



Expedition Programme No. 68

**RV "POLARSTERN"
ANTARCTIC XXI/2**

**Cape Town – Cape Town
17. 11. 2003 – 18. 01. 2004**

**Coordinator: H.-O. Pörtner
Chief Scientist: W. E. Arntz**

**LAND-BASED ACTIVITIES
2003/2004**

**Responsible Scientist: H. Gernandt
Field Operation: J. Janneck**

**ALFRED WEGENER INSTITUTE
FOR POLAR AND MARINE RESEARCH**

BREMERHAVEN, NOVEMBER 2003

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1 Summary and Itinerary

One of the outstanding results of the international „Polarstern“ expeditions EASIZ (Ecology of the Antarctic Sea Ice Zone) I-III has been the insight that iceberg strandings play an important role in structuring benthic biodiversity at the seafloor. We know from these studies that about 5% of the total shelf area of the eastern Weddell Sea is disturbed by iceberg scour. Within some topographically distinct areas which are usually referred to as „iceberg cemeteries“ or „iceberg restplaces“, up to 50% of the seafloor may be affected by this kind of perturbation. Iceberg scour inflicts substantial damage, often destruction, on the established communities of the endo- and epifauna and of demersal fish. In the course of recovery, which is assumed to be a very slow process as compared with time scales in temperate or tropical regions, it is possible to distinguish different successional stages of recolonisation although these cannot yet be placed in an absolute temporal sequence. There may also be various alternative states during this process.

As iceberg scour disrupts or destroys older and more mature community stages, it creates space for taxa which as „pioneer species“ initiate recolonisation of the affected areas, thus giving way to a gradual recovery of the community. Various hypotheses in the literature have attempted to describe the effect of such processes on biodiversity. The general result seems to be an enhancement of diversity on larger spatial scales due to the co-existence of a variety of different stages which all have their respective set of species. This may be the case, however, only for intermediate scour disturbance, and may not work if the impact scale is altered into one or the other direction, e.g. by a further increase of iceberg scour under continued global warming conditions. An alternate (and presumably shorter) way to study these processes is to cause artificial disturbance of different intensity at the seafloor.

Beside its effect on biodiversity, the time scale of the process of recolonisation and recovery after a disturbance may be considered an important question, because in comparison with communities at lower latitudes it illustrates the vulnerability and resilience of the polar ecosystem. This parameter is, as is biodiversity, of increasing importance in the context of the Antarctic Treaty and the Madrid Protocol, because conservation measures can be developed only considering these stability properties of the ecosystem.

The main programme thus intends to

- Quantify the dynamics of the shelf ice edge and the movements of icebergs using satellite remote sensing, helicopter and shipboard observation. The shelf ice edge will be measured from helicopters and compared with former measurements during EASIZ I-III. Iceberg displacement will be quantified in determined „restplace“ areas from helicopters and by the vessel's radar.
- Describe undisturbed areas as a basement measure of the *status quo ante*. These areas will serve later as control sites.
- Inflict an artificial mechanical perturbation similar to iceberg scour by heavy trawling on one of these sites, to follow recolonisation and succession in the next decade.
- Recover artificial hard-bottom substrates deployed during ANT XV/3 off Kapp Norvegia.
- Compare results on temporal and spatial succession in this area, in particular with regard to biodiversity, dominance and structural complexity, with published and own results from other marine ecosystems (shelf areas of the North Atlantic Ocean, Mediterranean, Humboldt Current upwelling, Arctic deep sea).
- Deduce (as a final goal) more general rules concerning the resilience of benthic marine ecosystems, and identify indicators of vulnerability, pioneer species, ecosystem engineers and other keystone species which may be helpful for conservation management.

This main research programme represents a medium term approach and will last at least 10 years. After subjecting the „benthos garden“ community to artificial disturbance, this site is to be revisited in more or less regular time intervals (ideally every second year) to register successional patterns and exchange moorings for the registration of biotic and abiotic variables.

To make optimal use of RV „Polarstern“ and to consider the needs of other international and national groups working on the Antarctic shelf mostly within the frame of the EASIZ programme, the main programme will be combined with the following associated programmes:

- Benthic-pelagic coupling, trophic structure and energy flow under polar spring conditions
- Scale-related biodiversity studies of high Antarctic benthos communities in comparison with those from the Arctic

- Taxonomic biodiversity studies to complement the inventory of high Antarctic benthic species
- Phylogenetic and biogeographic relationships and genetic variability of sub- and high Antarctic fauna (includes study at Bouvet)
- Studies on invertebrate life histories, reproductive strategies and meroplanktonic larvae along the latitudinal gradient (includes Bouvet)
- Availability of fish as food for seals and seal foraging in Drescher Inlet
- Reaction of seals to sound (Drescher Inlet)
- Adaptive competence of Teleostei: material for the study of temperature adaptation of Zoarcidae and Nototheniidae (includes Bouvet)
- Chemical ecology: material for the study of natural marine products
- Measurements of atmospheric trace gases.

RV "Polarstern" is scheduled to leave Cape Town, South Africa on 17 November 2003. On the way to the Antarctic continent, a two-day stay will be made near Bouvet Island to use baited traps and Agassiz trawls for the collection of benthos and fish to be studied within the various latitudinal gradient programmes. Most of the work planned for ANT XXI/2 will be carried out in the polynya area between Atka Bay and Drescher Inlet (Fig. 1), where we hope to arrive by the end of November if the ice situation allows. Equipment and provisions will be delivered to Neumayer station also depending on the ice situation. The seal and acoustics group will be transported to Drescher Inlet at the earliest convenience, and the participants remaining on board the vessel will be working predominantly off Kapp Norvegia during the entire month of December and the first week of January. The return to Cape Town will begin around 08 January, after picking up the Drescher party, and South Africa will be reached on 18 January 2004.

1 Zusammenfassende Übersicht und Fahrtverlauf

Eines der herausragenden Ergebnisse der internationalen EASIZ- (Ecology of the Antarctic Sea Ice Zone) Expeditionen auf der "Polarstern" war die Erkenntnis, daß Eisbergstrandungen eine wichtige Rolle für die benthische Biodiversität am Meeresboden spielen. Wir wissen aus diesen Untersuchungen, daß etwa 5% der gesamten Schelffläche des östlichen Weddellmeeres durch Eisberge gestört wird. In bestimmten Gebieten, die meist als "Eisbergfriedhöfe" oder "Eisbergastplätze" bezeichnet werden, kann diese Rate aufgrund der besonderen Topographie sogar bis zu 50% betragen. Eisbergstrandungen verursachen erhebliche Schäden, oftmals Vernichtung der örtlichen Gemeinschaften der Endo- und Epifauna sowie der Bodenfische. Im Verlauf der Erholung, vermutlich ein sehr langsamer Prozeß im Vergleich zu temperierten oder tropischen Gemeinschaften, lassen sich verschiedene Sukzessionsstadien der Wiederbesiedlung unterscheiden, die allerdings noch nicht in eine allgemeingültige zeitliche Reihenfolge eingeordnet werden können. Vermutlich gibt es dabei auch verschiedene Alternativen.

Eisberge beeinträchtigen oder zerstören ältere, reifere Gemeinschaften und schaffen dabei Platz für Pionierarten, welche die Wiederbesiedlung initiieren und dabei den Weg für eine allmähliche Erholung freimachen. In der Literatur gibt es verschiedene Hypothesen, in denen versucht wird, die Auswirkungen solcher Prozesse auf die Biodiversität vorherzusagen. Generell wird die Biodiversität auf größeren räumlichen Skalen offenbar durch das Nebeneinander vieler verschiedener Sukzessionsstadien gefördert, die jeweils spezifische Artenmuster aufweisen. Allerdings mag dies nur für Eisbergkratzer mittlerer Frequenz zutreffen und nicht mehr bei geringerer oder größerer Häufigkeit dieser Störungen, etwa im Fall einer Zunahme bei weiterer globaler Erwärmung. Eine (schnellere) Alternative, diese Prozesse zu untersuchen, besteht in der Durchführung künstlicher Störungen unterschiedlicher Intensität am Meeresboden.

Neben den Auswirkungen von Eisbergstörungen auf die Biodiversität sind auch die Zeitskalen der Wiederbesiedlung und Erholung nach der Störung von großer Bedeutung, weil sie im Vergleich mit Gemeinschaften niedrigerer Breiten Hinweise auf die Anfälligkeit und Erholungsfähigkeit polarer Ökosysteme geben. Diese Eigenschaft ist, ebenso wie die Biodiversität, von wachsender Bedeutung im Rahmen des Antarktisvertrags und des Madrider Protokolls, weil Schutzmaßnahmen nur unter Berücksichtigung der Stabilitätseigenschaften eines Ökosystems getroffen werden können.

Das Hauptprogramm auf ANT XXI/2 verfolgt daher die Absicht,

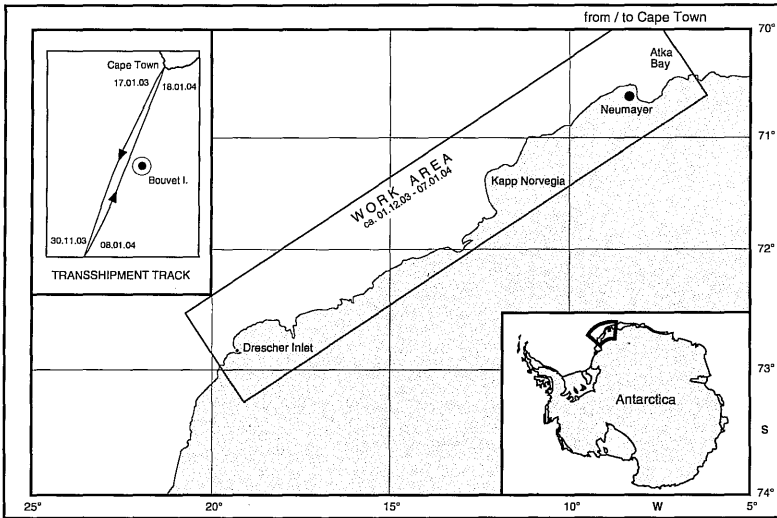
- die Dynamik der Schelfeiskante und von Eisbergstrandungen mittels Satellitentechnik und durch Beobachtungen von Helikoptern und vom Schiff zu quantifizieren. Die Eiskante wird vom Helikopter aus vermessen und mit früheren Meßwerten während EASIZ I-III verglichen. Die Drift von Eisbergen soll auf bestimmten "Rastplätzen" durch Helikopter und Schiffsradar erfaßt werden.
- ungestörte Areale als Basiswert für den *status quo ante* zu beschreiben. Diese Gebiete sollen später als Kontrollflächen dienen.
- auf einer dieser Flächen mit Hilfe eines schweren Trawls eine Eisbergkratzern vergleichbare, künstliche mechanische Störung durchzuführen, um Wiederbesiedlung und Sukzessionen im nächsten Jahrzehnt verfolgen zu können.
- künstliche Hartbodensubstrate aufzunehmen, die während ANT XV/3 vor Kapp Norvegia ausgesetzt wurden.
- die zeitliche und räumliche Sukzession im Versuchsgebiet, v.a. im Hinblick auf Biodiversität, Dominanz und strukturelle Komplexität, mit eigenen und Literaturbefunden aus anderen marinen Ökosystemen zu vergleichen (Schelfgebiete des Nordatlantiks, Mittelmeer, Auftriebsgebiet des Humboldtstroms, Arktische Tiefsee).
- (als Endziel) allgemeingültige Regeln hinsichtlich der Elastizität benthischer mariner Ökosysteme abzuleiten und Indikatoren für Anfälligkeit, Pionierarten, Ökosystemingenieure und andere Schlüsselarten zu identifizieren, die für das Ökosystemmanagement hilfreich sein könnten.

