappelijk Congres (NAC 7), Veldhoven, 5-6 April.

Rampen, S.W., S. Schouten, G. Muyzer, B. Abbas, F.E. Panoto, K.R.

Timmermans, C.N. Campbell, D.H. Green, J. Fehling, J.M. Moldowan &

J.S. Sinninghe Damsté. A diatomaceous origin for 24-norcholestanes in

sediments and oils. Gordon Research Conference on Organic

Geochemistry, Holderness, NH, USA, 8-14 August.

Reinthal, T., J. Arristegui, P. leB Williams & G.J. Herndl. Prokaryotic production

and growth yield in the North Atlantic Deep Water. Ocean Sciences

Meeting, 16-20 February.

Ridderinkhof, H. Current observations in the Mozambique Channel. ADCP's in

action. Nice, France, 3-4 June

Ridderinkhof, H. The LOCO (Long-term Ocean Climate Observations) programme

in the Netherlands. OceanSites steering committee meeting. Puerto Rico,

USA, 5-8 Januari.

Schouten, S. Isotopic composition of alkenones: a proxy for CO₂ concentrations

in the ocean? Benelux Isotope Users Meeting, Utrecht, 18-19 March.

Schouten, S. 6C update on CO₂ reconstructions using the alkenone paleobarom-

eter. Workshop Meeting EU project 6C, Blagnac, France, 11 September.

Schouten, S. Cretaceous and Cenozoic sea surface temperatures using a new

organic paleothermometer. Graduate course in Organic Geochemistry at

the International University of Bremen, Bremen, Germany, 10 November.

Schouten, S. Cretaceous and Cenozoic sea surface temperatures using a new

organic paleothermometer. Workshop: Greenhouse climate can carbon

cycle dynamics: lessons from the early Cenozoic. International University

of Bremen, Bremen, Germany, 11 November.

Schröder, J., J. Hooijmeijer, C. Both & T. Piersma. Which phenotypic traits are

correlated with reproductive success in the black-tailed godwit? Wader

Study Group Annual Conference, Papenburg, Germany, 4-7 November.

Sinninghe Damsté, J.S. Samenwerking UU-NIOZ op het gebied van organische

geochemie. Ondertekening samenwerkingsovereenkomst NIOZ-UU,

Utrecht, 10 March.

- International Wader Study Group, Annual Conference, Papenburg, Germany, 4-7 November.
- Van Der Meer, J. Long-term variability in secondary production of intertidal bivalve populations is strongly related to recruitment variability. The 33rd Annual Marine Benthic Ecology Meeting, Mobile, Alabama, USA, 25-28 March.
- Van Der Meer, J. Production of cockles and Baltic tellins. Recruitment Workshop, Royal NIOZ, Texel, 27 October.
- Van Der Meer, J., J.J. Beukema, G.C. Cadée, B. Brinkman, R. Dekker & C.J.M. Philippart. Draagvlak voor draagkrachtverlies? CEES-symposium Wetenschappelijke evaluatie van de ecologische effecten van schelpdiervisserij in de Waddenzee, Haren, 29 January.
- Van Dongen, B.E., S. Schouten, P.N. Pearson & R.D. Pancost. Investigation of Cretaceous and Paleogene pCO₂ levels and sea surface temperatures using unusually pristine sediments in Tanzania. 32nd International Geological Congress, Florence, Italy, 20-28 August.
- Van Duyl, F.C. Microbial Ecology of Coral Reefs. Invited lectures University of Amsterdam, Amsterdam, 22 January, 11 November
- Van Duyl, F.C. Nano- and picoplankton abundance and its depletion by coral reef benthos off East Kalimantan. Official visit Indonesian ICOMAR delegation, NIOZ, 5 October,
- Van Duyl, F.C., & J.M. De Goeij. Nano-and picoplankton removal by reef benthos along a trophic gradient in the Berau region (East Kalimantan, Indonesia). EKP Symposium, Naturalis, Leiden, 2 November
- Van Gils, J.A. & B. Spaans. Veranderingen bij kanoetstrandlopers en de mogelijke relatie met schelpdiervisserij. CEES-symposium Wetenschappelijke evaluatie van de ecologische effecten van schelpdiervisserij in de Waddenzee, Haren, 29 January.
- Van Gils, J.A. Effecten van schelpdiervisserij op kanoetstrandlopers. Open Universiteit, Utrecht, 2 October.
- Van Gils, J.A. Hotspots in the knot migration system: bottlenecks in two dimensions, a combined laboratory and field study. ESF Travelling to Breed Workshop Kalø, Denmark, 21-23 November.
- Van Gils, J.A. Prooi- en plaatskeuzen van kanoeten: optimal foraging theory in de praktijk. Gastcolleges aan IBED, Amsterdam, 13 February, 23 December.
- Van Gils, J.A. Scaling-up from digestive physiology to population ecology: a case study in red knots. Seminar at RUG, Groningen, 24 February.

- Van Gils, J.A. Scaling-up from digestive physiology to population ecology: a case study in red knots. Seminar at NIOO-CL, Nieuwersluis, 14 June.
- Van Gils, J.A., B. Spaans, A. Dekinga, C. Kraan & T. Piersma. Scaling-up from digestive physiology to population ecology: a case study in red knots. ISBE-conference, Jyväskylä, Finland, 10-15 July.
- Van Haren, H. Deep inertial motions in the Mediterranean Sea. LODYC, Univ. Pierre et Marie Curie, Paris, France, 8 June.
- Van Weering, T.C.E., H. De Haas, H.C. De Stigter, F. Mienis & Th. Richter. Carbonate mounds and reefs at the Rockall Trough and Gulf of Cadiz: Moundforce progress 2nd Euromargins Conference, Barcelona, Spain, 11-13 November.
- Vahl, W.K., T. Lok, J. Van Der Meer, T. Piersma & F.J. Weissing. Kleptoparasitism over small scale feeding sites; a potential interference mechanism. Verweij PhD-meeting, Texel, 28-30 January.
- Vahl, W.K., J. Van Der Meer, T. Piersma & F.J. Weissing. Foraging and Interference. Lecture undergraduate course 'Experimental Ecology', University of Groningen, 12 March.
- Vahl, W.K., J. Van Der Meer, T. Piersma & F.J. Weissing. The adaptive value of social interference among foraging waders. International Society for Behavioral Ecology. Jyväskylä, Finland, 10-15 July.
- Vahl, W.K., K. Meijer, J. Van Der Meer, T. Piersma & F.J. Weissing. Interference competition among foraging waders: a field experiment. Annual meeting of the Dutch Society for Behavioral Biology, Dalfsen, 25-27 November.
- Veldhuis, M. & J.P. Boon. The Ballast water issue: Techniques, Treatments and Measurements; a new Dutch Research Initiative.. ICES/IOC/IMO Working Group on Ballast and other Ship Vectors (WGBOSV), Cesenatico, Italy, 22-24 March.
- Veldhuis, M.J.W. Cell related processes and functional studies "The Role of Flow Cytometry in Marine Biodiversity and Ecosystem Functioning", Stazione Zoologica "A. Dohrn", Naples, Italy, 3-6 November.
- Veldhuis, M.J.W. Flow cytometry in Aquatic Sciences. Beckman Coulter Workshop, Woerden, 10 November.
- Veldhuis, M.J.W., M. Bossink & J.P. Boon. Effect of secondary Ballast Water Treatments on phytoplankton; a new technique to test the cell viability. Second International Conference & Exhibition on Ballast Water Management, Singapore, 19 – 21 May

- Veldhuis, M.J.W. Single cell analysis; current status and future potential. Rijks Universiteit Groningen. 18 March.
- Versteegh, G.J.M. & K.A.F. Zonneveld. Selective preservation of palynomorphs and its consequences. XI International Palynological Congress, Granada, Spain, 4-9 July.
- Versteegh, G.J.M. Proxy evidence for solar forcing of climate - more questions than answers ESF-HOLIVAR workshop Holocene climate variability and climate forcing, Kastanienbaum, Switzerland, 23-25 September.
- Versteegh, G.J.M. Sun-climate relations, evidence from the past. Workshop solar induced climate change. Royal Dutch Meteorological Institute, De Bilt, 6 September.
- Versteegh, G.J.M., E. Raevskaya. & T. Servais. On the biological affinities of galeate acritarchs: morphological and biogeochemical data. XI International Palynological Congress, Granada, Spain, 4-9 July.
- Versteegh, G.J.M., P.F. Van Bergen & J.W. De Leeuw. Biomacromolecules of plants and algae and their fossil analogues. Symposium: Plants and (Present and Past) Climate Change. Amsterdam, 23 April.
- Volkov, D.L. The comparative analysis of the sea level variability in the North Atlantic and North Pacific from 1993 to 2002, EGU General Assembly, Nice, France, 26-30 April.
- Volkov, D.L. The variability of sea level in the North Atlantic and North Pacific in 1993-2003 observed with satellite altimetry, Joint Assembly of AGU, CGU, SEG and EEGS, Montreal, Canada, May.
- Wagner, T., S. Kasten, S. Kolonic & the CT-Net Research Group. The mid-Cretaceous NW-African shelf basin at Tarfaya: A key site to assess rapid change in ocean chemistry under extreme climate conditions. ICP8 Meeting, Biarritz, France, 5-10 September.
- Weijers, J.W.H., E.C. Hopmans, S. Schouten, T. Wagner & J.S. Sinninghe Damsté. A novel proxy for fluvial terrestrial carbon input into the marine environment based on tetraether membrane lipids in sediments. Zevende Nederlandse Aardwetenschappelijk Congres, Veldhoven, 5-6 April.
- Wernand, M.R. The Arcane Colouring of Natural Waters; from Bacon to Raman. Ocean Optics XVII, Fremantle, Australia, 25-29 October.
- Werne, J.P., L.A. Powers, T.C. Johnson, E.C. Hopmans, J.S. Sinninghe Damsté & S. Schouten. The development of TEX86 for continental paleotemperature reconstruction. AGU Fall Meeting, San Francisco, USA, 13-17 December.

Wijmenga, J., Y. Verkuil, J. Hooijmeijer, C. Both, J. Jukema & T. Piersma.

Turnover rates and population estimates of spring migrating ruffs
(*Philomachus pugnax*) in southwest Fryslân, The Netherlands. Wader
Study Group Annual Conference, Papenburg, Germany, 4-7 November.

Wilke, I., F.J.C. Peeters & G.J.A. Brummer. Identification of the Agulhas leakage
planktic foraminiferal assemblage. NAC, Veldhoven 4 & 5 April.

Will A., U. Harlander & W. Metz. Singular vectors and teleconnections. 1st EGU
General Assembly, Nice, France, 26-30 April.

Winter, C., A. Smit, G.J. Herndl & M.G. Weinbauer. Linking bacterial community
composition with viral abundance and prokaryotic activity in the North Sea.
EGU Meeting, 26-30 April.

Witbaard, R., E. Jansma & U. Sass-Klaassen. Copepods link quahog growth to
climate. QRA MSG meeting, University of Wales, Bangor, UK, 7-9 January.

Witbaard, R., U. Sass-Klaassen & E. Jansma. Long term trends in the growth
rates of *Arctica islandica* from the northern North Sea and its indirect cou-
pling to climate. 7de Nederlands Aardwetenschappelijk Congres,
Veldhoven, 5-6 April.