Dieses Hauptuntersuchungsprogramm ist langfristig angelegt und wird mindestens 10 Jahre dauern. Nach Durchführung der künstlichen Störung im "Benthosgarten" soll dieses Gebiet in mehr oder weniger regulären Zeitabständen wiederaufgesucht werden (im Idealfall alle 2 Jahre), um Sukzessionsmuster zu registrieren und Verankerungen zur Messung biotischer und abiotischer Variablen auszuwechseln.

Um "Polarstern" optimal auszunutzen und die Bedürfnisse anderer internationaler und nationaler Gruppen, meist im Rahmen des EASIZ-Programms, zu berücksichtigen, soll das Hauptprogramm mit den folgenden assoziierten Programmen kombiniert werden:

- Benthopelagische Kopplung, trophische Struktur und Energiefluß unter den Bedingungen des polaren Frühjahrs
- Skalenbezogene Biodiversitätsstudien hochantarktischer Benthosgemeinschaften im Vergleich zu arktischen Gemeinschaften
- Taxonomische Biodiversitätsstudien zur Vervollständigung des Inventars hoch- und subantarktischer Benthosarten (incl. Bouvet)
- Phylogenetische und biogeographische Beziehungen und genetische Variabilität sub- und hochantarktischer Fauna (incl. Bouvet)
- Untersuchungen zu Lebensgeschichte, Reproduktionsstrategien und meroplanktischen Larven entlang latitudinalen Gradienten (incl. Bouvet)
- Verfügbarkeit von Fisch als Robbennahrung und Nahrungssuche von Robben im Drescher-Inlet
- Reaktion von Robben auf Geräusche (Drescher-Inlet)
- Anpassungsfähigkeit von Teleostiern: Material für Studien der Temperaturanpassung von Aalmuttern und Antarktischen Fischen (incl. Bouvet)
- Chemische Ökologie: Material für das Studium von Naturstoffen
- Messung atmosphärischer Spurenstoffe.

FS "Polarstern" wird Kapstadt (Südafrika) am 17. November 2003 verlassen. Auf dem Weg zum antarktischen Kontinent wird die Reise für zwei Tage bei Bouvet Island unterbrochen, wo beköderte Fallen und Agassiztrawls im Rahmen verschiedener Programme zu latitudinalen Gradienten für den Fang von Benthos und Fisch eingesetzt werden. Der überwiegende Teil der Arbeiten auf ANT XXI/2 wird in dem Polynjagebiet zwischen der Atkabucht und dem Drescher-Inlet stattfinden (**Fig. 1**), wo wir Ende November einzutreffen hoffen, wenn die Eisverhältnisse dies gestatten. Geräte und Versorgungsgüter für die Neumayer-Station werden ebenfalls in Abhängigkeit von der Eissituation abgeliefert. Die Robben- und Akustikgruppe soll so früh wie möglich zum Drescher-Inlet transportiert werden, während die Fahrtteilnehmer an Bord den gesamten Dezember und die erste Januarwoche vorwiegend vor Kapp Norvegia arbeiten werden. Die Rückreise nach Kapstadt wird um den 8. Januar beginnen, und die Ankunft in Südafrika ist für den 18. Januar 2004 vorgesehen.



2 Scientific Projects / Wissenschaftliche Vorhaben

2.1 Response of the benthic system to disturbance

Recent studies within the Antarctic sea ice zone (Polarstern expeditions EASIZ I-III) showed that iceberg scouring is a common event on the eastern Weddell Sea shelf. Within topographically distinct areas called "iceberg cemetery" or "iceberg restplace" (such as Austasen off Kapp Norvegia), almost 50% of the seafloor are affected by this kind of perturbation that normally results in complete destruction of the bottom fauna. Destruction is followed by different successional stages with characteristic community patterns in the benthos as well as in demersal fish. Regarding the whole shelf, the benthic realm shows a mosaic-like pattern formed by areas of different stages. Thus, iceberg scouring seems to play an important role in structuring benthic and demersal fish communities on the eastern Weddell Sea shelf.

The study of iceberg impact will include field experiments as well as continued surveys of benthos and demersal fish communities in undisturbed and disturbed areas and an attempt to recover tiles deployed six years ago for hard substrate colonisation studies.

2.1.1 Iceberg disturbance and recolonisation experiment (AWI, DZMB)

Objectives: Iceberg impact strongly affects community patterns within the benthos and demersal fish fauna. First attempts have been made to distinguish and characterize the individual successional stages; the time scale of recolonisation, however, is still unknown. Moreover, as the above mentioned spatial mosaic pattern of successional stages seem to facilitate overall diversity, this effect has to be confirmed and quantified. A controlled (spatial extension, time, magnitude) disturbance experiment is the only manageable approach to gain more insight into timescales and patterns of recolonisation processed on the Antarctic shelf.

Work at sea: The disturbance experiment will be carried out in the eastern Weddell Sea off Kapp Norvegia. A suitable shelf area at about 450 m water depth will be marked by transponders. The pre-disturbance state of meiobenthic, macrobenthic and fish communities will be evaluated. Then, this area will be mechanically disturbed and deprived of its benthic fauna by means of a modified Otter trawl.

Hydrography and sedimentation at the experimental site will be monitored by moorings equipped with current meters and sediment traps. The very first steps of recolonisation by meiofauna, macrofauna and fish will be monitored closely immediately after the impact. A faunistic survey in the neighbourhood of the experimental site will provide information on benthic community patterns at various spatial scales. Monitoring of the site will be continued for at least a decade.

2.1.2 Benthic biodiversity change: disturbance, dispersion, modelling (AWI, FIE)

Background: Intense investigations on grounding icebergs and their impact on the ecosystem have significantly contributed to the understanding of the relationship between biodiversity and disturbance in benthic communities. Milestones of increased knowledge based on several expeditions in the past decade were: (1) The impact of grounding and scouring Antarctic icebergs on the benthos belongs to the most effective disturbances that any known large ecosystem on earth experiences. (2) The availability of formerly devastated areas for recolonisers leads to an increased large-scale biodiversity whilst at a local scale biodiversity is highest in the undisturbed situation. (3) Recolonisation is obviously determined by a variety of unknown variables and is hardly predictable. Consequently, benthic "species turnover" is higher when recolonisation stages are included compared with that in undisturbed assemblages.

Objectives: As a next step to disentangle generally relevant relationships between biodiversity and ecological performance in the Antarctic benthos the following questions can be addressed as a contribution to the SCAR project EVOLANTA: (A) Which main drivers of Antarctic benthic biodiversity can be identified by a spatially explicit simulation model? (B) What response can be expected in case of environmental changes, e.g. increased or decreased calving of icebergs? (C) Is a benthic system with high or low diversity more susceptible to environmental changes? (D) Which role do isolated shallow-water areas play for the dispersion and maintenance of species under specific Antarctic conditions?

Work at sea: The questions raised above should be answered by different approaches. (i) Ecological quantitative modelling allows reconstruction and predictions of benthic diversity succession, especially for a hardly accessible area and when changes are very slow (decades to centuries). Ecological hypotheses (e.g. insurance

hypothesis) can be checked. (ii) Conceptual models including evolutionary aspects are to be developed by analyzing large scaled field data derived from unusually shallow sites, e.g. 4-Season Bank or Atka Bay. Data acquisition for both these aspects will be carried out by imaging methods. (iii) Iceberg groundings should be used as a kind of large *in situ* field experiments without anthropogenic impact, with low effort, and without any bias due to the manipulation by man. ARGOS transmitters should be placed on grounded icebergs in order to determine the position of the iceberg in combination with the time when they drift away and provide pristine areas for recolonisation to be monitored during future expeditions. Suitable single icebergs and areas with higher or lesser iceberg impact must be selected in the field.

2.1.3 Iceberg scouring effects on bioavailability of heavy metals: Analysis of spatial patterns (ICMB)

Background: The polar marine system is one of the most interesting places regarding bioaccumulation of metals in organisms. Deficiencies of some essential elements like copper and high bioconcentrations of potentially toxic elements like cadmium have been frequently reported. The latter is referred to as 'polar cadmium anomaly'. The bioavailability of metals can be locally influenced by processes such as melting of sea-ice, upwelling phenomena, related high turnover rates of phyto- and zooplankton and probably iceberg scouring. Generally, aquatic sediments show higher metal concentrations than seawater or organisms. Thus, iceberg scouring could increase the metal availability for organisms colonising such areas in comparison to undisturbed areas.

Objectives: The present study aims to analyse whether organisms collected from areas disturbed by iceberg scouring (working area I, II and III) have significantly higher metal concentrations than organisms collected from undisturbed areas. As far as it is possible to date iceberg scourings, time dependent metal uptake should be analysed as well. Thus, we will consider selected species of the macrozoobenthos such as endobenthic polychaetes or epibenthic amphipods and isopods. Sampling will be done using a standard Agassiz trawl. If possible, additional near bottom zooplankton samples taken by zooplankton nets or samples taken under the ice will be considered. Sampling localities will conform to the general expedition scheme.

Work at sea: Our experimental design corresponds to a classical stratified sampling strategy which can be evaluated by analysis of variance procedures. However, this strategy does not take into account spatial autocorrelations. A straightforward approach to analyse autocorrelated data is the application of spatial analysis, in particular methods of non linear geostatistics, regarding variables such as metal concentrations in organisms. But it is also possible to model the spatial distribution of organisms itself. In this concept we plan to use indicator kriging, one of the most powerful tools in modern geostatistics. To apply this it is necessary to define so-called cut-off levels, e.g. certain metal (background) concentrations or certain biomasses of one species. Subsequently, stations with values below this level are coded with 0 and stations above with 1. The 0/1 transformed data set is then subjected to a geostatistical analysis involving variography and kriging. As a result, contour maps will be displayed indicating the probability to exceed the pre-selected cut-off levels and their errors of estimation. The maps created in this way may be imported to a geographical information system and overlaid with observed iceberg scourings, eventually supporting the above hypothesis of an increased bioavailability of metals in disturbed areas.

2.1.4 Continuing Tasks

a) The impact of iceberg scouring on the demersal fish fauna (AWI)

Objectives: Former investigations (EASIZ II & III) have shown that iceberg disturbances significantly influence the composition of demersal fish communities. These communities are characterized by the dominance of the genus *Trematomus* (Nototheniidae), which accounts for more than 50% of individuals. Within this genus a distinct adaptive niche separation was found, with some species that are common on undisturbed bottoms (e.g. *Trematomus scotti*) and other species that are specialized to live in disturbed areas (e.g. *Trematomus pennellii*). Similar distribution patterns are found in other families, too. Analysing demersal fish communities in undisturbed and disturbed areas will be continued during this cruise.

Work at sea: North off Kapp Norvegia, undisturbed and disturbed areas will be trawled using a 140 feet otter trawl (GSN) and an Agassiz trawl (AGT). Species will be sorted, determined and individuals will be measured and weighed. Furthermore, sex and maturity stages will be

determined, otoliths will be taken for age analyses and stomachs will be removed for diet examinations and stored in 10% formalin.

b) Colonisation of artificial hard substrata (ICM-CSIC)

Background: During the expedition EASIZ II (ANT XV/3) hard-bottom substrates (tiles) were deployed off Kapp Norvegia at 341 m depth (71°35.35'S, 13°54.25'W; a GPS position is also available). It is assumed that these tiles, which have been exposed for almost 6 years, should have been colonized by pioneer species. As this kind of experiments in situ has been carried out seldom in the Antarctic, and has met with little success, the fauna to be collected from the tiles is expected to provide very important data on colonisation, succession and growth of hard-bottom organisms on the Antarctic continental shelf. Similar work in shallow water (subtidal) is being conducted at the Spanish Juan Carlos I station at Livingston.

Objectives: The idea is to register species composition, population density and individual growth of the hard-bottom species that may have colonized the substrates (ascidians, sponges, bryozoans, gorgonians, actinians, brachyopods, etc.), and to derive minimum estimates for colonisation rates and growth within a known period (6 years).

Work at Sea: We intend to localize the substrates, which were deployed in 6 bags of about 1 m³ each in a very restricted area below the principal zone of iceberg scour, by multibeam sidescan, and to collect at least one of them using a modified bottom trawl which will be used for the disturbance experiments of our German partners. The estimated search time is 2 hours, and up to 4 hauls of 30 minutes each will be taken with the trawl. Total estimated time for this project is up to 2 days.

2.2 Adaptation to isolation and glacial cycles

2.2.1 Adaptive competence of Teleostei (AWI)

Objectives: The main focus of our research interest is on temperature adaptability of cold eurythermal versus more stenothermal Antarctic fish species (Zoarcidae and Nototheniidae). We intend to take a close look at the four most energy demanding processes, which consume up to 80% of a cell's energy: protein synthesis, RNA synthesis and ion regulation together with the proton

leak across the inner mitochondrial membrane. Temperature sensitivity also manifests in the ability to regulate the cellular acid-base status with some relevance for the cellular energy budget. We therefore intend to investigate possible synergistic effects of temperature and extracellular pH on the intracellular pH, with particular reference to the Na⁺/H⁺-exchanger. A second aim is to collect tissue samples from fishes freshly caught in bottom and pelagic trawls and freeze them for further analysis, partly onboard the vessel, partly for molecular biological analysis at the AWI (eg. for gene expression studies). Another, possibly alternative research topic will deal with the limited ability of decapod crustaceans to immigrate into the Southern Ocean. Recently, it was proposed that the biogeography of marine crustaceans in cold oceans was related to the combined effects of extracellular magnesium and low temperature (Frederich et al. 2001, Polar Biol 24:719-723). During the last cruise (ANT XX), measurements of spontaneous activity of the Antarctic isopod *Glyptonotus antarcticus* at different extracellular magnesium concentrations were performed to test this hypothesis, showing that extracellular magnesium had indeed a sedating effect on *Glyptonotus antarcticus*.

Work at sea: By means of baited bottom traps we aim to catch sub-Antarctic eelpouts (zoarcids, supposedly more cold eurythermal) off Bouvet Island during the first days of the cruise. In high Antarctic waters we expect to catch further, more stenothermal eelpouts and, by use of floating fishtraps under the ice, cold stenothermal pelagic notothenioids. Subsequently, the effects of temperature on the energy budget of liver cells of these fish species will be examined. Regarding effects of temperature and extracellular pH on intracellular pH, we will inhibit selected metabolic and ion exchange processes in respiration experiments of isolated liver cells at different temperatures and estimate their fractional contribution to total respiration. From these experiments, we hope to gain insight into the thermal sensitivity and flexibility of energy metabolism and budget in these species as well as into the role of proton leak in cold adapted eury- versus stenothermal polar fish.

Onboard "Polarstern", we intend to investigate the temperature sensitivity of a number of enzyme components of the respiratory chain, the Krebs cycle and ion regulation in mitochondrial suspensions and tissue homogenates. Furthermore, we shall start with comparative investigations of the lipid composition of cellular and mitochondrial membranes in eury- versus stenothermal Antarctic fish. Thereby, we

hope to identify various strategies of energetic and thermal adaptation in these species.

The experiments with *Glyptonotus antarcticus* on this cruise will test whether the anaesthetizing influence of extracellular magnesium can be alleviated by the addition of different other ions such as potassium and calcium. Individuals of *Glyptonotus antarcticus* from various bottom trawls will be kept in aquaria in normal seawater as well as at different ion concentrations. We will estimate oxygen consumption rates of *Glyptonotus antarcticus* kept at different ion concentrations in single chambers by means of micro-optodes. Furthermore, by implanting micro-optodes into the circulatory system of the animals we will be able to measure hemolymph pO_2 as it depends upon ambient Mg^{2+} concentrations and seawater pO_2 . These investigation will address the influence of magnesium regulation on oxygen limited thermal tolerance in this animal group

2.2.2 Life history diversity in cold water invertebrates (ULEC)

Background: Polar communities are among the most suitable environments to evaluate the relative contribution and interplay between phylogenetic and ecological factors in selecting life history traits. Both Hydrozoa and Polychaeta represent important components of the Antarctic benthos, in terms of their contribution to overall biodiversity and ecological role. Both these groups show also a large variety of life cycle traits and reproductive strategies. Despite their high frequency, diversity and abundance, life history traits and their adaptive significance in both hydroids and polychaetes are poorly known in general and particularly in the Antarctic. This research proposal falls within the above conceptual framework, and it is a continuation of previous studies carried out on board of R/V Polarstern during three EASIZ and one ANDEEP cruises. The proposal is articulated in three closely related sub-projects.

a) Biodiversity, life cycle, and reproductive biology of Hydrozoa

Polyp stages of Hydrozoa are an important component of the Antarctic benthos. Owing to commonly adopted stressful sampling techniques (trawls) and to the difficulties of keeping these animals alive, studies of hydrozoan diversity mostly rely on morphological analysis of large exoskeletons, thus nearly neglecting species with small polyp stages, which in most cases do not have distinctive chitinous hydrothecae. These species usually produce long-living medusae which are common

components of planktonic communities. Owing to the paucity of hard substrata, the polyp stage of several species developed epibiotic, species-specific relationships with several invertebrate taxa. These symbiotic associations are somehow cryptic and may remain unobserved without appropriate laboratory rearings. Sampling will be made either on benthic and planktonic stages. Rearings on board would give the opportunity also to obtain new data on developmental time and modes of benthic and pelagic hydrozoans.

b) Life cycle variability and reproductive biology of Polychaeta

About 800 polychaete species are known from Antarctica, but life cycle and reproductive biology are known for less than 4% of them. Many species show a reduced larval phase (demersal larvae) or brooding, even in families with strong phylogenetic constraints in larval development, such as the Polynoidae. Also members of Sabellidae have been observed as brooders, despite their relatively large size. On the other hand, many polychaetes in polar waters are represented by small-sized forms, with short life span and belonging to families generally showing many r-strategy traits in their life history (e.g., Cirratulidae, Paraonidae, Capitellidae). Participation in the 2003/04 cruise will increase our knowledge on reproductive biology of several Antarctic polychaetes. Sampling will be performed mainly by means of Agassiz and bottom trawls, and will be completed, if possible, by box-corer and grab. Rearing of larvae on board would give the opportunity to gather, as in Hydrozoa, new information on developmental time and modes of polychaetes.

c) Cyst diversity in Antarctic sediments

The ecological importance of resting stages in neritic areas is widely investigated, and the presence of resting eggs of Calanoida, Cladocera and Rotifera in marine shelf sediments is inversely correlated with distance from coastline and/or depth. On the contrary, the significance of cysts in cold water systems is mostly neglected. Resting stages constitute "potential biodiversity" allowing a structural continuity against the functional discontinuity represented by the presence of species in the water column. Resting stages should represent a fundamental biological link, via submarine canyons, in shelf-slope and shallow-deep sea coupling. During upwelling events, significant quantities of water and sediment coming from the deep bottom are pumped out of canyons toward the coasts. If so, the functioning of coastal Antarctic waters would be intimately linked with that of offshore ones, via canyon-driven circulation of propagules. The study of resting stage dynamics in shelf canyons will be a further step in this

direction. Collection of resting stages by cores and traps from sediments, waters, and possibly pack ice within the framework of the ANT XXI/2 cruise would contribute to increase our knowledge on seed bank composition and temporal variability, in the light of the overall ecosystem dynamics and processes.

2.2.3 Reproductive strategies of high latitude invertebrates (AWI, NIOZ)

Scientific background: Reproductive strategies of marine benthic invertebrates in high latitudes have been discussed controversially during the past two decades, but only a few attempts have been undertaken in the southern hemisphere to scrutinize the comprehensive work done by Thorson in the Arctic. Thorson's work led to the hypothesis that a mismatch between food availability (due to distinct seasonality) and prolonged larval development at low temperatures should strongly select against planktotrophic larval development in polar environments.

Autecological studies on invertebrate larval development in the Antarctic are still scarce, and this is particularly true for the regionally impoverished decapod fauna. Since reproductive trade-offs reflect best the vulnerability of larvae to ecological and physiological constraints, we believe that the study of invertebrate larvae, their occurrence, distribution, and modes of development are an adequate approach to understand evolutionary trends in cold environments.

Work at sea: We plan the use of baited traps at Bouvet Island and in the Weddell Sea to capture ovigerous females of shrimps and crabs. In addition, decapod material will be separated from bottom trawls and dredges (e.g. AGT, Rauschert dredge), mainly for molecular work. Demersal invertebrate larvae will be sampled with epibenthic sledges and an autonomous plankton lander (ALTRAP, Autonomous Lander for in-situ larval studies) which will be used for the first time in Antarctic waters, allowing for sampling the epibenthic sediment-water interface. In addition to this sampling device, we plan to deploy a so-called water-box system which allows the sampling of 250 l water to be sieved later on deck. Both ovigerous crabs and/or larvae will be kept on board for studies on larval development and oxygen consumption. Live material will be shipped to the labs in Germany.

2.3 Weddell Sea shelf food web and benthic-pelagic coupling

2.3.1 Trophic structure and energy flow of the Weddell Sea shelf ecosystem (AWI)

Objectives: Communities of shelf and slope areas play a significant role in Antarctic carbon cycling. In order to understand this role, we have to identify the major pathways of carbon through the shelf communities. Our long-term effort in the analysis of trophic relations and population dynamics aims at a balanced carbon flow model for the Weddell Sea shelf and slope ecosystem.

Work at sea: During ANT XXI/2 our work will focus on the following topics:

- Trophic links between different species of the shelf community
Stable isotope ratios ($^{14/15}\text{N}$, $^{12/13}\text{C}$) in organic matter change with the passing of N and C through the food web owing to selectivity of enzymes for one of the isotopes. Hence, stable isotope ratios can be used to determine the relative trophic position of taxa/groups within the community. On board "Polarstern", samples will be collected and prepared for analysis of stable isotope ratios (N, C). During this cruise we attempt to fill gaps in our stable isotope data of the shelf community, especially regarding demersal fish species. Additionally, gut and stomach contents will be sampled and analysed for identification of food taxa.

- Metabolic activity of important benthic taxa
Onboard "Polarstern" respiration rates of a range of benthic taxa, especially molluscs and sponges, will be determined in order to obtain basic information on the metabolism of these taxa and to compare metabolic activity during austral **spring** with activity during austral **summer and autumn**.