External professional functions

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M.A. Baars

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

R.P.M. Bak

- professor Tropical Marine Biology, University of Amsterdam
- Editorial Advisor Marine Ecology Progress Series
- member Visitation Committee Wissenschaftsrat
- member Board Foundation for Scientific Research Surinam and the Netherlands
Antilles
- member council International Society for Reef Studies
- lid programmacommissie Biodiversiteit NWO

M.J.N. Bergman

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

W. Boer

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

J.P. Boon

- Member of the ICES Marine Chemistry Working Group
- Member "Commissie voor de Milieu-Effect Rapportage (CMER)"
- Member of the advisory board of the Institute for Risk Assessment Sciences (IRAS), Utrecht University
- Member of the Dutch Delegation at the 3rd inter-sessional meeting of the ballast water working group of the Marine Environmental Protection Committee (MEPC) of IMO, London, 4-8 October

G.-J.A. Brummer

- Coordinator Bilateral Cooperation Programme NWO-DFG "Divalent cations: development and validation of proxies"
- advisory member ESF-EUROCLIMATE programme
- advisory member EU-FP6 programme "6C"
- member NWO/ALW 'Gebruikers-adviesgroep verankerde instrumentatie'

G.C. Cadée

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

C.J. Camphuysen

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

H.J.W. De Baar

- professor of oceanography, University of Groningen
- associate editor Marine Chemistry
- life member Clare Hall College, Cambridge
- chairman, Netherlands SCOR Committee of Royal Academy of Sciences (KNAW) SCOR= Scientific Committee Oceanic Research
- chairman, Users Advisory Group, Nutrients, national Marine Research Facilities
- deputy coordinator, CarboOcean Integrated Project of European Union Framework Program VI.
- member Netherlands SCAR committee of Royal Academy of Sciences (KNAW) SCAR= Scientific Committee Antarctic Research
- member Scientific Steering Committee Netherlands-Bremen Oceanography (NEBROC)
- member IGBP/WCRP Committee of Royal Netherlands Academy of Sciences (KNAW)
- associate member SCOR Group for international GEOTRACES program on Trace Elements and Isotopes in the Oceans
- member Users Advisory Group, CTD systems, national Marine Research Facilities
- external adviser BELCANTO (Belgian research Carbon uptake in the ANTArctic Ocean)
- external member thesis evaluation committee Dr. Agathe Laes, UBO, Brest.

T.F. De Bruin

- Chair - Netherlands National Oceanographic Data Committee (NL-NODC)
- Chief Officer - Joint SCAR-COMNAP Committee on Antarctic Data Management (JCADM)
- Member - ICES Working Group on Marine Data Management (ICES-WGMDM)
- Member - International Expert Team for Evaluation of Flanders Marine Institute (VLIZ)

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 of the Centre for African Wetlands, University of Ghana, Accra, Ghana
- Member Audit Committee Research component Nederland-Gruttoland, Vogelbescherming
- Member of Committee of Experts for Natuurmonumenten
- Member of Board It Fryske Gea

J. Reneerkens

- Editor Limosa

H. Ridderinkhof

- Member Committee 'Milieueffectrapportage'
- Member 'Beleidsadviescommissie Aardwetenschappen ALW - NWO'
- Member EUROGOOS-NL
- Member 'Programma commissie NCK'
- Member 'NWO committee Marine Research Facilities'

M.J. Rietveld

- Chair International research Ship Operators Meeting' (ISOM)
- member Ocean Facilities Exchange Group (OFEG)
- member European Research vessel Operators (ERVO)
- member ESF Marine Board Ocean Research Fleets Working Group (OFWG)
- member POGO Working Group Research Vessels and Cruises Database
- member Interdepartementaal Overleg Zeegaande Vaartuigen (IOZV)

S. Schouten

- Associate editor Organic Geochemistry
- Member of the steering committee of the Benelux Isotope Users Group
- Member of the steering committee International Census of Marine Microbes

J.S. Sinninghe Damsté

- Part time professor University of Utrecht, Faculty of Geosciences
- Associate editor Organic Geochemistry
- Associate editor Geology
- Member of the Klankadviesgroep Euromargins
- Co-ordinator of EC Network C/T-Net
- Member of the Science Comm. of the NIOO
- member "ALW apparatuur commissie"
- member "ALW VICI commissie"

C.C. Ten Hallers-Tjabbes

- Advisor to IUCN for the London Convention 1972.
- Advisor to IUCN for the International Maritime Organization, London (IMO)

- IUCN Representative for the Marine Environment Protection Committee of the IMO
- Advisor Netherlands Delegation White Water to Blue Water- Miami Conference
- Lady Chairman Animal Navigation Group, Royal Institute of Navigation, London, U.K
- Advisor to IUCN for the Globallast UNDP-IMO-GEF Global Project

H.M. Van Aken

- Member ICES Oceanography Committee
- Member ICES Working Group on Oceanic Hydrography
- Chairman "ALW gebruikersadviesgroep CTD-systemen"
- Member "ALW apparatuurcommissie"
- Member Editorial Advisory Board of the Archive of Fishery and Marine Research
- member OCEANSITES International Time Series Science Team

M.A. Van Arkel

- member Working group 'Monitoring rond Mijnbouwininstallaties'

A.J. Van Bennekom

- Member "Deutsche Arbeits Kreis Geschichte des Meeresforschung"

P. Van Den Hout

- Secretary Nederlandse Ornithologische Unie

S.J. Van Der Gaast

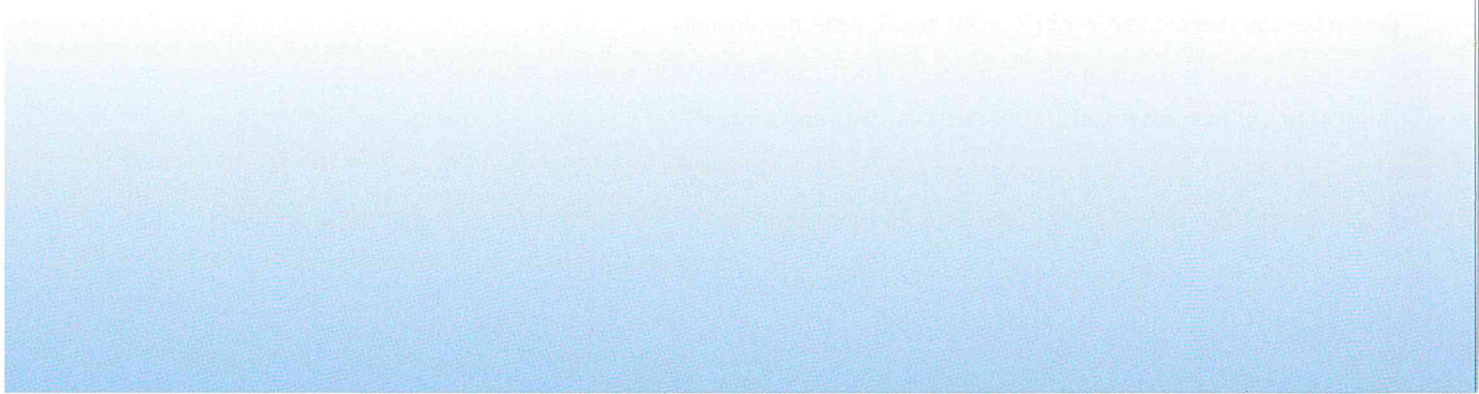
- member editorial board of Applied Clay Science
- member of the XRPD group of the NKV (Ned. Kristallografische Ver.)

H. van Haren

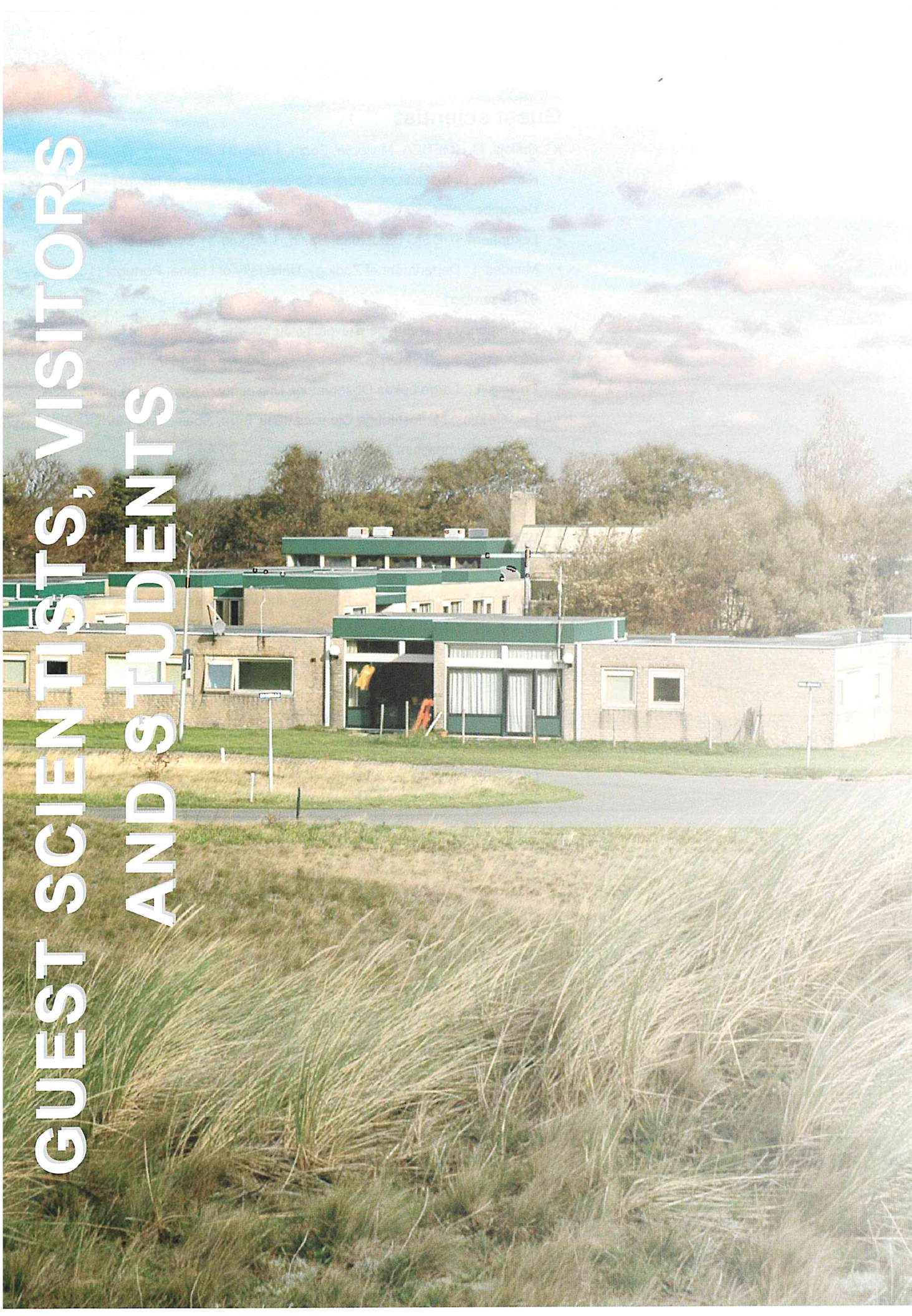
- Convenor EGU 1st General Assembly session OS3 'Small and meso-scale processes and their impact on the large scale', Nice 26-30 April.
- Guest editor Deep-Sea Research II, volume on 'Small and meso-scale processes and their impact on the large scale'.
- Member editorial board Journal of Sea Research.
- TOPIC EDITOR OCEAN SCIENCE
- Chairman "ALW gebruikersadviesgroep Verankerde Instrumentatie"