2.3.2 Benthic-pelagic coupling under polar spring conditions (ICM-CSIC, UAB, US, AWI)

Objectives: The main objective of the present project is to test some hypotheses about the mechanisms of ecological success of benthic Antarctic suspension feeder communities during austral spring. The aspects related to the trophic ecology of suspension feeders and environmental conditions, which facilitate the processes of energy transfer between benthic and water column systems will be emphasized. In particular, we propose the following question: Is the

formation of organic matter (export primary production) in the photic zone significant for suspension feeders? What do we know about the fate of this organic material and what is available in near-bottom waters or at the sea floor? Which processes are responsible for the availability of food to suspension feeders (vertical transport, resuspension or lateral advection)? Which is the role of bacteria in the diet of benthic organisms and how do they influence the growth and production of microbial communities near the bottom? To what extent are the abundance, reproduction, and patchiness of suspension-feeder communities a consequence of biological and environmental factors, which facilitate the development of benthic communities?

From previous investigations (EASIZ I, II, and III) during summer and autumn conditions we know that:

- Nutrients in the water column showed weak stratification and low concentrations. Off Austasen, nutrient concentrations differed significantly from those off Four Season Bank and Kapp Norvegia. Influence of icebergs is hypothesised.
- Currents near the bottom varied between 5 and 15 cm s⁻¹ and showed tidal influence. These conditions are favourable for sediment resuspension.
- Benthic organisms (gorgonians and sponges) showed high trophic activity, feeding especially on fine particulate matter (pico-, nano-, and microplankton).
- Many organisms showed high reproductive potential (with two or three gonad generations) and others had developed their larvae but they had not released them yet.
 - In the surface sediment the organic matter content and its nutritive value for benthic suspension feeders were high.

What do we expect during spring conditions (ANT XXI/2)?

- Stronger stratification in the water column with higher nutrient concentrations close to the bottom due to benthic activity (nutrient releases). Do differences in the Austasen region still remain?
- Currents near the bottom should be similar to other seasons; thus providing conditions for stable year-round sediment resuspension.
- Do benthic organisms (gorgonians and sponges) feed on coarser particulate matter (phytoplankton and/or faecal pellets) or are they still filtering the fine fraction of seston?
- Are larvae already released and ready to benefit from the seasonal fresh organic matter input?

- There should be a higher organic matter content and nutritive value in the bottom sediments due to seasonal exports from the euphotic zone.

Work at sea: The response of benthic suspension feeders to spring conditions will be analysed by:

- incubation experiments (probably with *Stylocordila* sp.) to determine filtration rates.
- analysing changes in the nutrient concentrations and the microbial food chain in the water layer close to the seafloor.
- studying microbial biomass, diversity, and production in the water layer close to the seafloor and inside benthic organisms (sponges).

Differences in water column, sediment, and organism characteristics between summer-autumn and spring are analysed by:

- water, sediment and benthic organism samples from undisturbed areas to be analysed partially on board (chlorophyll, biochemistry, and organic compound).
- studying larval development and reproductive state of various species.

Within the frame of the disturbance experiment (see above) we will

- study the time required for transfer processes of organic matter in the water column through radionuclide analysis (^{210}Po and ^{234}Th).
- analyse differences in the spring patterns relative to summer-autumn conditions studied before.
- analyse water column and sediment/benthos interactions in scour marks and undisturbed adjacent areas by means of (a) measurements of water column, sediment, and benthos community characteristics before and after the disturbance, and (b) analysis of water column and sediment/benthos interactions in scour marks and undisturbed adjacent areas by monitoring water currents, phytoplankton, particle flux, and sediment biochemistry at both sites.

2.3.3 Trophic links between zooplankton, fish, and Weddell seals (AWI)

Objectives: The pelagic fish fauna in the Drescher Inlet is dominated by *Pleuragramma antarcticum* (Nototheniidae, 70 % of total fish biomass), and by *Anopterus pharao* (Anopteroidea, 20 % of total fish biomass, EASIZ II, 1998). Both species have been shown to undertake diel vertical migrations in the study area. While *A. pharao* seems to be primarily piscivorous, *P. antarcticum* is known to feed predominantly on copepods, their eggs and larvae, and on Antarctic krill. On the other hand, *P. antarcticum* is an important prey of

predatory fishes, seals, and birds. As this species obviously is an important link in the marine pelagic food web of the Drescher Inlet, the study will cover occurrence, composition and vertical distribution of phyto- and zooplankton (including fish larvae), the feeding of dominant zooplankton species, the diet and vertical migrations of *P. antarcticum*, and the predation on this species by Weddell seals (*Leptonychotes weddellii*).

Work at sea: As standard device for the quantitative collection of zooplankton a multinet equipped with 5 nets of 100 µm mesh size will be used. The net can be opened and closed sequentially. Species composition, abundances and biomass, and vertical distribution patterns of dominant species and their developmental stages will be analysed from these samples. Additionally, experiments on feeding and faecal pellet production of dominant species will be carried out on board. Live animals will be caught by means of a bongo net from the upper metres of the water column. For quantitative and qualitative studies on feeding behaviour, experiments will be conducted in a cooled container. Various food organisms (phytoplankton cultures, naturally occurring particles and ciliates) will be supplied in different concentrations, and ingestion rates and faecal pellet production will be estimated. Furthermore, analyses of stable isotope compositions are planned.

Diel vertical migration patterns of *P. antarcticum* will be studied by 24h trawling with a benthopelagic net (BPN). Fishes will be measured and weighed on board and otoliths and stomachs will be preserved for later analysis.

2.3.4 Foraging ecology of seals (AWI, ORI-NIPR, UHB)

Background & Objectives: During the EASIZ (II) cruise of RV "Polarstern" a joint seal-fisheries study was carried out in the Drescher Inlet. Data loggers on Weddell seals provided dive records over a period of intensive ice break-up. During daylight, diving occurred in the upper water column and near the 450 m deep seabed. During night, dives were shallowest. Trawling during daytime confirmed that *Pleuragramma antarcticum* were by far the most abundant fish, both in the pelagial and close to the bottom. Pelagic night hauls indicated a highly variable fish biomass. The Drescher campaign in December 2003 provides the opportunity to replicate the study on predator-prey relationships in a season that is characterized by unbroken ice and permanent daylight. Weddell seals will be used to obtain visual (image data) information on the vertical distribution patterns of plankton, krill

and fish, data records of the seals' spatial foraging movements, prey catch, and of hydrographic features under the sea ice. Data from the new logger systems combined will allow us to characterize the foraging strategy of seals and to quantify their pelagic and benthic foraging success. A comparison with the results derived from ecological studies of fish (Knust et al.) and zooplankton (Schiel et al.) communities will provide new insights into the complexity of intermediate and upper level trophic interactions and energy flows in pelagic and benthic food webs.

Work at sea: The NIPR developed a Digital Still Picture Logger (DSL) and an Acceleration Logger (AL). The DSL provides snapshots of the prey-field ahead of diving seals. The images are converted to a grey-scale and objects in the prey-field are identified and counted according to their brightness. Based on this, a "prey index" is calculated for each image and the prey distribution along the seal's dive path is compared with dive depth. The AL data allow a reconstruction of the 3-d diving activities. The IfMK developed an Inter Mandibular Angle Sensor (IMASEN) and a Multiple Channel Logger (MCL). The IMASEN is a Hall-sensor-magnet unit recording feeding events which allow estimates of the number, size and type of prey ingested by the seal. The MCL uses a compass, speed sensor, pressure transducer and body-angle sensors to record a detailed 3-d swimming route of the seal. Water temperature and light are also recorded. As a back-up technique for DSL, AL, IMASEN and MCL, simple depth-recorders will be used on (other) seals to obtain comparative data on their overall-diving behaviour.

2.4 Chemical ecology of Antarctic organisms (CSIC-CEAB, UAF)

Objectives: The aim of the ECOQUIM project is to obtain bioactive natural products from Antarctic benthic invertebrates that may provide information on the chemical ecology of the involved species and may as well be useful to humans because of their pharmacological potential. Our previous studies on the chemical ecology of Antarctic invertebrates did provide positive results and for this reason we intend to collect and to study selected species of the following benthic invertebrate groups: molluscs, sponges, tunicates, nemertines, echinoderms, bryozoans and cnidarians. The ECOQUIM project intends to deepen and to extend the studies carried out individually in recent years through the collaboration of expert scientists in the different aspects of the chemical ecology of Antarctic invertebrates, who will

share their particular knowledge and know-how, to reach wider and more ambitious results at a multidisciplinary level. The project will develop five specific objectives:

- to identify the natural products present in the analyzed species.
- to identify the origin of such compounds (diet, symbiotic organisms, biosynthesis).
- to localize the natural products in the organisms at histological, cytological and immunocytochemical levels.
- to test the ecological role of the isolated compounds and extracts by using activity tests (deterrence and toxicity) against sympatric predators.
- to analyze the antitumour activity of extracts and isolated compounds for their potential pharmacological use.

Work at sea: The Weddell Sea area is rich in benthic invertebrates which have been scarcely analysed for the presence of natural products. For this reason, the probability of discovering species which possess bioactive compounds with pharmacological interest is very high. Samples will be collected during the Antarctic cruise ANT XXI/2 by Agassiz trawl (AGT) and bottom trawl mainly. The specimens will be taxonomically identified, fixed or frozen immediately or maintained alive for experimentation on board. Experiments on board will include feeding deterrence tests, toxicity tests, and feeding preference experiments.

2.5 Biodiversity, evolution & genetics

2.5.1 Genetic variability in Antarctic marine invertebrates (BAS)

Background: The shelf areas of eastern Weddell Sea are one of the best-investigated areas in the Antarctic and the faunal composition is well known. For selected invertebrate groups, e.g. Bivalvia, Gastropoda, Bryozoa and Amphipoda, comprehensive biogeographic and/or phylogenetic analyses have been carried out. These data provide the basis for our studies on population genetics on selected benthic invertebrates to investigate the influence of their reproductive mode on spatial genetic structure, colonisation and their roles in the speciation process. We propose to sample marine invertebrates with contrasting modes of larval development (brooding/direct developing versus free-spawning) and contrasting adult lifestyles (sessile versus motile). To investigate the population genetic structure we aim to collect DNA sequence data from mitochondrial (16 S, COI, CytB) and

nuclear (ITS-1) regions from a small number of species. These genes will also confirm whether the studied taxa are truly monophyletic or whether they consist of cryptic species, which only show minor morphological differences and have therefore been synonymised. The more polymorphic regions will allow us to examine the spatial genetic structure of specimens collected from the cruise at different locations and with material from other cruises / shore-based collections. Furthermore we will collect recently neglected taxa such as nemertines and pycnogonids for phylogenetic and population genetic studies. We aim to use the epibenthic sledge in iceberg scars to investigate the abundance and composition of the epi- and suprabenthic fauna and to identify possible first recolonizers for those disturbed areas.

Objectives:

- Tempo and mode of species diversification in the Antarctic
- Population structure in Antarctic invertebrates: cryptic species or ecologically most successful species? - Gene flow among free spawning species is higher than in brooders? - Epibenthic species richness in disturbed areas

Work at sea: - Selected marine invertebrates, e.g. bivalves, prosobranch gastropods, eusirid and epimeriid amphipods, pycnogonids, bryozoa and nemerteans, sampled by bottom trawl, Agassiz trawl, and Rauschert dredge will be collected and prepared for further analysis (SEM, PCR). DNA from living material of selected species, such as *Nutallochiton mirandus*, *Harpovoluta charcoti*, *Parmaphorella mawsoni*, arcoid bivalves, and eusirid and epimeriid amphipods, will be extracted on board and first PCR amplifications will be done using the fresh samples.