J. Van Der Meer

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



GUEST SCIENTISTS, VISITORS AND STUDENTS



Guest scientist

- Calleja, M., IMEDEA, Mallorca, Spain, 1 May-31 July.
- Kitazawa, D. Institute of Industrial Science, University of Tokyo, (Japan) 1 December 2004 -30 November 2005
- Lekunberri, I., CSIC Barcelona, Spain, 1 August-31 September.
- Mendes, L. Department of Zoology, University of Lisboa, Portugal (1 January - 31 December)
- Partington, J., Cambridge University, 30 March – 8 April.
- Pernthaler, J., MPI Marine Microbiology, Bremen, 12-16 January.
- Powers, L., Large Lakes Observatory, University of Minnesota Duluth, USA.
- Rejas Alejos, M., Institut de Ciències de la Terra, Spain, 1-19 March.
- Stuke, F, Gymnasium Munster, Germany, 5 – 20 April
- Tsikos H., University of Oxford, UK.
- Wagner, T., University of Bremen, Germany.
- Williams P. leB., School of Oceanography, Univ. of Wales, Bangor, 21-25 January
- Zegers, B.N., Institute for Biodiversity and Ecosystem Dynamics (IBED), University of Amsterdam.

Visitors

- Anand, P., Faculty of Earth and Life Sciences, Free University Amsterdam.
- De Visser, Dr J., University of Amsterdam, 27 January Larcombe, P., CEFAS, Lowestoft, UK, 7 October
- Elderfield, Prof. Dr. H., Faculty of Earth Sciences, Cambridge University, UK.
- Gill, R.E., Jr., Alaska Science Center, US Geological Survey, Anchorage, Alaska, USA
- Husrin, Ir. S., Agency for Marine and Fisheries Research, Jakarta, 15 October 2004 - 15 January 2005
- Lymer, D. PhD-student. Limnology/Department of Ecology and Evolution, Evolutionary Biology Centre, Uppsala University, Uppsala, Sweden. 6-19 July.
- Menge, B.A. Prof Dr, Oregon State University, Oregon USA, 26-28 October
- Moodley, Dr. L., Department of Ecosystem Studies, Netherlands Institute of Ecology (NIOO), Centre for Estuarine and Marine Ecology (CEME), Yerseke.
- Nigam, Dr. R. Geological Oceanography Division, National Institute of Oceanography, Dona Paula, Goa, India.
- Peeters, Dr. F.J.C., Faculty of Earth and Life Sciences, Free University Amsterdam.

- Pierre, Dr. C., CNRS Laboratory of Dynamic Oceanography and Climatology of the University of Pierre and Marie Curie (UPMC), Paris, France, 28-30 October.
- Saraswat, Dr. R., Geological Oceanography Division, National Institute of Oceanography, Dona Paula, Goa, India.
- Taberber, C., Institut de Ciències de la Terra, Barcelona, Spain, 26 March.
- Turner, Dr. S., Queensland Museum, Queensland, Australia
- Vähätalo, A., Ph.D., Dept. Biological & Environmental Sciences, University of Helsinki, Finland.
- Van Soest, Dr R.W.M., University of Amsterdam, 3 August
- W. Cresswell, University of St Andrews, UK, 22-24 October.

Undergraduate University Students

- Appelhof M., Friesland College, Faculty Microbiology; Leeuwarden
- Bangma, M., Hogeschool Amsterdam.
- Battigelli, C., University of Torino, Italy.
- Baudana, M., University of Torino, Italy.
- Bongaerds, P., Universiteit Utrecht
- Buschman, F., Wageningen University.
- Cleto, S., University of Porto, Portugal
- De Bruijn, J., Utrecht University.
- De Jong, F. Universiteit Utrecht
- De Jongh, F., Universiteit van Amsterdam
- De Vos, J. Hogeschool Amsterdam.
- Eijkelenboom, H., Wageningen University and Research Center
- Feringa, S.A., Universiteit van Groningen.
- Flohil M., Academy Utrecht, Faculty Life Sciences & Chemistry; Utrecht
- Groot, L. ROC, Amsterdam.
- Kester, L., Mondriaancollege, Delft.
- Lammerts, L., Drenthe College.
- Mai, D. ROC, Amsterdam.
- Martins, A.R., University of Porto, Portugal
- Mimpfen, R. Hogeschool InHolland, Delft.
- Minderman, J., Universiteit van Groningen.
- Minkenberg, C., Fontys Hogeschool, Eindhoven.
- Neven, I. Rijksuniversiteit Groningen.

- Rodriguez-Hernandez, D., Hogeschool Zeeland, Vlissingen.
- Sanchez, L., Hogeschool Zeeland
- Sap K.. Academy Rotterdam, Faculty Biology & Medical Laboratory Research; Rotterdam
- Schulting, S., Universiteit Wageningen
- Shaikh, D. International University of Bremen.
- Sjollema, S., Hogeschool Utrecht
- Sperber, V. Landbouw Universiteit Wageningen.
- Sprangers, M. Utrecht University.
- Van 't Hof, P., Universiteit Wageningen
- Van Bemmelen, R., Universiteit van Amsterdam
- Van Den Berg H.A., Rijksuniversiteit Groningen
- Van Der Schaik R.. Laboratorium Technical School, Faculty Microbiology; Leeuwarden.
- Van der Zeijden, M., Mondriaancollege, Delft.
- Van Leverink, D., Vrije Universiteit Amsterdam.
- Van Oostveen, M.M., Rijksuniversiteit Groningen
- Van Opstal, L. Fontys Hogeschool, Eindhoven.
- Woltering M., Saxion Hogeschool IJsselland.

TECHNICAL SUPPORT SERVICES

Jan van Ooyen, Marieke J. Rietveld & Marck Smit

Research Vessel PELAGIA

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

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



Repair work at A-frame of RV PELAGIA during MOUNDFORCE cruise

Smaller research vessels

Research Vessel NAVICULA: NIOZ has a 25 m research ship specially designed for working in the shallow Wadden Sea. She has been built in 1980, and was elongated in 1999. In spring 2004 major upgrading was completed.



RV Navicula

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The new build RV NEREIS (20m) that was planned for delivery early 2004 had serious delay due to requirements of the Dutch Shipping Inspection, that were badly understood by the shipyard. Extra work was needed to meet all classification requirements.

NEREIS is a small fast aluminum twin hull RV with waterjet propulsion (20 kn) for the shallow Wadden Sea (draught: 0.8m) and nearby coastal work. A shared ship with the Netherlands Organisation for Applied Technology (TNO)

NIOZ harbour

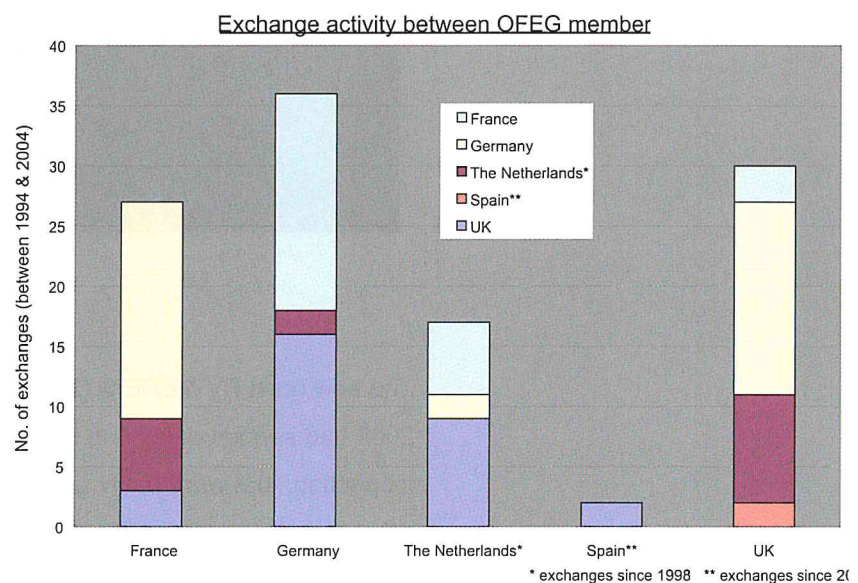
Work is ongoing to change the lay-out of the NIOZ harbour in order to protect the smaller ships from damage by stormy easterly winds.

Ocean Facilities Exchange Group

The OFEG's primary objective is bartering shiptime and exchange of major marine equipment without the need to exchange money. This arrangement has significant advantages. It allows scientists access to a

wider range of facilities and equipment than would otherwise be possible, and it also reduces wasted time, and therefore wasted costs on long transit passages. In 2004 Dutch scientists sailed on German and UK ships under this arrangement, and a German team sailed on RV Pelagia for a three week research cruise in the East Mediterranean.

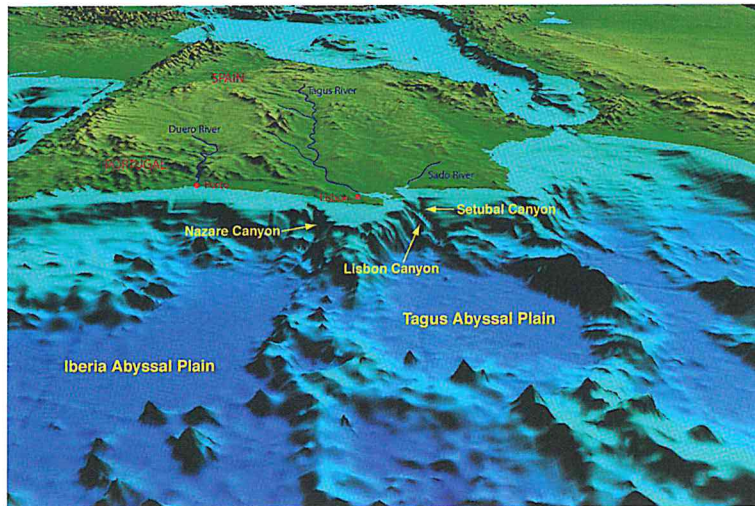
Another favourable development evolving from the partnership is the impulse to international co-operation and exchange of marine technicians for training and support on board. A senior NIOZ marine technician boarded the RRS Discovery for piston core training of SOC technicians. Three marine technicians of NIOZ participated in the 5th INMARTECH Workshop that was organised by the British Antarctic Survey in Cambridge.



Cruise programme 2004

After maintenance, and fitting of a USBL tube at portside for the Posidonia antenna in RV PELAGIA sailed for 230 operational days, including 1 barter/charter cruise (University of Hamburg – SAGA project) of 20 days in the East Mediterranean. No commercial charters.