- Epibenthic sledge samples from iceberg scars will be fixed in ethanol, sorted and analyzed at home for juvenile stages of possible recolonizers.

- All invertebrate material collected will be identified and used for taxonomic, phylogenetic, biogeographic and diversity studies.

2.5.2 Phylogeny, biodiversity and functional ecology of amphipod crustaceans (IRSNB, AWI)

Background: Weddell Sea benthic amphipod crustaceans are characterized by high diversity, often high abundance, and a remarkable ubiquity. These characteristics make them a good model group for studying patterns and processes of biodiversity and biogeography. A large dataset on amphipod diversity and distribution

has been produced by previous “Polarstern” campaigns in the eastern Weddell Sea, the Peninsula and the Scotia Sea regions and is being synthesized. Recent deep sea investigations (ANDEEP) gave new insights in the diversity of some very poorly investigated parts of the Southern Ocean. New insights on phylogeny, biogeography and phylogeography can now be gained from molecular approaches. In particular, the colonisation processes between the shelf and the deep sea – in both directions – remain to be elucidated. First attempts to characterize the ecofunctional role of the Antarctic amphipod communities dealt with the trophic habits of selected species and their habitat diversity and complexity. Investigations on the amphipod trophic role relied on digestive tract analyses, feeding experiments, functional morphology of feeding appendages, as well as trophic marker approaches using stable isotopes, lipids and fatty acids. Results revealed a rather large diversity of trophic types among the selected species which, however, does not represent yet the full spectrum of trophic types and roles within the whole amphipod taxocoenosis. On the other hand, the understanding of the quantitative role of the rich and diverse amphipod taxocoenosis in the benthic food web is still very limited.

Objectives:

(a) Biodiversity

- composition and characteristics of the high Antarctic amphipod fauna in comparison with the other Antarctic and Subantarctic zoogeographical sub-regions and with the deep slope and abyssal zones. The detection of cryptic taxa by molecular genetics is of particular interest.

- photographic documentation of Antarctic benthos for the AWI illustrated identification keys in preparation by M. Rauschert.

- taxonomical material, photographic records, distribution and ecological data for the ongoing revision of the whole Antarctic fauna and for the development of new identification tools by the “Antarctic Amphipodologist Network”.

(b) Phylogeny and Biogeography - Phylogeography

Phylogeny of selected amphipod taxa (in particular Lysianassoidea) and their biogeographical history by a parallel molecular and ecomorphological study relying on both shelf and deep sea (ANDEEP) material. In particular, to investigate and check the polar submergence hypothesis within selected taxa by molecular data, using different nuclear and mitochondrial genes.

(c) Functional ecology

- ecological characterization of the amphipod taxocoenosis in particular the habitat diversity, the ecomorphological types and life styles.
- detailed investigation of the trophodiversity and the trophodynamics of the amphipod taxocoenosis in the eastern Weddell Sea benthic communities. The approach will be multiple involving
 - analyses of feeding behaviour and diet in aquaria
 - use of stable isotope (C and N) ratio and fatty acids as amphipod diet tracers to delineate the trophic relationships involving amphipods in the benthic food web of the Weddell Sea shelf.
 - trophic adaptive radiation in selected taxa by a morpho-functional approach coupled with a molecular identification of trophic homologies and analogies and molecular polarization of the ecomorphological adaptations.
- significance of the amphipods as preys for other macrobenthos and demersal fishes.

Work at sea: Sampling will be performed by different collecting methods: trawls, "Rauschert" dredge, corers, autonomous trap system. Sorting and identification on board will be attempted as far as possible, as well as DNA extractions. Observations and experiments on living specimens will be performed in a cool container.

2.5.3 Biogeographic and phylogenetic relationships between sub- and high Antarctic fauna: sampling at Bouvet Island (AWI)

Background: Sampling for elucidating biogeographic patterns of, among other taxa, decapod crustaceans and notothenioid fish has been carried out during various „Polarstern“ cruises since the beginning of the 1980s, revealing interesting distribution modes and connections between subregions of the Southern Ocean. The most recent attempt of this kind was the „LAMPOS“ cruise covering the Scotia Arc all the way to the South Sandwich Islands in 2002. This cruise showed that the Magellan fauna extends far to the east, but that the present exclusion of reptant decapods (excl. lithodid crabs) from Antarctic waters south of the Polar Front is valid also for the southern branch of the Scotia Arc. Bouvet Island, situated much farther to the east at 54°26' S, 3°24'E, provides an ideal case study to find out what colonisation by larval drift, algal or driftwood transport in the West Wind Drift can do. Furthermore, Bouvet Island might be touched by the Weddell Gyre and serve as an intermediate station for colonisation of

the high Antarctic continental shelf. For these reasons, Bouvet is also an interesting site for the study of phylogenetic relationships between high and Subantarctic (incl. Magellan) fauna. Finally, its rather northerly position also calls for physiological work on thermal and reproductive adaptation strategies of fish and decapods compared to their relatives on the Weddell Sea shelf and at the Antarctic Peninsula.

Objectives: The proposed study intends to clarify biogeographic, phylogenetic and physiological traits of the marine fauna living at Bouvet Island, in relation to the fauna sampled during former cruises on the high Antarctic – Magellan latitudinal gradient. The focus will be on fish (Zoarcidae and Notothenioidei) and decapod crustaceans; further fauna sampled will be studied for their biogeography and biodiversity.

Work at Sea: The intention is to work two days near Bouvet, on the way to Atka, and to use an Agassiz trawl, a triangle dredge and baited traps. Exact positions will be selected depending on water depth, topography and type of sediment.

2.6 Bioacoustic research on seals in the Drescher Inlet (AWI)

Background: Marine mammals use sound for communication, prey detection and orientation. Derived from the hearing ability of humans (18 Hz – 20 kHz), sounds <18 Hz are termed infrasound, and >20 kHz ultrasound. Baleen whales and seals produce sounds in the infrasonic range, and in the range audible to humans. Toothed whale communication is mainly above 1 kHz, and their echolocation “clicks” are reaching far into the ultrasonic range. The sensitive hearing of marine mammals has led to concerns that intense anthropogenic sounds could impede communication, cause stress or damage hearing.

Objectives: The bioacoustic investigations at the Drescher Inlet are part of a new project on “Oceanic Acoustics” integrating the studies of geophysicists and zoologists to assess the need and scope of mitigation measures for the effects of anthropogenic sounds in the ocean, to develop acoustic census techniques and to examine the influence of man-made sound on the behaviour of marine mammals. The listening conditions in the Drescher Inlet are favourable because firm ice acts as an insulator to wind and wave noise so that, apart from ice rearing, little background noise will be present in the acoustic recordings. The first approach of our feasibility study comprises:

(1) measurements of vocalizations of whales and seals and (2) observations of the behaviour of surfacing whales.

Work at sea: Omnidirectional hydrophone systems will be lowered over the fast-ice edge to obtain sound records of whales and seals. The data will be used: (1) to identify and classify species-specific vocalizations, (2) to describe the time, frequency and amplitude characteristics of vocalizations, and (3) to analyse diurnal variation in vocalization rates of marine mammals. A digital video camera will be used to document the individual behaviour and the respiration (blow) rates of whales surfacing (between repetitive dives) directly at the ice edge. Finally, an infrared camera will be used to test whether surfacing whales can be detected by their own heat radiation.

2.7 MAX-DOAS measurements of atmospheric trace gases (UYO)

Objectives: An important aspect of environmental research is the knowledge of trace gases and their concentration in the atmosphere. A recognized method for this is the Differential Optical Absorption Spectroscopy DOAS, identifying trace gases by their absorption in different wavelength ranges of solar light spectra. For these measurements, sunlight scattered by molecules of the atmosphere is observed, dispersed in a spectrograph and the resulting spectra are recorded by CCD detectors. In this way the concentration of tropospheric trace gases such as NO_2 , H_2O , HCHO , IO and SO_2 in different heights can be measured as well as the concentrations of other, mainly stratospheric absorbers such as O_3 , NO_2 , BrO , OCIO , H_2O , HCHO , O_4 and IO .

Work at sea: Due to the fact that some of these gases (BrO , SO_2 and HCHO) show absorption only in the ultraviolet, others (H_2O and IO) only in the visual, and again others such as O_3 , NO_2 , OCLO and O_4 in both spectral ranges, and because it is necessary to have different spectral resolutions in the ultraviolet (0.5 nm) and the visual (1.0 nm) range, two separate instrument set-ups are used in this experiment. The UV unit covers the spectral range from about 300 to 400 nm, the Vis unit the range from about 400 to 700 nm.

The UV unit consists of 3 moveable telescopes from 0° (zenith) to 90° (horizon) to gather light simultaneously from 3 different lines of sight. The observed light is conducted by 7 glass fibres per telescope to one spectrograph, where they form an entrance slit of about $1200 \times 150 \mu\text{m}$. The resulting 3 spectra are then recorded by a 2-dimensional CCD

array with 1024 x 256 pixels. The Vis unit uses only one moveable telescope, whose light is conducted by one 800 μm diameter glas fibre to a spectrograph with a 2048 pixel CCD row. The obtained spectra from both units are saved for further analysis by a PC also controlling the whole experiment's functions. The seven-months-cruise of RV Polarstern will result in about 40 GB of data. The name MultiAXis-DOAS results, of course, from the different lines-of-sight of the moveable telescopes.

Because of the steadily improved experimental set-up, the ship-based MAX-DOAS measurements will provide a high-quality set of data of a large latitudinal cross-section. Particularly important are measurements within the tropics, where there are few long-term footholds for such experiments up to now.

The gained data will also be used to validate the SCIAMACHY instrument on-board the European research satellite ENVISAT (in fact, the experiment was planned for this reason) continuing the work of GOME on satellite ERS-2 in measuring important trace gases such as O_3 , BrO, NO_2 , OClO and HCHO in the world's atmosphere. The value of SCIAMACHY data will depend on their exactness determined strongly by ground-based control experiments. Since ENVISAT is on a polar orbit similar to the main direction of the ANT XXI/2 cruise, the data gathered onboard RV Polarstern during this cruise will be important for validation purposes.

Ship-borne DOAS measurements have been carried out before in the years 1990, 1993, 2001-2002 and 2002-2003 with good success by the Heidelberg Institute for Environmental Physics.