Projects were funded by the Netherlands Research Council NWO (also funding 122 days shiptime, including the EUROCORES programme EUROMARGINS (MOUNDFORCE and MEDIFLUX/MIMES), the European Union (EUSTRATAFORM – no shiptime funds, the IGBP-LOICZ (excl. shiptime), and NIOZ (88 days of which 38 matching EU/IGBP projects).



Research area EUSTRATAFORM off Portugal (Image courtesy SOC).

To accommodate these cruises diplomatic clearance has been requested from Cyprus, France, Greece, Ireland, Israel, Italy, Libya, Morocco, Portugal, and Spain. Permission from Libya was withheld. Besides calling at homeport Texel, port calls for change of crew and scientific party as well as (un)loading scientific equipment took place in Toulon (France), Iraklion (Greece), Limassol (Cyprus), Cadiz (Spain), Galway (Ireland), Las Palmas (Spain). and in Funchal (Madeira – Portugal)

MARINE TECHNOLOGY

Marck Smit, Jonathan Hess, Bob Koster & Gerhard Herndl,

Besides the ongoing flow of projects supporting Marine Science on shore and at sea, several major developments were finalized in 2004:

- * The integration of the three departments Mechanical, Instrumentation and Electronics officially started in April 2004. The new start was also a reason for a new name of the department, which fits better with its activities: Marine Technology (MTC).
- * Two Computerized Numerical Controlled (CNC) turning lathes were purchased and commissioned.
- * The new offices and a part of the workshop space of Marine Technology Mechanical became available.



The new workshop-space and offices of Marine Technology Mechanical



In January 2004, Herman Ridderinkhof had the honour of laying the 'highest' brick

PROJECTS

MOVE Mobile Vehicle for benthic research



Recovery of the MOVE after the first sea trials

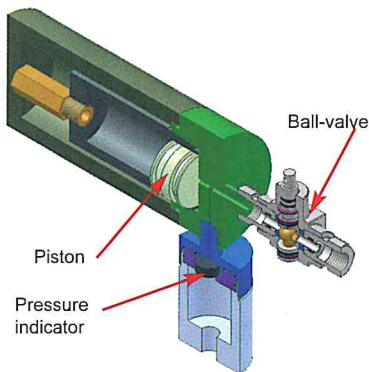
The development of this deep-sea crawler designed to cover up to 30 stations at a maximum depth of 6.000 meters continued. The first shallow water sea-trials showed good results on manoeuvrability, energy consumption and stability on the seafloor



The MOVE mounted in its deployment-frame ready for sea-trials

HIGH PRESSURE SAMPLER

The meso- and the bathypelagic oceanic realms are by far the least explored systems on earth. Much less is known about biological and biogeochemical processes and their rates in the ocean's "inner space" than, for example, in the euphotic layer or, at and in the deep-sea floor. Most of the few studies reporting rate measurements from these layers assume that pressure does not affect these measurements. The few comparative data from measurements under in situ (high) pressure and (low) surface pressure conditions indicate, however, that hydrostatic pressure might considerably affect the rate measurements. As a consequence, the actual rates of biological and biogeochemical processes in the ocean's interior are essentially still unknown.



Section view of the Sampler

This gap in our knowledge on the actual material flux in the largest oceanic subsystems is directly addressed in the new Science Plan of the NIOZ in the Theme 'Dark Ocean Processes' and in the ALW-funded ARCHIMEDES project. The availability of a new type of "High Pressure Sampler" with a large number of small volume chambers to obtain sufficient replicates is crucial for both themes. The chambers should be easily mountable on a CTD-frame and rapidly transferable into temperature-controlled incubators once retrieved on board of the ship.

The first step in the development of a high pressure sampling system was the evaluation of existing systems. Essentially all existing high pressure retaining systems including the one at the Centre National de la Recherche Scientifique (CNRRS) in Marseille (France) have the main drawback that they have large volume chambers making them inappropriate for intensive use with radioactive tracers.



Tests in the pressure tank at the Dept. of Marine Technology

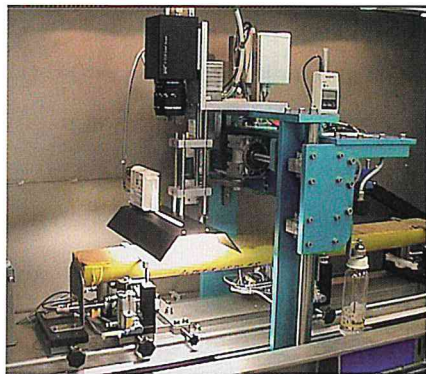
Thus, in order to meet the specific requirements, a whole new system had to be developed. This system consists of several small volume bottles (50 ml and 200 ml) to allow sampling of sufficient replicates at one depth and sampling at several depths. The high-pressure sampling and incubation device operates like a syringe. On deck the tracer used for metabolic activity measurements is added to the individual chambers and the valve closed. At the sampling depth, the valve is opened by the trigger mechanism and the piston pushed down by the entering seawater. The chamber behind the piston is filled with seawater and by lowering the piston this water flushes through a couple of nozzles into the outer cylinder. The nozzle acts as a hydraulic brake, which ensures that the piston is slowly pressed down in the cylinder. After the cylinder is filled, the valve is closed.

To avoid pressure loss during retrieval of the samplers, the sampler is constructed with a double wall. The inner cylinder holds the water sample and the chamber between the inner and outer cylinder has almost the same pressure as at sea level. At sampling depth the inner cylinder will deform due to the pressure just as it would deform under surface pressure conditions with the same inner pressure. A single cylinder would deform during retrieval to the surface by the decreasing external pressure. But now, both during filling and retrieval to the surface, the pressure condition of the depth of sampling is retained. Only temperature causes small pressure changes of the sample (generally less than 8 %).

The new device was extensively tested during the BADE-cruise and several small modifications will be made on the basis of the experience gained. About 100 of these pressure-chambers should be operational in the early summer of 2005, so that they can be used during the ARCHIMEDES expedition to the Canary Abyssal Plain in September / October 2005.



Preparations for testing during the BADE-cruise on board of R/V Pelagia in Sept/Oct2004.

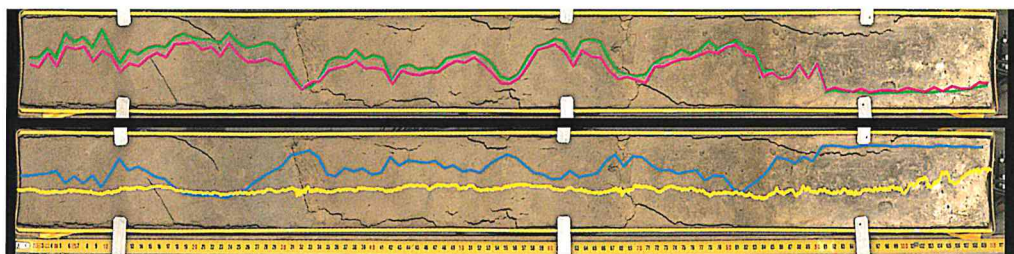


COLOUR ANALYSIS MODULE for XRF-Sediment Core scanner

A high resolution Colour Line Scan Camera with a spatial resolution: $< 0,1 \text{ mm}$ was mounted on our X-Ray Fluorescence (XRF)-Sediment Core Scanner. This enables scientists to perform high-resolution colour analysis on their vertically split sediment cores directly on board.

High resolution 3-CCd camera mounted on XRF-Core Scanner

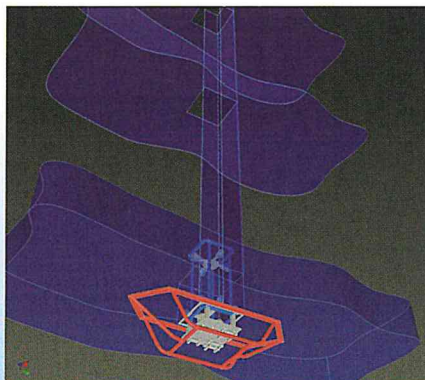
Color images are also used to interpret the data obtained from the XRF-analysis.



MOONPOOL on new TESO Ferry 'Dr. Wagemaker'.

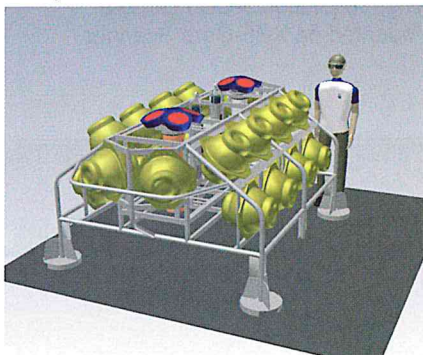
Measurements for the research project 'tidal and morphodynamics of coastal zones' will also be carried out from the new TESO ferry 'Dr. Wagemaker'. Just like the 'Schulpengat', this new ferry will also cross the Marsdiep inlet of the Wadden Sea between Den Helder and Texel during its operational life. Because NIOZ has been involved in the design of the ship from the beginning, we have been able to obtain a moonpool. This allows the equipment to be lifted from the ships' bottom. In this project the NIOZ scientists can obtain numerous data via an on-line connection between the ferry and the institute.

Data on the current strength and direction, water temperature and salinity will also be displayed on-line for the general public on two big plasma screens in the passenger areas of the new ferry, which will start its operational life in June 2005.



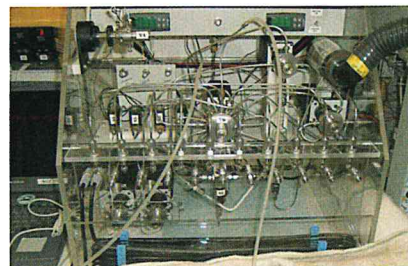
ADCP/fast thermistor string BOTTOM-LANDER

A flat and stable deep-sea lander for ADCP and thermistor string measurements. The pictures show a 3-D engineering model and the lander ready for shipping. In October, the lander was deployed near the top of the Great Meteor Seamount in the Canary Basin of the Atlantic Ocean at a depth of 530m.



CFC-analyser

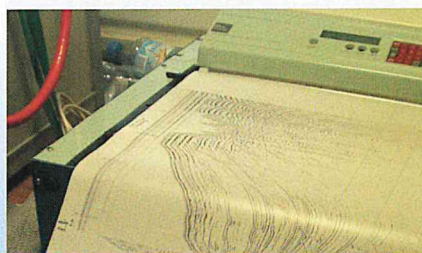
The first prototype of our Chlorofluorocarbon (CFC) analyser for the measurements of low concentrations of CFCs in seawater was tested on the North Sea in November 2004. A gas chromatograph is the core of this equipment and the software was developed in house by MT-Electronics.



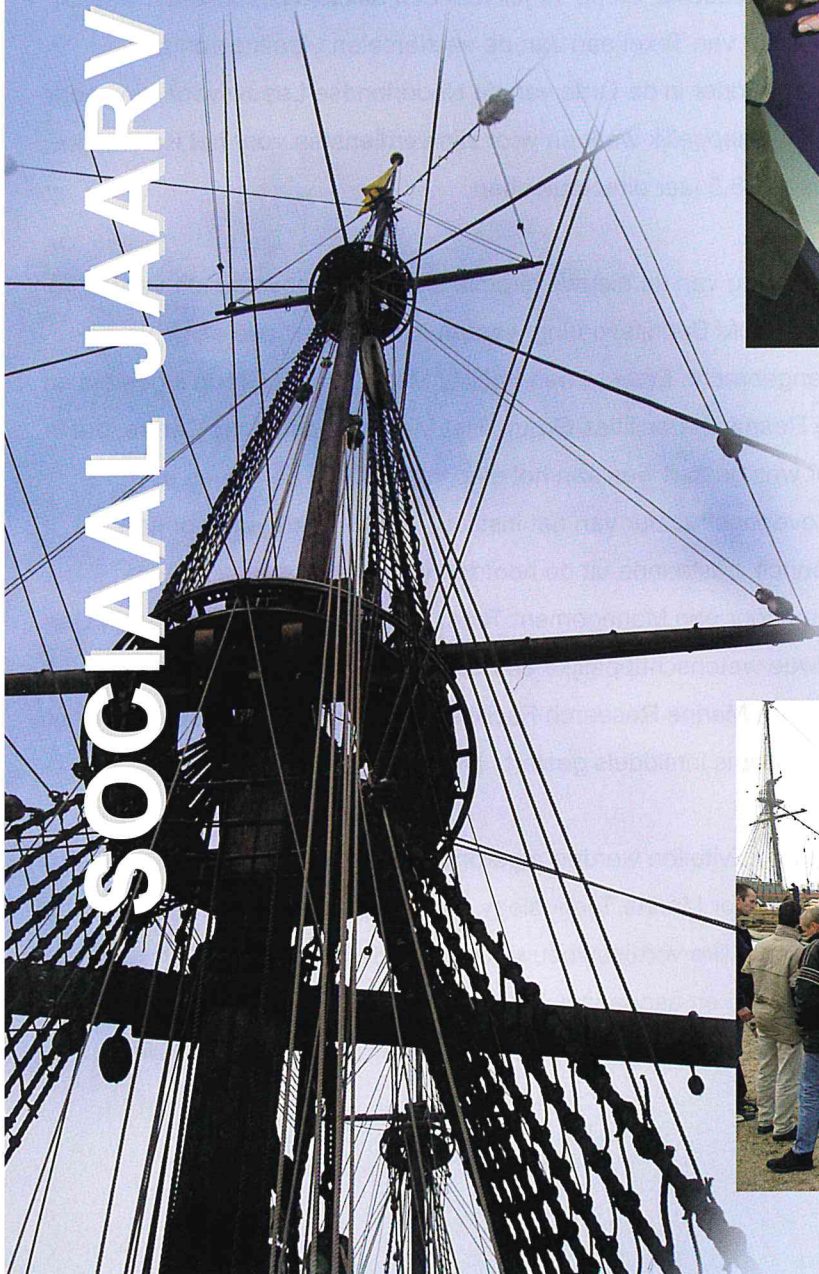
OPERATIONAL ASSISTANCE during cruises

Technical assistance during sea-going cruises on the RV Pelagia but also on other research vessels as the RRS Charles Darwin (SOC) and the French RV Marion Dufresne (IPEV).

On a preparatory cruise for the IODP-proposal coordinated by Utrecht University in October 2004, NIOZ carried out seismic research on the Marion Dufresne.



SOCIAAL JAARVERSLAG



ALGEMEEN

In 2004 werd de directiestructuur van het NIOZ ingrijpend veranderd. De Benoemingsadviescommissie slaagde er niet in om een opvolger te vinden voor Prof.dr. Jan W. de Leeuw, en zag zich genoodzaakt haar opdracht terug te geven aan het bestuur. Omdat Jan de Leeuw als directeur terug zou treden per 1 juli 2004, vond het bestuur een uitweg uit het dilemma door op tijdelijke basis een managing director, Ir. Jan Smit en een deeltijd wetenschappelijk directeur, Prof. dr. Johan E. Meulenkamp te benoemen. Beide benoemingen voor de duur van twee jaar.

Het afscheid van Jan de Leeuw werd twee maal gevierd, tijdens een feestelijke bijeenkomst van het personeel op Jan's laatste werkdag, met muziek, dans en cabaret, en op 14 juli met een officiële bijeenkomst waarbij de Burgemeester van Texel aan Jan de versierselen uitreikte van zijn benoeming tot Ridder in de Orde van de Nederlandse Leeuw voor zijn voortreffelijke wetenschappelijk werk en voor zijn verdiensten voor het Koninklijk NIOZ tijdens zijn 8.5 jaar directeurschap.

Met de benoeming van de nieuwe directie en het daaropvolgende vertrek van de Controller/Hoofd Bedrijfsvoering werden in de organisatie enige veranderingen aangebracht. Er werd een Facility Management Group ingesteld en een Marine Research Facilities Group. Het Marine Technology Centre, dat in het voorjaar was gestart was aan het eind van het jaar compleet. De bestaande overlegstructuur van het instituut werd vervangen door een Science Council, bestaande uit de hoofden van de wetenschappelijke afdelingen en door een Management Team, dat naast beide directeuren vier leden telt, twee wetenschappelijke en twee uit respectievelijk Facility Management en Marine Research Facilities. De wervingsprocedure voor een nieuwe Controller is inmiddels gestart.

De nieuwbouwactiviteiten werden afgerond met de opening van de Oceaanvleugel voor Marine Technology. Daarnaast zijn plannen uitgewerkt voor de noodzakelijke vernieuwbouw van de oude gebouwen. De haven werd uitgebaggerd en aangepast voor de bouw van een drijvende steiger voor een veiliger ligplaats voor de kleine schepen bij harde oostenwind.

RV Pelagia ontving in april 2004 een prijs als VOS (Voluntary Observing Ship) van de KNMI, omdat zij in 2003 van alle Nederlandse schepen de meeste weerwaarnemingen heeft verricht.

In 2004 is hard gewerkt aan de afronding van het Science Plan en aan de voorbereiding van de Zelfevaluatie voor het Peer Review, waarvoor in mei 2005 een site-visit zal plaatsvinden. Bij dit Peer Review zullen de aanbevelingen van het rapport dat in het voorjaar 2004 werd gepresenteerd door de Commissie positionering NIOZ in het Toekomstige Zeeonderzoek (CNTZ) een belangrijke rol spelen, evenals het rapport van de Commissie Mariene Faciliteiten (CMF) inzake het toekomstig zeeonderzoek in Nederland.

Tot slot konden na een lange procedure de zaken rond de voorgenomen nieuwbouw van het Logeercentrum de Potvis afdoende worden geregeld. Er zal een geheel nieuw Potvis verrijzen, waarmee in 2005 wordt aangevangen.

BESTUUR EN WETENSCHAPCOMMISSIE

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Bestuur Stichting NIOZ

Per 31 december 2004 was het bestuur als volgt samengesteld:

Prof.dr. L. van Vloten-Doting, voorzitter	Plantenziektkundige Dienst, Ministerie LNV, Wageningen
Prof.dr. P. Hoekstra	Vakgroep Geologie, Universiteit Utrecht
G.H. Westerveld, penningmeester	The Greenery, Barendrecht
Prof.dr. W. Wolff	Vakgroep Mariene Biologie, Rijksuniversiteit Groningen
Ir. W. Verhage is per 1 oktober teruggetreden als penningmeester.	

Het bestuur kwam in het verslagjaar 2004 zeven maal met de directie in vergadering bijeen, op 12 januari te Utrecht, op 11 februari te Texel, op 8 april te Wageningen, op 24 juni te Texel, op 1 oktober te Utrecht, op 19 november te Texel en op 10 december te Utrecht.

De vergaderingen werden namens de algemeen directeur van NWO bijgewoond door Dr. H. Weijma, die per 1 oktober 2004 werd opgevolgd door Dr. R. Dekker.

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

Wetenschapcommissie NIOZ

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

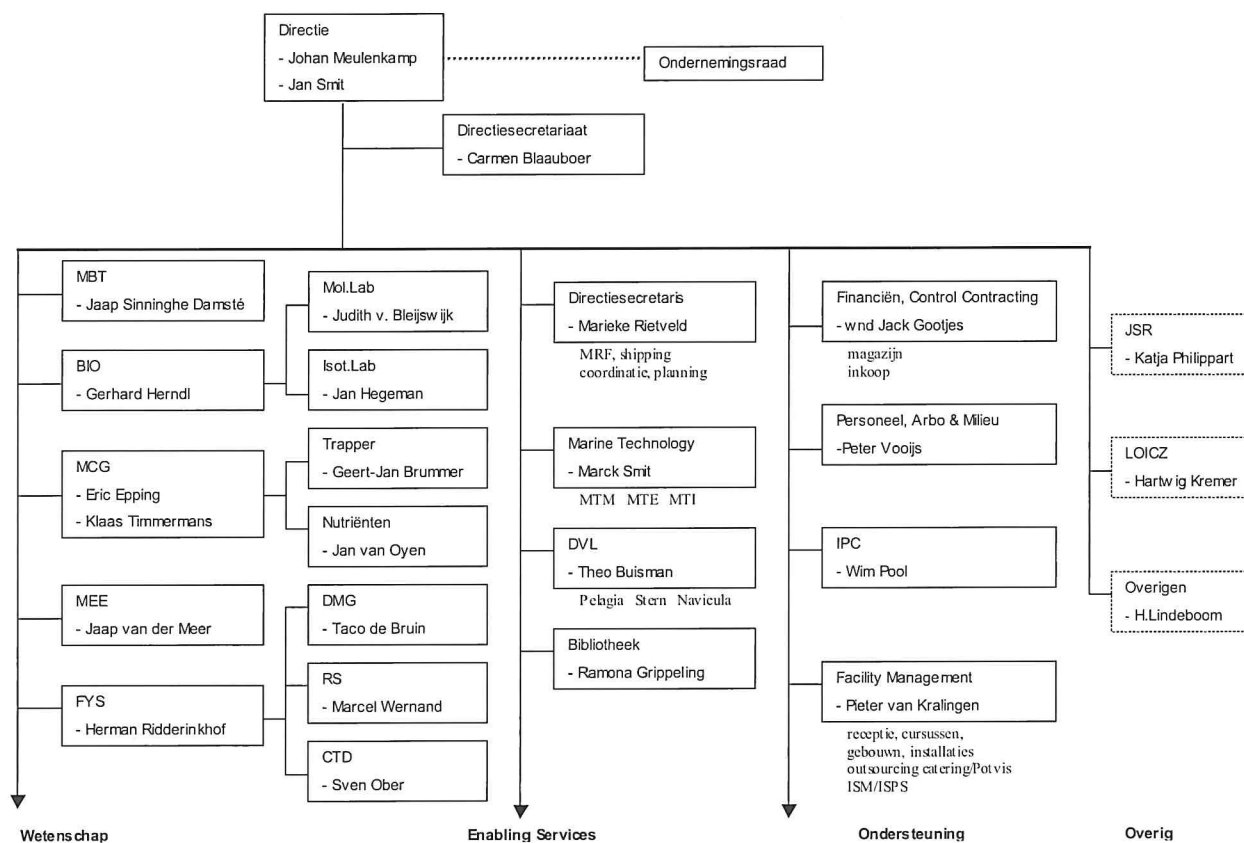
De Wetenschapcommissie was per 31 december 2004 als volgt samengesteld:

Prof.dr. W. Wolff, voorzitter	Vakgroep Mariene Biologie, Rijksuniversiteit Groningen
Prof. dr. J.-P. Henriët	RCMG/Mariene Geologie, Universiteit Gent, België
Prof. dr. J. Simpson	School of Ocean Sciences/ UCNW, Bangor, Groot Brittannië
Prof. dr. L. Labeyrie	Laboratoire des Sciences du Climat et de l'Environnement, Université Paris Sud-Orsay, Gif sur Yvette, Frankrijk
Prof. dr. P. Herman	Afdeling Spatial Ecology, NIOO-CEME, Yerseke

De Wetenschapcommissie kwam in 2004 twee maal bijeen te Texel: op 9 – 11 februari waarbij site visits plaatsvonden aan de afdelingen MBT en MCG, en op 17 – 19 november waarbij de afdeling BIO werd bezocht. De zittingstermijnen van Prof. dr. Karin Lochte en Prof. dr. R.J. Law eindigden met de vergadering op 19 november.