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DZMB	Deutsches Zentrum für Marine Biodiversitätsforschung	Schleusenstr. 1, 26383 Wilhelmshaven
FIELAX	Gesellschaft f. wiss. Datenverarbeitung	Schifferstr. 10-14, 27568 Bremerhaven
IAEA	Marine Environment Laboratory	4 Quai Antoine Premier, MC 98000 Monaco
IFM	Institut für Meereskunde	Universität Kiel, Düsternbrooker Weg 20, 24105 Kiel, Germany
ICBM	Institute of Chemistry and Biology of the Marine Environment	Universität Oldenburg, POB 2503, 26111 Oldenburg, Germany
ICM (CSIC)	Institut de Ciències del Mar	Passeig Marítim de la Barceloneta, 37-49, 08003 Barcelona, Spain
IRSNB	Institut Royal des Sciences Naturelles de Belgique	Rue Vautier, 29, 1000 Bruxelles, Belgium
NIOZ	Royal Netherlands Institute for Sea Research	POB 57, 1790 Den Burg Texel, The Netherlands

Acronyme	Institution	Address
OS	Optik Simon	Schildergasse 78-82, 50667 Köln, Germany
ORI	Ocean Research Institute	The University of Tokyo, 1-15-1 Minamidai, Nakano, Tokyo, 164-8639 Japan
RAS	Russian Academy of Science	P. P. Shirshov Institute of Oceanology, 36 Nakhimovski Prospekt, 117997 Moscow, Russia
RUB	Ruhr-Universität Bochum	ND05-788, 44780 Bochum, Germany
UAF	University of Alaska Fairbanks	School of Fisheries and Ocean Sciences, POB 757220, Fairbanks, AK 99775-7220
UHB	Universität Bremen	Bibliothekstraße 1, 28359 Bremen
USE	Universidad de Sevilla	Avd. Reina Mercedes No.6, 31012 Sevilla, Spain
UYO	University of York	Dept. of Chemistry, York YO10 5DD, UK

Schiffsbesatzung / Ship's Crew

Operator: Reederei F. Laeisz (Bremerhaven) G.m.b.H.

Name	First Name	Rank	Country
Domke	Udo	Master	German
Grundmann	Uwe	1. Offc.	German
Pluder	Andreas	Ch. Eng.	German
Spielke	Steffen	2. Offc.	German
Peine	Lutz	2. Offc.	German
Fallei	Holger	2. Offc.	German
Kohlberg	Eberhard	Doctor	German
Koch	Georg	R. Offc.	German
Delff	Wolfgang	1. Eng.	German
Ziemann	Olaf	2. Eng.	German
NN		3. Eng.	German
Muhle	Heiko	Electr.	German
Baier	Ulrich	FielaxElo	German
Fröb	Martin	FielaxElo	German
Muhle	Helmut	FielaxElo	German
Roschinsky	Jörg	FielaxElo	German
Loidl	Reiner	Boatsw.	German
Reise	Lutz	Carpenter	German
Gil	Iglesias	A. B.	Spain
Pousada Martinez	S.	A. B.	Spain
Winkler	Michael	A. B.	German
Guse	Hartmut	A. B.	German
Hagemann	Manfred	A. B.	German
Schmidt	Uwe	A. B.	German
Bastigkeit	Kai	A. B.	German
NN		A. B.	German
Bäcker	Andreas	A. B.	German
Preußner	Jörg	Storek.	German
Ipsen	Michael	Mot-man	German
Voy	Bernd	Mot-man	German
Elsner	Klaus	Mot-man	German
Hartmann	Ernst-Uwe	Mot-man	German
Grafe	Jens	Mot-man	German
Haubold	Wolfgang	Cook	German
Völske	Thomas	Cooksmate	German
Silinski	Frank	Cooksmate	German
Jürgens	Monika	1. Stwdess	German
Wöckener	Martina	Stwdess/KS	German

Czyborra	Bärbel	2. Stwdess	German
Silinski	Carmen	2. Stwdess	German
Gaude	Hans-Jürgen	2. Steward	German
Möller	Wolfgang	2. Steward	German
Huang	Wu-Mei	2. Steward	China
Yu	Kwok Yuen	Laundrym.	Hongkong

1 ANT XXI-Land - Antarktischer Sommer an Neumayer, Kohnen und Novolazarevskaya (Zusammenfassung)

Die Sommersaison ANT XXI-Land von November 2003 bis März 2004 beinhaltet umfangreiche wissenschaftliche und auch logistische Projekte. Um diese Kampagne zu verwirklichen, werden die daran teilnehmenden Personen wieder von Kapstadt aus mit einer russischen Transportmaschine, einer Iljushin 76, über die Station Novolazarevskaya, kurz Novo, eingeflogen und zum Ende der Kampagne wieder ausgeflogen. Um die 60 Personen werden auf diese Art reisen. Auch ein nicht unerheblicher Teil an Fracht wird auf diesem Weg mitgeschickt, damit wissenschaftliche Projekte gleich zu Beginn der Saison starten können. Saisonbeginn ist bereits Anfang November. Mit dem ersten Iljushin-Flug gehen drei Personen nach Neumayer, ein Mann vom Deutschen Wetterdienst (DWD) und zwei Wissenschaftler der Universität Hannover. Der DWD wird, wie bereits in der vergangenen Saison, die Flugwetterberatung für den Flugverkehr im Dronning Maud Land übernehmen. Unter dem Namen CASE werden von der Uni-Hannover unterschiedliche Strahlungsmessungen über den gesamten Verlauf des Sommers durchgeführt.

Im darauffolgenden Iljushin-Flug Mitte November reist ein deutsch-russisches Team von Wissenschaftlern des VISA-Projekts ein. Sie werden von Novo aus mit Skidoos im Feld operieren. Hierzu wird von der Logistik umfangreiches Material für die geplanten Skidoo-Traversen bereitgestellt und mit der IL76 eingeflogen. Weitere Messungen zu VISA finden während der Kampagne durch die Dornier-Flugzeuge Polar 2 und Polar 4 statt.

Gegen Ende November reisen 10 Techniker der Kohnen-Station mit dem dritten Iljushin-Flug ein. Die Dornier-Flugzeuge bringen sie weiter zur Kohnen-Station. Nach Inbetriebnahme der Station reisen Anfang Dezember mit einem weiteren Iljushin-Flug 17 Wissenschaftler von EPICA ein, um die Eisbohrung an Kohnen durchzuführen. Mit diesem Flug kommen auch sämtliche Sommergäste und das neue Überwinterungsteam nach Neumayer, insgesamt 26 Personen. Die Zubringerflüge von Novo nach Neumayer werden durch zwei russische Antonov 2-Flugzeuge durchgeführt.

Die Versorgung der Neumayer- und Kohnen-Station mit Fracht, Proviant und Treibstoff wird wieder über die „Polarstern“ Anfang Dezember stattfinden. Ende Januar und Mitte Februar 2004 wird ein Großteil der Personen mit der Iljushin abreisen. Die Entsorgung der Neumayer-Station findet Anfang März 2004 durch das südafrikanische Schiff „Agulhas“ statt. Mit dem Schiff verlassen auch die letzten Techniker Neumayer.

Das 23. Überwinterungsteam an der Neumayer Station wird von der Nachfolgegruppe, bestehend aus fünf Frauen und vier Männern, abgelöst. Die neuen Überwinterer wurden zuvor in Bremerhaven intensiv geschult und auf ihre Überwinterung vorbereitet.

Im Zuge von Wartungsarbeiten am Neumayer-Stationsbauwerk finden diverse Aufstockungsarbeiten statt. Das Dach der Fahrzeughalle wird erhöht, die Ostrampe, Radom, diverse Be- und Entlüftungsschächte der Station,

Notausstiege und verschiedene Plattformen der im Außenbereich liegenden Observatorien müssen erhöht werden.

Des weiteren wird außerhalb der Station ein weiterer Container aufgestellt, die „Bibliothek im Eis“, die einen Ruheort an Neumayer darstellt und als künstlerisches Projekt gesehen wird. Eine Einweihung des Projekts wird in der nächsten Saison stattfinden.

Im Eistunnel zur Fahrzeughalle der Station wird die tief hängende Decke freigeschnitten, damit für die im Tunnel geparkten Fahrzeuge wieder ausreichend Höhe zum Unterstellen vorhanden ist. Die Meßfelder der in der vergangenen Saison neu errichteten Infraschall-Anlage, IS27, werden routinemäßig erhöht. Diese umfangreichen Arbeiten werden von insgesamt acht Fremdmonteuren zusammen mit den Mitarbeitern der Logistik durchgeführt.

1 ANT XXI-land activities - Antarctic summer at Neumayer, Kohlen and Novolazarevskaya Station (Summary)

In the summer season ANT XXI from November 2003 to March 2004, a great number of scientific and logistic projects will be carried out in the course of the land activities. In order to realize this campaign, the participating persons will again be flown into Antarctica from Cape Town on board of a Russian transport plane, Iljushin 76, via Novolazarevskaya ("Novo") Station, and transported back the same way after the end of the campaign. The number of persons travelling this way amounts to about 60. Also a substantial part of the freight will be sent down this way in order to get the scientific projects started from the beginning. The season starts already at the beginning of November. Three persons will be taken to Neumayer on the first Iljushin flight: One representative from Deutscher Wetterdienst (DWD) and two scientists from Hannover University. As already in the last season the DWD will be responsible for the flight weather forecasts for the air traffic in Dronning Maud Land. In a project named "CASE", the scientists from Hannover University will perform various radiation measurements during the whole summer.

With the next Iljushin flight mid November, a German-Russian team of scientists will arrive to work for the "VISA" project. They will perform field operations by means of skidoos from Novo Station. For these planned skidoo traverses extensive material will be provided by our logistics and flown down by Iljushin 76. Additional measuring for the "VISA" project will be performed during this campaign by Dornier aircrafts Polar 2 and Polar 4.

On board of the third Iljushin flight ten technicians will travel down to Kohlen Station by the end of November. From Novo they are taken to Kohlen Station by Dornier aircrafts. After the station has been put into service, 17 "EPICA" scientists go down there on board of a further Iljushin flight beginning December in order to carry out the ice coring. All summer guests and the new overwintering team will also travel to Neumayer with this flight - 26 persons in

total. The feeder flights from Novo to Neumayer will be performed by two Russian Antonov aircrafts.

The supply of Neumayer and Kohnen Station with freight, provisions and fuel will again be effected by "Polarstern" at the beginning of December. The majority of persons will depart with the Iljushin end January and mid February 2004. The back freight and waste disposal from Neumayer Base will be done by the South African RV "Agulhas" at the beginning of March. Also the last technicians will leave Neumayer on board of this ship.

The 23rd overwintering team at Neumayer Station will be relieved by its successors, a group of five women and four men. This new team has been intensely trained and prepared for its task in Bremerhaven.

In the course of maintenance works at the Neumayer Station building, the vehicle hangar, the eastern ramp, the Radom, numerous shafts for aeration resp. de-aeration, emergency exits as well as different platforms of the observatories in the outer area have to be increased.

Moreover, outside the station a further container is positioned, the "Library in the Ice" representing a place of silence at Neumayer which is meant as an object of art. In the next season this project is planned to be inaugurated.

In the ice tunnel leading to the vehicle hangar of the station, the ceiling has to be cut out, offering enough height for the vehicles to be parked in the tunnel.

The measuring fields belonging to the infrasound array IS27 which has been established last season will be increased by routine. This great amount of work is performed by eight mechanics from a hired firm together with the technicians from the logistics.

2 Wartung und Erweiterung des Meteorologie-Observatoriums Neumayer

In der Sommersaison 2003/2004 sind im Meteorologie-Observatorium von Neumayer folgende Arbeiten geplant:

- Umbau der Radiosondenanlage. Die bisherige DigiCora II soll durch eine DigiCora III (Vaisala) ersetzt werden.
- Installation des Sichtweitenmeßsystems FS11 (Vaisala). Ein entsprechendes System wird für die Wettervorhersage zur Unterstützung der Flugaktivitäten benötigt.
- Installation eines Repeaters, um bereits innerhalb der Ballonfüllhalle GPS-Signale zur Windbestimmung zu empfangen.
- Installation von 2 Ultraschall-Anemometern. Diese Sensoren sollen nach einem Jahr Parallelbetrieb die vorhandenen Schalenkreuz-Anemometer ersetzen.
- Austausch aller Strahlungsgeber mit neu geeichten Sensoren.
- Verbesserung des Lüftungssystems der Temperaturgeber.

- Installation größerer Festplatten sowie eines Farb-Druckers.
- Einweisung der neuen Überwinterer.
- Anpassung der Datenerfassung und Verarbeitungsprogramme.
- Vorbereitung der Überwinterung 2004/2005.

2 Maintenance and Expansion of the Meteorological Observatory of Neumayer

In the coming summer season 2003/2004 the following activities are planned:

- Upgrade of the radiosonde system from DigiCora II to DigiCora III (Vaisala).
- Installation of the visibility sensor FS11 (Vaisala). This system will be used mainly for the aviation forecasting service .
- Installation of a repeater in order to make the reception of GPS-signals possible within the ballon-launching hall. This is needed to improve the wind-finding system.
- Installation of two ultra-sonic anemometers. After a one year test these sensors shall replace the existing cup anemometers.
- Exchange of all radiation sensors with recently calibrated ones.
- Improvement of the ventilating system of the thermometers.
- Installation of bigger hard disks, as well as a colour-printer.
- Training of the overwinterers.
- Updating the data-acquisition and the processing programs.
- Preparation of the overwintering periode 2004/2005.

3 Luftchemisches Programm

R. Weller (AWI), D. Wagenbach (IUPH) und B. Rappenglück (IFU/FZ Karlsruhe)

Teilnehmer: J. Käbbohrer (ÜWI 2003), A. Richter (ÜWI 2004)

An der Neumayer Station werden während der Sommerkampagne 2003/2004 im Spurenstoff-Observatorium Servicearbeiten, Gerätewartung, Validierung der Messdaten sowie die Einarbeitung des neuen Überwinterers im Vordergrund stehen. Zusätzlich soll als neues Experiment die Sammlung von Luftproben in Edelstahlbehältern (2000 cm³ Inhalt bei 2,5 bar) installiert werden. Diese Proben werden auf flüchtige Kohlenwasserstoffe im Heimatlabor des Instituts für Meteorologie und Klimaforschung des FZ Karlsruhe in Garmisch Partenkirchen (IFU/FZ Karlsruhe) untersucht. Das Projekt ist im WMO Global Atmosphere Watch Programm eingebunden.

Im Mittelpunkt der atmosphärenchemischen Arbeiten an der EPICA Bohrstelle (Kohnen Station) steht die Wartung eines automatischen Aerosolsammlers zur ganzjährigen Aerosolprobenahme. Das Experiment wurde in einem speziell konzipierten Container während der Sommerkampagne 2002/2003 im Reinluftsektor ca. 300 m nordöstlich der EPICA-Bohrstelle aufgebaut. Eine autonome Stromversorgung der Apparatur wurde mittels Windturbine und Solarzellen, gepuffert durch Ni/Cd-Batterien, realisiert. Der Aerosolsammler besteht aus 22 einzelnen Filterhaltern, ausgerüstet mit Teflon/Nylon

Filterkombinationen. Somit erhält man pro Jahr 22 Aerosolproben mit einer zeitlichen Auflösung von ca. 15 Tagen. Der Aerosolsammler wird in dieser Saison ausgetauscht und die Proben auf ihre ionische Zusammensetzung mittels Ionenchromatographie analysiert. Das Projekt ist eine Kooperation mit dem Institut für Umweltphysik der Universität Heidelberg (IUPH). Daneben konzentrieren sich unsere Sommeraktivitäten an der Kohnen Station auf ergänzende Aerosolmessungen. Hierzu wird eine High-Volumen-Besaugungsanlage des IUPH eingesetzt. Die Aerosolproben, die jeweils über zwei Tage gesammelt werden, sind zur nachfolgenden Analyse bezüglich der ionischen Zusammensetzung und dem Gehalt an kosmogenen Radioisotopen (^{210}Pb , ^7Be , ^{10}Be , ^{36}Cl) bestimmt, die am IUPH durchgeführt wird.

3 Air Chemistry Programme

R. Weller (AWI), D. Wagenbach (IUPH) and B. Rappenglück (IFU/FZ Karlsruhe)

Participants: J. Käßbohrer (over-winterer 2003), A. Richter (over-winterer 2004)

During the forthcoming summer campaign, our activities at the Air Chemistry Observatory of Neumayer Station will focus on maintenance of the equipment, validation of the measured data, as well as practice of the new over-winterer. In addition a novel experiment for sampling of ambient air in specially designed stainless steel container (volume: 2000 cm³ at 2.5 bar) will be installed. The air samples are destined for analysis of volatile organic compounds (so-called VOCs) by the Institut für Meteorologie und Klimaforschung of the FZ Karlsruhe in Garmisch-Partenkirchen (IFU/FZ Karlsruhe). This experiment is part of the WMO Global Atmosphere Watch programme (GAW).

The main focus of our work at Kohnen Station (EPICA-DML) is maintenance of the automated aerosol sampler designed for year-round measurements. The equipment was set up during last summer campaign in a purpose-built container located in the clean-air sector about 300 m north-easterly of the drilling trench. Electric power supply is realized by a combination of a wind turbine and solar panels, buffered by Ni/Cd batteries. The aerosol sampler consists of 22 filter holders, each one equipped with a teflon/nylon filter combination. Hence in total 22 aerosol samples per year are achievable with an individual sampling period of 15 days. Now the aerosol sampler has to be exchanged and the samples will be analysed by ion chromatography. The project is a close cooperation with the Institut für Umweltphysik, University of Heidelberg (IUPH). From December 2003 to February 2004 complementary air chemistry investigations are scheduled. A high volume aerosol sampling device will be operated with an individual sampling period of 2 days. The samples are destined for analysis of the ionic composition of the aerosol and the content of cosmogenic radionuclides (^{210}Pb , ^7Be , ^{10}Be , ^{36}Cl) by the IUPH.

4 Sommerprogramm der Geophysik-Gruppe an der Neumayer Station (AWI)

Während der Sommerkampagne 2003/2004 ist an der Neumayer Station kein zusätzliches wissenschaftliches Programm vorgesehen. Ein eigenes Geophysik-Programm wird jedoch im Rahmen des VISA Projektes im östlichen Dronning Maud im Bereich des Wohlthat Massivs durchgeführt (siehe dort). Ein Teilprojekt in diesem Vorhaben ist dabei der Aufbau eines temporären seismologischen Netzwerkes zur Untersuchung der regionalen und lokalen Seismizität. Zur genaueren Lokalisierung von möglichen Erdbeben in diesem Gebiet sollen jedoch auch die Registrierungen des seismologischen Netzwerkes an der Neumayer Station und der Breitbandstation an SANAE IV mit herangezogen werden, sofern diese lokalen Beben stark genug sind, um auch in einigen 100 km Entfernung noch ein deutliches, auswertbares Signal zu erzeugen. Nicht zuletzt aus diesem Grund sind die alljährlich während der Sommerzeit durchzuführenden Wartungsarbeiten an den seismologischen Außenstationen an der Neumayer Station von großer Bedeutung. Es sind dies das seismologische Detektionsarray VNA2 auf dem Halvfar Ryggen und die 3-Komponenten Station VNA3 auf dem Søråsen Ice Rise. Die Wartungsarbeiten an diesen beiden Stationen sollen aber vorrangig den autarken, kontinuierlichen Winterbetrieb sicherstellen. Dazu müssen die Batterien gewechselt und die Antennenmasten ausgegraben und neu aufgestellt werden. Durch den jährlichen Schneezutrag, der besonders an der Station VNA3 sehr hoch ist (2 – 3 Meter pro Jahr), müssen an beiden Stationen die 3-Komponenten Seismometer wieder ausgegraben und neu installiert werden. Der Container am Array VNA2 muß evtl. ebenfalls aus dem Schnee herausgezogen werden, zumindest aber sind die Schneeverwehungen im Container-Bereich wegzuschieben und das Gelände in diesem Bereich wieder zu planieren.

An der Kohnen Station wurde während der letzten Sommer-Kampagne ein 3-Komponenten STS-2 Breitband-Seismometer mit einem RefTek Datenerfassungs-System installiert. Sollte es unter den extremen Bedingungen dort über den Winter hinweg kontinuierlich registriert haben, dann dürfte die 6 GB Flash Disk nahezu voll geschrieben sein. Die Daten sind dann auf einen Laptop zu überspielen. Sollte dieses Experiment erfolgreich verlaufen sein, dann wäre diese Station eine wichtige Ergänzung zu dem bestehenden Stationsnetzwerk einschließlich der Station SNAA an Sanæ IV.

Das frühere sog. Seismik-Observatorium, in dem bis vor einem Jahr u. a. auch noch die gesamte Datenerfassung für die Erdmagnetfeld-Registrierungen untergebracht war, wurde bereits während der letzten Sommer-Saison weitgehend leergeräumt. Ein Großteil der Mess-Elektronik wurde dabei im Container der Infraschall-Station IS27 installiert. Während dieser Saison sollen nun alle restlichen verbliebenen Einrichtungen und Installationen aus dem Seismik-Observatorium entfernt werden. In der Firnkaverne sollte nur der leere Container zurückbleiben. Die komplette Stilllegung des Seismik-Observatoriums erfordert aber zugleich eine neue

Stromversorgung des Magnetik-Observatoriums, da dieses bisher vom Seismik-Observatorium aus versorgt wurde.

Für die Registrierung der zeitlichen Variationen des Erdmagnetfeldes wurde dieses Jahr ein neues digitales 3-Komponenten Flux-Gate Magnetometer beschafft. Dieses zweite Registrier-System hat gegenüber dem alten System eine wesentlich höhere Auflösung und Dynamik, und es zeichnet sich durch eine größere Langzeitstabilität aus. Die Messwerte werden dabei bereits digital vom Magnetik-Observatorium zu einem Notebook im IS27 Container übertragen. Mit dem neuen System soll vermieden werden, daß längere Lücken in den Registrierungen auftreten, die in letzter Zeit mit dem bisherigen Erfassungssystem doch etwas zahlreicher wurden. Es soll während der Sommerzeit installiert und in das Rechnernetz der Station integriert werden.

Der Großteil der zur Verfügung stehenden Zeit soll vor allem dazu genutzt werden, um die neuen Überwinterer mit allen Geräten und Routinearbeiten vertraut zu machen, so daß sie gut vorbereitet ihre Überwinterung antreten können. Daneben ist ihre Mithilfe auch noch bei den notwendigen Arbeiten am IS27 Infraschall-Array notwendig.

Arbeiten am Infraschall-Array IS27 (AWI, BGR)

Im Februar 2003 wurde an der Neumayer Station das Infraschall-Array mit der Bezeichnung IS27 in Betrieb genommen. Es ist eine von weltweit insgesamt 60 geplanten Infraschall Messstationen, vier davon sind in der Antarktis (Neumayer, Palmer Station, „Windless Bight“ - McMurdo, Davis). Mit diesem globalen Stationsnetz soll die Einhaltung des Atomwaffen-Test-Stop-Abkommens kontrolliert werden, in diesem Falle das Verbot von Nuklearwaffen-Tests in der Atmosphäre.