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

ORGANOGRAM



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personeelslijst 31-12-04

DIRECTIE

Leeuw J.W. de Prof. dr.	34.2 uur	directeur	tot 01-07
		sabbatical	m.i.v. 01-07
Smit J. Ir.		managing director	m.i.v. 01-06
Meulenkamp J.E. Prof. dr.	15.2 uur	scientific director	m.i.v. 01-07
Rietveld M.J. Drs.		directie-secretaris	

Directiesecretariaat

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

STAFEEENHEDEN

Mens en Mariene Milieu		
Lindeboom H.J. Dr.	11.4 uur	senior onderzoeker

Personeels-, Arbo en Milieuzaken

Vooys P.C.		hoofd
Mulder-Starreveld J.P.	28.5 uur	medewerker
Bredewold J.J.H.		personeelsfunctionaris
Kuip T.	22.8 uur	arbocoördinator

Bedrijfsbureau

Haas R.G. Drs. ir.		hoofd bedrijfsvoering/ controller	tot 01-10
Kralingen P. van Ing.		plv. hoofd bedrijfsvoering	

Financiën en control

Heerwaarde van C.W.	hoofd fin. Administratie		tot 31-12
Arkel M.A. van Drs.		Projectcontroller	
Gootjes J.A.		ass. controller	
Wernand-Godee I.	30.4 uur	medew. project-administratie	
Keijser A.	20 uur	medew. financiële administratie	
Tuinen H.A. van		medew. financiële administratie	
Kooijman-Biermans M.H.M.	30.4 uur	medew. financiële administratie	
Poleacov-Maraiala C.	32.3 uur	medew. financiële administratie	
Brand J.A.		medewerker	tot 01-02
Nieuwenhuizen J.M.		medewerker inventarisbeheer	
Kalf J.		medewerker inventarisbeheer	

CORE PROJECT OFFICE (LOICZ/IGBP)

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

WETENSCHAPPELIJKE AFDELINGEN

AFDELING FYSISCHE OCEANOGRAPHIE

Ridderinkhof H. Dr.	hoofd
Veth C. Drs.	senior onderzoeker
Zimmerman J.T.F. Prof. dr.	26.6 uur senior onderzoeker
Aken H.M. van Dr.	senior onderzoeker
Maas L.R.M. Dr.	senior onderzoeker
Haren J.J.M. van Dr.	senior onderzoeker
Bruin T.F. de Drs.	datamanager MRF

Harlander U. Dr.		postdoc	
Gerkema T. Dr.		postdoc	m.i.v. 01-11
Merckelbach L.M. Dr.		postdoc	
Hosegood P.J.		OIO	tot 01-05
Volkov D.		OIO	tot 05-08
Veldhoven A.K. van		OIO	tot 01-11
Terra G.		OIO FOM	tot 01-05
Buijsman M.C.		projectmedewerker	
Eijgenraam F.		automatiseringsdeskundige	
Nieuwenhuis J.		medewerker Data Management Group	
Wernand M.R.	32.3 uur	senior onderzoekmedewerker	
Ober S. Ing.		senior onderzoekmedewerker	
Hillebrand M.T.J.		senior onderzoekmedewerker	
Hiehle M.A.		medewerker Data Management Group	
Koster R.X. de		medewerker Data Management Group	

AFDELING MARIENE CHEMIE EN GEOLOGIE

Timmermans K.R. Dr.		wnd hoofd	m.i.v. 22-01
Epping H.G. Dr.		wnd hoofd	m.i.v. 22-01
Baar H.J.W. de Prof. dr. ir.	32 uur		
Weering T.C.E. van Prof. dr.		senior onderzoeker	
Jansen J.H.F. Dr.		senior onderzoeker	
Brummer G.J.A. Dr.		onderzoeker	
Stigter H.C. de Drs.	30.0 uur	projectonderzoeker	m.i.v. 15-03
Haas H. de Dr.		projectmedewerker	
Koning F.A. Dr.		onderzoeker	tot 01-11
Thomas H. Dr.		onderzoeker	tot 31-12
Richter T.O. Dr.		onderzoeker	
Gerringa A.L. Dr.	19.0 uur	postdoc	
Kramer J. Dr.		postdoc	tot 15-02
Karpen V.A. Dr.		postdoc	tot 08-03
Bergh van den G. Dr.		postdoc	m.i.v. 15-10
Loncaric N.		onderzoeker	m.i.v. 01-02
			tot 01-03
Bonnin J. Dr.		postdoc	m.i.v. 01-03
			tot 01-06
Rijkenberg M.		OIO RuG	tot 15-04

Bozec Y.		OIO	
Mienis F.		OIO	
Keuning M.E.		OIO	m.i.v. 11-10
Gaast S.J. van der		senior onderzoekmedewerker	
Ooijen J.C. van		senior onderzoekmedewerker	
Bakker K.M.J.		onderzoekmedewerker	
Boer W. Ing.		onderzoekmedewerker	
Iperen J. van	8.0 uur	senior laboratoriummedewerker	
Gonzalez S.R.		senior laboratoriummedewerker	
Schogt N.	25.5 uur	laboratoriummedewerker	
Witte A.J.M.	19.0 uur	laboratoriummedewerker	
Laan P.		laboratoriummedewerker	
Weerlee E.M. van		laboratoriummedewerker	
Crayford S.J.		laboratoriummedewerker	

AFDELING MARIENE BIOGEOCHEMIE EN TOXICOLOGIE

Sinninghe Damsté J.S.			
Prof. Dr. ir.	34.2 uur	hoofd	
Boon J.P. Dr.		senior onderzoeker	
Booij K. Dr.	30.4 uur	onderzoeker	
Schouten S. Dr. ir.		senior onderzoeker	
Versteegh G.J.M. Dr.		postdoc	
Hopmans E.C. Dr.	30.4 uur	onderzoeker	
Coolen M.J.L. Dr.		postdoc m.i.v. 16-02	
Forster A. Drs.		postdoc	
Herfort L.M.C.C. Dr.		postdoc	
Stadnitskaia A. Drs.		postdoc	
Boumann H.A.		postdoc	m.i.v. 01-12
Breugel van Y.		OIO	
Wuchter C.		OIO	
Weijers J.W.H.		OIO	
Huguet M.C.		OIO	
Rampen S.W.		laboratoriummedewerker	tot 01-07
		OIO	m.i.v. 01-07
Jaeschke A.		OIO	m.i.v. 01-08
Brandsma J.		OIO	m.i.v. 01-09
Rattray, J.E.		OIO	m.i.v. 01-01

Baas M.		onderzoekmedewerker
Rijpstra W.I.C.	22.8 uur	onderzoekmedewerker
Bommel R. van		laboratoriummedewerker
Kienhuis M.V.M.		laboratoriummedewerker
Panoto F.E.	30.4 uur	laboratoriummedewerker
Mets A.		laboratoriummedewerker
Ossebaar J.		laboratoriummedewerker
Rietkerk M.D.A.		laboratoriummedewerker
Woltering M.L.		laboratoriummedewerker
Abbas B.A.		laboratoriummedewerker m.i.v. 01-05

AFDELING BIOLOGISCHE OCEANOGRAPHIE

Herndl G.J. Prof.Dr.		hoofd	
Ruardij P. Drs.		onderzoeker	
Baars M.A. Dr.		senior onderzoeker	
Veldhuis M.J.W. Dr.		senior onderzoeker	
Duyf F.C. van Dr.		senior onderzoeker	
Kuipers B.R. Dr.		onderzoeker	
Bleijswijk J.D.L. van Dr.	19.4 uur	hoofd mol. lab.	
Brussaard C.P.D. Dr.		postdoc	
Arrieta J.M.		postdoc	
Teira Gonzalez E.M. Dr.		postdoc	tot 01-06
ElKalay K. Dr.		postdoc	
Stoderegger K.E. Dr.	27.55 uur	postdoc	tot 01-11
Maier C. Dr.		postdoc	m.i.v. 01-07
Sintes E. Dr.		postdoc	m.i.v. 01-08
Reinthal T.		postdoc	m.i.v. 06-12
Kramer G.D.		OIO-NOW	tot 15-09
Baudoux A.C.		OIO	
Parada V.S.		OIO	
Goeij J.M. de		OIO	
Wilhartitz I.C.		trainee	tot 01-08
Oosterhuis S.S.		onderzoekmedewerker	
Hegeman J.		onderzoekmedewerker	
Noordeloos A.A.M. Ing.		onderzoekmedewerker	
Noort G.J. van		onderzoekmedewerker	
Witte H.J.		senior onderzoekmedewerker	

Bossink M.		laboratoriummedewerker tot 01-02
Smit A.T.		laboratoriummedewerker

AFDELING MARIENE ECOLOGIE

Meer J. van der Dr.		hoofd	
Bak R.P.M. Prof. dr.		senior onderzoeker	
Veer H.W. van der Dr. ir.		senior onderzoeker	
Piersma T. Prof. dr.	15.2 uur	senior onderzoeker	
Bergman M.J.N. Ir.		onderzoeker	
Duineveld G.C. Drs.		onderzoeker	
Daan R. Dr.		onderzoeker	
Dekker R. Drs.		onderzoeker	
Philippart C.J.M. Dr.ir.	30.4 uur	onderzoeker	
Lavaley M.S.S. Drs.		Projectonderzoeker	m.i.v. 01-04 tot 01-12
Witbaard R. Dr.		projectonderzoeker NWO	tot 01-05
Holmes S.P. Dr.		postdoc	tot 01-08
Nugues M.M.		postdoc	tot 01-02
Honkoop P.J.C. Dr.		postdoc	
Bocher P.P.H. Dr.		postdoc	m.i.v. 01-03 tot 01-09
Gils J. van Dr.	19 uur	onderzoeker	tot 01-03
Drent J. Dr.		postdoc	m.i.v. 01-09
Camphuijsen C.J.		projectonderzoeker	
Vahl W.K.		OIO RuG	tot 01-06
Amaro T.		OIO	tot 01-09
Cardoso J.		OIO	tot 01-09
Smallegange I.M.	30.4 uur	OIO	
Reneerkens J.W.H.	30.4 uur	OIO	
Compton T.		OIO RuG	
Hout P.J. van den	30.4 uur	OIO	
Kraan C.	30.4 uur	OIO	
Dapper R.		automatiseringsdeskundige	
Berghuis E.M.		senior onderzoekmedewerker	
Nieuwland G.		senior onderzoekmedewerker	
Spaans B. Drs.		senior onderzoekmedewerker	
Dekinga A. Drs. Ing.		senior onderzoekmedewerker	

Mulder M.		onderzoekmedewerker
Witte J.IJ.		onderzoekmedewerker
Koutrik A. van Ing.	15.2 uur	laboratoriummedewerker
Bol-den Heijer A.C.	29.25 uur	laboratoriummedewerker
Iperen J. van	15.2 uur	senior laboratoriummedewerker
Waasdorp C.M.		laboratoriummedewerker m.i.v. 01-02
Brugge M.C.		dierversorger

DIENT GEBOUWEN EN INSTALLATIES

Groot S.P.	22.8 uur	medewerker
Lakeman R.	20.0 uur	medewerker
Daalder R.M.		medewerker
Witte R.J.C.		medewerker
Trap B.		medewerker
Heerschap J.H.		medewerker

Bonne E.		medewerker (detachering)
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Receptie

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

Informatie en Presentatie Centrum (IPC)

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

Bibliotheek

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

Redactie

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

MARINE TECHNOLOGY

Smit M.G. Ir.		hoofd
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Marine Technology Instrumentation

Boekel H.J.		coordinator	
Keijzer E.J.H.		technicus	
Heerwaarden J. van		technicus	
Bakker R.		technicus	m.i.v. 01-11

Marine Technology Electronics

Groenewegen R.L. Ing.	34.2 uur	coordinator
Koster B. Ing.		plv. hoofd
Franken H. Ing.		hoger electronicus
Laan M.		hoger electronicus
Asjes A.J.		medewerker
Buijsman D.J.		medewerker

Marine Technology Mechanical

Porto H.H. de		werkvoorbereider	
Schilling J.		coordinator	
Polman W.		medewerker	
Bakker M.C.		medewerker	
Blom J.J.		medewerker	
Wuis L.M.		medewerker	
Boom L.		medewerker	
Gieles S.J.M.		medewerker	
Grisnich P.W.		medewerker	
Witte Y.		medewerker	m.i.v. 01-03
Zijm J.M.		medewerker tot 19-01	

Vaartuigen en logistiek

Buisman T.C.J.		hoofd
Alkema P.R.	35.15 uur	medewerker

Jourdan M.T.	16.0 uur	administratief medewerkster	
Groot J.C.		senior gezagvoerder	tot 01-05
Leeuw C.O.		senior gezagvoerder	
Ellen J.C.		gezagvoerder	
Duyn M.D. van		stuurman	
Puijman E.A.		stuurman	
Seepma J.		hoofdwerktuigkundige	
Kikkert K.C.		hoofdwerktuigkundige	
Kleine M.D.M. de		2e werktuigkundige	
Mik G.		scheepskok	
Stevens C.T.		scheepstechnicus	
Betsema G.L.J.		scheepstechnicus	
Slikke R. van der		scheepstechnicus	
Maas J.J.M.		scheepstechnicus	
Heide R. van der		scheepstechnicus	
Meijer N.O.		scheepstechnicus	tot 01-09
Boon P.		scheepstechnicus	tot 04-08
Vermeulen G.P.		matroos/kok	
Dresken J.T.		matroos/kok	
Adriaans E.J.		havenmeester/schipper	
Star C.J. van der		schipper	
Vis van der P.C.A		machinist/motordrijver	
Vries de H.		scheepstechnicus/kok	
Jongejan W.P.		medewerker	

GASTMEDEWERKERS

Beukema, J.J.
 Bik, M.H.
 Cadée, G.C.
 Frade, P. Rodrigues
 Goeij, P.J. de
 Hallers-Tjabbes, C.C. ten
 Hermes, Y.
 Kitazawa, D.
 Prins, R.

Tarff, M.

Vézina, F.

Vooy, C.G.N. de

Zegers, B.N.

ARBEIDSVoorwaarden

Collectieve Arbeidsovereenkomst Onderzoekinstellingen (CAO-OI)

Nadat hierover tussen de CAO partijen overeenstemming was bereikt, is de Collectieve Arbeidsovereenkomst voor de Onderzoekinstellingen (CAO-OI) per 1 oktober 2003 verlengd tot 1 januari 2005 zonder noemenswaardige veranderingen.

In deze verlengde CAO-OI is geen generieke salarisverhoging opgenomen, zulks in de lijn van het Najaarsakkoord dat tussen kabinet en sociale partners in oktober 2003 was overeengekomen.

Daartegenover zijn de salarissen van de onderzoekers in opleiding aanzienlijk verbeterd en lopen hiermee in de pas van de salarisontwikkeling zoals die geldt voor deze categorie bij de Nederlandse Universiteiten.

Per 1 januari 2004 is een vereenvoudigd verlofstelsel ingevoerd door het onderscheid tussen vakantieverlof en de zogenaamde ADV-dagen te laten vervallen. Vanaf genoemde datum is er sprake van één regeling vakantieverlof waarbij de fulltime medewerker ten minste recht heeft op 338 vakantieuren. De regeling Arbeidstijdverkortung is door de invoering van het nieuwe stelsel vervallen. De uit deze vervallen regeling stammende week-, jaar- en meerjarenvarianten zijn in aangepaste vorm overgenomen in de regeling vakantieverlof.

Verlofstuwmeer

Het in 2003 bij het Koninklijk NIOZ ingevoerde beleid gericht op het terugdringen van het verlofstuwmeer is in 2004 aangescherpt o.a. doordat in de verlengde CAO hierover tevens afspraken zijn opgenomen. Uitgangspunt hierbij is dat het saldo vakantieverlof bij een volledig dienstverband aan het eind van enig kalenderjaar niet meer dan 80 uur bedraagt, te vermeerderen met eventuele verlofspaarvarianten. Ondanks de wettelijke verjaringstermijn van 5 jaar biedt deze CAO-bepaling voor de werkgever de mogelijkheid om met de werknemer bindende verlofaf-

spraken te maken teneinde te voorkomen dat meer dan 80 uren naar een volgend kalenderjaar worden meegenomen.

In de CAO is een overgangstermijn opgenomen die op 31 december 2008 zal aflopen. Grosso modo is bij het Koninklijk NIOZ het voor 2004 toegekende CAO-verlof volledig opgenomen, vermeerderd met een reductie van het verlofstuwmeer van circa 10%. Het gestelde doel om een vermindering van 20% te realiseren is niet bereikt. Voor het jaar 2005 zal een inhaalslag noodzakelijk zijn.

Arbeidsvoorwaarden op maat

In 2004 is de belangstelling voor het gebruik van AVOM ten opzichte van 2003 weer sterk toegenomen. Met name van het inzetten van verlofuren voor de verschillende doelen is veel gebruik gemaakt. Eind augustus van dit jaar heeft het kabinet de pc privé regeling met onmiddellijke ingang afgeschaft. Deelname AVOM 2004:

PC's	44 medewerkers
Fietsen	28 medewerkers
Verkopen verlofuren	62 medewerkers
Kopen verlofuren	4 medewerkers
Studieregeling	1 medewerker

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Opleiding en training

In 2004 is er 1 groepscursus georganiseerd, te weten cursus Nederlands voor anderstaligen. Er zijn 12 medewerkers aan de cursus begonnen, waarvan 5 medewerkers de cursus met succes hebben afgerond.

Verder hebben 15 medewerkers op individuele basis een (externe) opleiding, cursus of training gevolgd. Deze staan los van wetenschappelijke bijeenkomsten/seminars, zijn functiegericht en aan de werkplek gerelateerd. Een aantal van deze opleidingen/cursussen/trainingen loopt door in 2005.

In het kader van de bedrijfshulpverlening is er voor alle medewerkers in het instituut een korte training kleine blusmiddelen georganiseerd. Zo'n 50 medewerkers hebben aan de training deelgenomen. Het was een groot succes en zal in de toekomst een vervolg krijgen.

Verder is er in het kader van de BHV 3 keer een herhalingscursus EHBO georganiseerd en heeft de bedrijfsbrandweer een dag in een trainingscontainer geoefend.

Eveneens zijn er door enkele bemanningsleden van de onderzoekschepen een aantal wettelijk verplicht cursussen en trainingen gevolgd

Individueel Klachtrecht

Koninklijk NIOZ beschikt sinds jaren over een regeling Individueel Klachtrecht. Deze regeling biedt werknemers de mogelijkheid om klachten, over een gedraging door of vanwege de werkgever bespreekbaar te maken en te doen onderzoeken. In 2004 zijn er bij de Klachtadviescommissie geen klachten ingediend.

Arbo- en Milieujaarverslag 2004

Inleiding

In dit verslag wordt gerapporteerd over de belangrijkste activiteiten op het terrein van arbo en milieu die in 2004 hebben plaatsgevonden.

Beleid

In het afgelopen jaar is, binnen het kader van de ARBO-wet, een (deel)risicoinventarisatie en evaluatie (RI & E) uitgevoerd. Deze inventarisatie had betrekking op de recente nieuw- en verbouw, zoals het aquariumgebouw en de nieuw gebouwde bouwlagen zoals het lab MEE en de kantine. Uit deze RI & E is een plan van aanpak voortgekomen met de nodige actiepunten. Hoofdpijn van dit plan vormen de aandachtspunten voor het werken met chemicaliën en voor bij voorbeeld de algemene veiligheid van elektrische apparaten.

De interne webpagina van arbo en milieu is verbeterd en aangevuld met nieuwe informatie voor het personeel.

Arbo- en Milieucommissie

De Arbo- en Milieucommissie heeft een adviserende en signalerende taak naar de directie en Ondernemingsraad op het gebied van veiligheid en milieu. De commissie is breed van samenstelling, vanuit verschillende geledingen.

De commissie heeft in het verslagjaar onder andere gewerkt aan de procedure voor het veilig werken op het wad (zie hieronder) en aan het rookbeleid binnen het instituut. Voor dit laatste zijn, voor degenen die roken, in het gebouw twee rookruimtes gecreëerd.

Ongevallen

Op een paar kleine incidenten na zijn er in 2004 geen ongevallen voorgevallen. De kleine incidenten beperkten zich tot ongevallen met kleine verwondingen zoals een brandblaas en een schaafwondje. In geen geval is er personeel doorverwezen naar een huisarts of ziekenhuis.

Veiligheids- en milieuzaken

In de maand juni is er een milieucontrole uitgevoerd door de gemeente Texel. Uit deze controle zijn geen noemenswaardige actiepunten voortgekomen die voor het Koninklijk NIOZ directe consequenties hadden. Uit de controle kwam wel naar voren dat de opslag van chemicaliën beter geregeld moet worden door bij voorbeeld het inrichten van speciale opslagkluizen.

Medio september is er een controle geweest van het Provinciaal Waterleiding Bedrijf. Uit deze controle bleek dat het drinkwaternet aangepast dient te worden. Het betreft hier vooral het installeren van terugslagkleppen en beluchters teneinde "besmetting" van het leidingnet te voorkomen.

Om de opslag van formaline en formalinehoudende producten te centraliseren is het opslaggebouw naast het aquariumgebouw uitgebreid. Hiermee is een begin gemaakt voor het centraal opslaan van deze producten buiten het hoofdgebouw.

Via de container van het afvalverwerkingsbedrijf SITA is het nodige Klein Chemisch Afval afgevoerd. De belangrijkste af te voeren componenten waren oplosmiddelen, giftige chemicaliën, laboratoriumafval en batterijen.

Handleiding veilig werken op het wad

Werken op het wad en varen met rubberboten brengen risico's met zich mee. Na de in 2003 georganiseerde cursus voor het behalen van het Klein Vaarbewijs (I+II), verplicht voor het bevaren van rubberboten met een snelheid van meer dan 20 kilometer per uur, is er in nauw overleg

met enkele geledingen een handleiding "Veilig werken op het wad" tot stand gekomen. Naast praktische informatie en adviezen zijn in deze handleiding instructies en richtlijnen opgenomen waarvan men kennis moet nemen en waaraan men zich dient te houden.

Bedrijfsgezondheidszorg

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

Ziekteverzuim

De laatste jaren is er sprake van een verdergaande daling van het ziekteverzuim. Ook in 2004 zette deze ontwikkeling zich voort. Ten opzichte van 2003 is het ziekteverzuim in 2004 met 0.55% afgenomen (3.25% in 2004 tegen 3.8% in 2003).

	WP	M	V	NWP	M	V	Overall%
2000	5.6	5.8	4.9	8.6	6.9	15.6	6.8
2001	3.7	4.0	2.5	5.7	4.1	12.9	4.5
2002	3.5	3.5	3.4	5.0	3.1	13.9	4.1
2003	1.5	1.3	2.3	6.8	6.7	7.4	3.8
2004	2.5	1.8	4.6	4.3	4.2	4.9	3.25

Bedrijfshulpverlening

Voor de EHBO organisatie zijn zestien personen op herhalingscursus geweest voor het eenheidsdiploma EHBO van het Oranje Kruis. De cursus werd gegeven op het instituut door DHTC. Van deze zestien zijn er zes opvarenden van de schepen. Een deel van de opvarenden zal in het vervolg de verplichte training Medical Care moeten volgen waardoor het EHBO-diploma niet langer relevant is.

De leden van de bedrijfsbrandweer oefenden naast de reguliere maandelijks oefeningen ook in het bijzonder in het werken met kleine blusmiddelen. Voor deze training, verzorgd door InterSafe, werd er gebruik gemaakt van diverse met gas gesimuleerde branden. Om vooral de training voor het bestrijden van binnenbranden te kunnen uitvoeren is er voor

deze training gebruik gemaakt van een speciaal ingerichte container. Hier kon men, omgeven door rook en voorzien van ademluchtapparatuur, de meest voorkomende branden bestrijden zoals een computerbrand en een brand in een prullenbak. Naast de bedrijfsbrandweer was ook het personeel voor de training uitgenodigd. In drie dagen hebben hieraan zestig personen deelgenomen inclusief de leden van de bedrijfsbrandweer.

Investeringsen

Voor het komende jaar zijn de investeringen beperkt tot de aankoop van alarmerings-pagers voor de leden van de bedrijfsbrandweer.

Vergunningen

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

Het Koninklijk NIOZ heeft opgave gedaan van de geloosde hoeveelheid zeewater en laboratoriumafvalwater in m³/kwartaal. Deze gegevens zijn uiterlijk één maand na het beëindigen van ieder kwartaal toegezonden aan Rijkswaterstaat Directie Noord Holland met afschrift aan het RIZA in Lelystad.

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Verslag van de Ondernemingsraad

De samenstelling van de or is dit jaar gewijzigd. De termijnen van Rogier Daan en Harry Witte liepen per 1 juli af. Er zijn daarom verkiezingen uitgeschreven voor de twee vrijgekomen posities in combinatie met de drie posities die al langere tijd vakant waren. Na afloop van de inschrijvingstermijn bleek dat er zich één kandidaat had aangemeld voor elke vakante positie. Daarmee waren al deze kandidaten ook automatisch gekozen. De samenstelling van de or zag er per 1 juli 2004 als volgt uit:

Ewout Adriaans
Ramona Grippeling
Piet van den Hout
Sven Ober (voorzitter)

Swier Oosterhuis
Klaas Timmermans
Kees Veth (secretaris)
Ruud Witte

Hiermee was de or voor het eerst sinds jaren weer voltallig. Er was wel sprake van een kleine complicatie, want Klaas Timmermans kon zijn orlidmaatschap niet combineren met zijn functie als interim werkgroep leider van de afdeling MCG. Daarom heeft, na overleg met de geleding onderzoekers, Rogier Daan zich beschikbaar gesteld om de or-werkzaamheden van Klaas Timmermans tot het eind van het jaar over te nemen.

Een van de belangrijkste gebeurtenissen dit jaar was de benoeming van een nieuwe directie. Mede in verband hiermee, en vooruitlopend daarop, heeft de or een 'cultuur/structuur-notitie' uitgebracht, waarin een visie wordt gegeven op de organisatie van het NIOZ. Tevens wordt hierin een standpunt geformuleerd over wat er met betrekking tot structuur, communicatie en managementtechnieken op het NIOZ te verbeteren valt. De notitie is in februari aan het NIOZ-bestuur voorgelegd, zodat het bestuur de visie van de or mee kon nemen in de besluitvorming rond de benoeming van een nieuwe directie. Toen in april het bestuur in eerste instantie kwam met de interim-oplossing van een tweehoofdige directie voor een periode van 2 jaar, heeft de or daar een positief advies over uitgebracht. Wel werd bedongen dat de or over de invulling van de nieuwe structuur advies mocht uitbrengen en gekend zou worden in het directiestatuut. In tweede instantie werd vervolgens door de or ook positief geadviseerd met betrekking tot de door het bestuur voorgestelde kandidaten voor de nieuwe directie.

Overlegvergaderingen waren er dit jaar met zowel bestuur als directie. Tot 1 juli vond formeel overleg drie keer rechtstreeks plaats met (een delegatie van) het bestuur in verband met de verstoord geraakte relatie tussen de or en de vorige directie. Na het aantreden van de nieuwe directie per 1 juli zijn de verhoudingen genormaliseerd en vond weer regelmatig informeel overleg plaats tussen or en directie, en was er ook één keer een formeel overleg. Tenslotte vond in november nog een ontmoeting plaats met het voltallige bestuur, waarbij algemene zaken werden besproken. Afgesproken werd om zo'n ontmoeting jaarlijks op de kalender te zetten.

Naast de adviezen rond de vorming van de nieuwe directie heeft de or over nog diverse andere zaken advies uitgebracht. Zo werd de or om

advies gevraagd over vier kandidaten die in de loop van het jaar zijn voorgedragen om zitting te nemen in het NIOZ-bestuur. Op elk van de vier voordrachten heeft de or positief geadviseerd. Ook over de herbenoeming van de zittende voorzitter van het bestuur werd positief geadviseerd.

Zeër veel tijd kostte de adviesaanvraag betreffende de verkoop en nieuwbouw van logeergebouw 'de Potvis'. Aanvankelijk maakte de or zich vooral zorgen over de hoogte van de huur van de nieuw te bouwen kamers en appartementen. Nadat echter de zekerheid was verkregen dat toekomstige studenten en stagiaires een volledige huurcompensatie zullen krijgen, heeft de or uiteindelijk in meerderheid besloten om toch positief te adviseren. Voor de huurcompensatie-aanpassing was overigens wel een wijziging nodig in het Uitvoeringsreglement, waaraan de or zijn instemming heeft verleend. Bovendien werd de garantie verkregen dat extra onkosten die zittende Potvisbewoners moeten maken in verband met verhuizing naar tijdelijke vervangende woonruimte tijdens de nieuwbouw, vergoed zullen worden door het NIOZ.

De or heeft ook een adviesaanvraag ontvangen over het oprichten van een afdeling Facility Management, in grote lijnen de opvolger van het voormalige "Bedrijfsbureau" in combinatie met de Dienst Gebouwen en Installaties. Naar aanleiding van deze aanvraag werd een achterbanraadpleging georganiseerd met de betrokken medewerkers en is de directie om een toelichting gevraagd tijdens een formeel overleg. Dit heeft geleid tot enkele aanvullingen en wijzigingen van de plannen en uiteindelijk tot een positief advies van de or.

Tot slot waren er nog 2 instemmingsplichtige voorstellen van de zijde van de directie. Het ene betrof een 'voorstel voor ophoging uitbetaling AVOM-uren' en het andere de invoering van een 'handleiding veilig werken op het wad'. Met beide voorstellen heeft de or ingestemd.

De or -website werd in de loop van de herfst vernieuwd en geactualiseerd. Deze website is een belangrijk communicatiekanaal tussen de or en de achterban. Men kan hier onder meer de actuele onderwerpen vinden die aan de orde zijn, de onderwerpen waarover recent advies dan wel instemming is gegeven, notulen van overlegvergaderingen en jaarverslagen. Daarnaast is ook zakelijke informatie opgenomen zoals taakverdeling binnen de or, links naar de sites van vakbonden en het ABP en naar het or-reglement.

De personeelsvereniging

Bestuur

Na 4 jaar NIOZ is Astrid van Veldhoven aan haar promotie-boekje begonnen en heeft hiermee haar plekje in het PV-bestuur op moeten geven. Astrid was een super actief lid met goede ideeën en altijd in voor het organiseren van activiteiten; bedankt Astrid! Gelukkig hebben we ook versterking gekregen van twee nieuwe leden: Marian Keuning en Johan Dreskens.

Activiteiten

In 2004 hebben we ons keurig gehouden aan de activiteiten die we volgens de begroting geplanned hadden. In de winter was er het schaatsmiddagje waarbij deze keer iedereen zijn eigen rondjes kon draaien. In het voorjaar werd het pannenkoekenfeest georganiseerd, waarbij mensen van MBT en de Pelagia geholpen hebben met het bakken van de pannenkoeken. Zo'n 40 kinderen en ouders hebben hierbij zo'n 300 pannenkoeken verorberd. Daarna hebben ze gekeken naar een vreselijk spannend heksentoneelstuk waarna ze bij konden komen met een ijsje.

In het najaar heeft er een NIOZ-uitje plaats gevonden. Hierbij zijn het Aviodrome en de Batavia werf/stad bezocht, waarna de dag is doorgenomen bij de chinees. In december hebben de leden een fles wijn gekregen en was er weer een knallende kerstborrel. Helaas viel de feestdatum wat ongelukkig en waren de meeste buitenlanders al thuis. Mede hierdoor kon er ook na zes uur nog van het buffet gebruik gemaakt worden. Dit voortreffelijke buffet was in huis/boot klaar gemaakt door Johan Dresken, Santiago Gonzalez, Marian Keuning en Evaline van Weerlee. Het was weer een gezellige en lekkere "borrel" en hierbij bedank ik iedereen die geholpen heeft bij de organisatie.