Das Infraschall-Array an der Neumayer Station besteht aus insgesamt neun einzelnen, spiralförmig angeordneten Einzelstationen mit je einem Mikro-Barographen als Sensor. An jeden dieser Sensoren sind über 10, 20 oder 30 Meter lange Plastikschläuche zwischen 16 und 32 poröse Schläuche von je 15 Metern Länge angeschlossen. Sie wurden gleichförmig radial verlegt. Diese porösen Schläuche, die in geschlitzte Plastikrohre eingezogen wurden, sollen den durch Wind verursachten Rauschanteil im Signal reduzieren. Insgesamt wurden so 6.4 km Schläuche und Rohre auf der Schneeoberfläche verlegt. Durch den ständigen Schneezutrag von ca. 1 Meter pro Jahr müssen in der Sommersaison 2003/2004 nun alle Rohre und Schläuche wieder ausgegraben und neu an der Oberfläche verlegt werden.

Damit die Station IS27 offiziell in das International Monitoring System (IMS) integriert wird, werden zwei Mitarbeiter der BGR im Auftrag der Comprehensive Treaty Organization (CTBO) die Station IS27 im Februar auf ihre Funktionsfähigkeit hin untersuchen und zertifizieren.

4 Summer Programme of the Geophysics Group at Neumayer Station (AWI)

During the summer campaign 2003/2004 no additional scientific project is planned at Neumayer Station. However, a special geophysics programme will be performed within the frame of the VISA project in the Wohlthat Massive area in Eastern Dronning Maud Land (look there). A part of this project is the installation of a temporary seismological network for the investigation of the local and regional seismicity. For a more precise localization of eventual earthquakes in this region recordings at the seismological network at Neumayer Station and at the broadband station at SANAE IV base shall also be incorporated if these local earthquakes are strong enough to produce clear, evaluable signals, even at distances of some 100 km. For this reason the regular service works at the remote seismological stations near Neumayer Station during the summer are of great importance. These remote stations are the seismological detection array VNA2 on Halvfjar Ryggen and the 3-component station VNA3 on Søråsen Ice Rise. However, first of all the service works are necessary to ensure an autonomous and continuous operation during the winter. Batteries have to be changed, and the antenna masts must be set up again at a higher level. Due to the annual accumulation of snow, which is especially high at station VNA3 (2-3 meters per year), at both stations the 3-component seismometers must also be recovered and installed again. The container at the array site VNA2 must eventually be pulled out of the snow. At least wind-accumulated snow masses around the container have to be removed and the surface must get levelled.

At Kohonen Station a 3-component STS-2 broadband seismometer together with a ReITek data acquisition unit was installed last summer campaign. If the system has operated continuously under the severe environmental conditions the 6 GB flash disk may almost have reached its capacity. Data will then have to be transferred to a laptop or another PC. In case this experiment was successful this station would be an important supplementation to the existing network including the station SNAA at Sanae IV base.

The former seismic observatory, where until last year among others the complete data acquisition system for recording the Earth's magnetic field was installed, was already dismantled to a great extent last summer season. The major part of the electronics was moved to the container of the infrasound station IS27. This season all other remaining installations shall be removed. Only the empty container shall be left in the firm cavern. This complete shut-down of the seismic observatory makes a new power supply for the magnetic observatory necessary since it was connected to mains via the seismic-observatory.

For the recording of the time variations of the Earth's magnetic field it is intended to install a new digital 3-component flux gate magnetometer. Compared to the old system this new recording system shows an excellent resolution and a much higher dynamic range. It also is characterized by a very low long term scale drift. Measured data are transmitted already in digital form

from the magnetic observatory to a notebook in the IS27 container. The new system shall avoid longer recording gaps which recently increased somehow with the old system. It has to be installed and integrated into the station's computer network during this summer season.

Most of the time, however, is needed to make the new over-winterers familiar with all the instruments and the routine works which have to be done. This should thoroughly prepare them for their wintering time. Their assistance is also required for necessary service works at the IS27 infrasound array.

Service Works at the Infrasound Array IS27 (AWI, BGR)

In February 2003 the infrasound array IS27 at Neumayer Station started operation. It is one of 60 planned infrasound stations in the world. Four of these stations are located in Antarctica (Neumayer, Palmer Station, „Windless Bight“ - Mc Murdo, Davis). This global monitoring network should control the compliance with the nuclear test ban treaty, in the case of infrasound the ban of testing nuclear weapons in the atmosphere.

The infrasound array at Neumayer Station has nine single recording stations with a micro-barograph as sensor. The stations are arranged on a spiral with increasing distances to the central point of the array. Each sensor is connected to 16 or 32 porous plastic hoses of 15 meters length via non-porous plastic hoses of 10, 20 and 30 meters length. The porous plastic hoses are installed again within slit plastic tubes. They were radially laid out on the snow surface in order to reduce the wind-induced noise in the signal. Last season in total 6.4 km of hoses and tubes were laid out. Because of the continuous accumulation of snow of approx. 1 meter per year all hoses and tubes have to be recovered and laid out again this season.

For the official integration of IS27 into the International Monitoring System (IMS) two members of BGR, commissioned by the Comprehensive Test Ban Treaty Organization (CTBTO), will inspect and certify this station in February 2004.

5 Aerogeophysikalische Meßprogramme mit Polar 2 und Polar 4 (AWI, DLR, Optimare)

In der Antarktissaison 2003/04 werden die beiden Polarflugzeuge Polar 2 und Polar 4 in Dronning Maud Land eingesetzt. Die Anreise der beiden Flugzeuge geschieht wie in der Vergangenheit von Deutschland über Südamerika sowie den britischen Überwinterungsstationen Rothera (Antarktische Halbinsel) und Halley (Brunt Ice Shelf) zur Neumayer Station. Dort wird die geophysikalische Meßausrüstung installiert.

Die Neumayer Station wird in der kommenden Meßkampagne zur Einrüstung und Überprüfung der Meßausrüstung sowie als Basis für die Eiskerntransportflüge von der Kohlen Station genutzt. Die Meßflüge für das VISA-Projekt werden von der südafrikanischen Überwinterungsstation SANAE

IV und der russischen Überwinterungsstation Novolazarevskaya aus durchgeführt. Für das Projekt SEAL sind einige Meßflüge ex Novolazarevskaya vorgesehen.

Für die Saison 2003/04 sind insgesamt 350 Flugstunden mit Polar 2 und Polar 4 geplant. Davon entfallen 150 h auf die geophysikalischen Meßprogramme SEAL (30 h) und VISA (120 h). Weitere 200 h entfallen auf die logistische Unterstützung der EPICA-Tiefbohrung mit Polar4.

Um die genaue Lagebestimmung des Flugzeugs während des Flugs mittels kinematischen GPS (Global Positioning System) zu ermöglichen, werden in Abstimmung mit dem Projekt VISA-Land /Boden mehrere GPS-Referenzstationen für den Zeitraum der Meßflüge aufgestellt und betrieben. An Novolazarevskaya und an der Kohnen Station werden zudem noch magnetische Basisstationen installiert.

In der Karte in Abbildung ABB-AERO sind die Fluglinien des geplanten aerogeophysikalischen Meßprogramms sowie die Lokationen einiger GPS- und Magnetikstationen verzeichnet. Daneben sind auch bekannte Vogel- und Robbenansammlungen im Untersuchungsgebiet und angrenzenden Regionen zwischen Halley und Novolazarevskaya eingetragen.

SEAL IV 2003/04

Für das während der ANT XVIII-Kampagne im Rahmen des HGF-Strategiefonds begonnene Projekt **Sea Level Change (SEAL)** sollen Eismächtigkeiten mit einem fluggestützten Radarsystem auf Polar 2 vermessen werden. Im Rahmen von SEAL steht die Frage nach dem Eismassenabfluß aus Dronning Maud Land im Vordergrund. Mit der Kenntnis der Fließgeschwindigkeit und der hier bestimmten Eismächtigkeiten soll später der Massenabfluß über die Aufsetzlinie im Sektor zwischen etwa 25°W und 10°E abgeschätzt werden. Dementsprechend liegen die Fluglinien im Bereich der Aufsetzungen von Brunt Ice Shelf, Riiser-Larsenisen, Jelbartisen und Fimbulisen. Der Hauptausstrom aus dem zentralen Dronning Maud Land erfolgt über den Jutulstraumen in das Schelfeis Fimbulisen. In dieser Saison sollen die Auslaßgletscher im Bereich des Randgebirges zwischen Neumayer und Novolazarevskaya erfaßt werden. Im Bereich des Veststraumen westlich der Neumayer Station sollen die bereits bestehenden Profile verdichtet werden.

VISA III 2003/04

Die neuen Satellitenmissionen von CHAMP und GRACE zur Kartierung des Schwere- und Erdmagnetfeldes lassen für die Antarktis neue, spektakuläre Erkenntnisse hinsichtlich des geologischen Aufbaus der Antarktis, aber auch der Massenbilanz des größten Eisschildes der Erde erwarten. Aufgrund des bis zu 4 km mächtigen Eisschildes ist die Antarktis der einzige Kontinent, dessen Oberflächengeologie kaum bekannt ist. Informationen können nur indirekte geophysikalische Methoden wie Gravimetrie, Magnetik und EMR liefern. Die Kombination dieser Methoden mit der Geologie der wenigen Aufschlüsse sichert eine solide Interpretation der Ergebnisse.

Die o. g. Satelliten werden eine großräumige Vermessung der Antarktis hinsichtlich ihrer Krustenstruktur und der Massenbilanz des Eisschildes ermöglichen. Je nachdem, ob die Bilanz positiv oder negativ ist, wird sich das Schwerfeld der Erde geringfügig verändern. Das Problem besteht nun darin, dieses Signal zu erfassen und unter Berücksichtigung aller Einflußfaktoren zu interpretieren. Für eine zuverlässige Validierung der Satellitenmessungen in der Antarktis sind daher vergleichbare Messreihen nahe der Oberfläche erforderlich. Für die ausgesuchte Testfläche in der Antarktis sollen daher parallel zu den Satellitenmessungen flugzeuggestützte Schwere-, Magnetik- und Eisdickendaten erhoben werden. Die Ergebnisse können direkt mit den Daten von GRACE/CHAMP verglichen werden und erlauben in Kombination mit den anderen Arbeitsthemen eine verlässliche Bestimmung der unterschiedlichen Massenbeiträge zum Schwerfeld. Damit ist eine gesicherte Interpretation der Massensignale für das Arbeitsgebiet durch die Satellitenmissionen möglich.

Ein weiterer Nutzen der für die Validierung gewonnenen aerogeophysikalischen Daten besteht in deren geophysikalisch/geologischer Interpretation. Die gewonnenen Potentialfelddaten (Schwere und Magnetik) sollen in Kombination mit den Eisdickenmessungen für eine verbesserte Interpretation der subglazialen Geologie und des tieferen Untergrundes im Dronning Maud Land verwendet werden. Die Messungen sind so angelegt, daß vorhandene Daten verdichtet werden, so daß das Verständnis der subglazialen Geologie verbessert wird. Dies gilt insbesondere für die Magnetik.

Verwendete Akronyme:

CHAMP	C hallenging m inisatellite p ayload)
EMR	elektromagnetisches R eflexionsverfahren
EPICA	E uropean P roject for I ce C oring in A ntarctica
GPS	g lobal p ositioning s ystem
GRACE	G ravity R ecovery and C limate E xperiment
SEAL	S ea level change
VISA	V erdichtung und I nterpretation von S atellitendaten zur Bestimmung von Magnetfeld, Schwerfeld, Eismassenhaushalt und Krustenstruktur in der Antarktis unter Nutzung flugzeuggestützter und bodengebundener Messungen

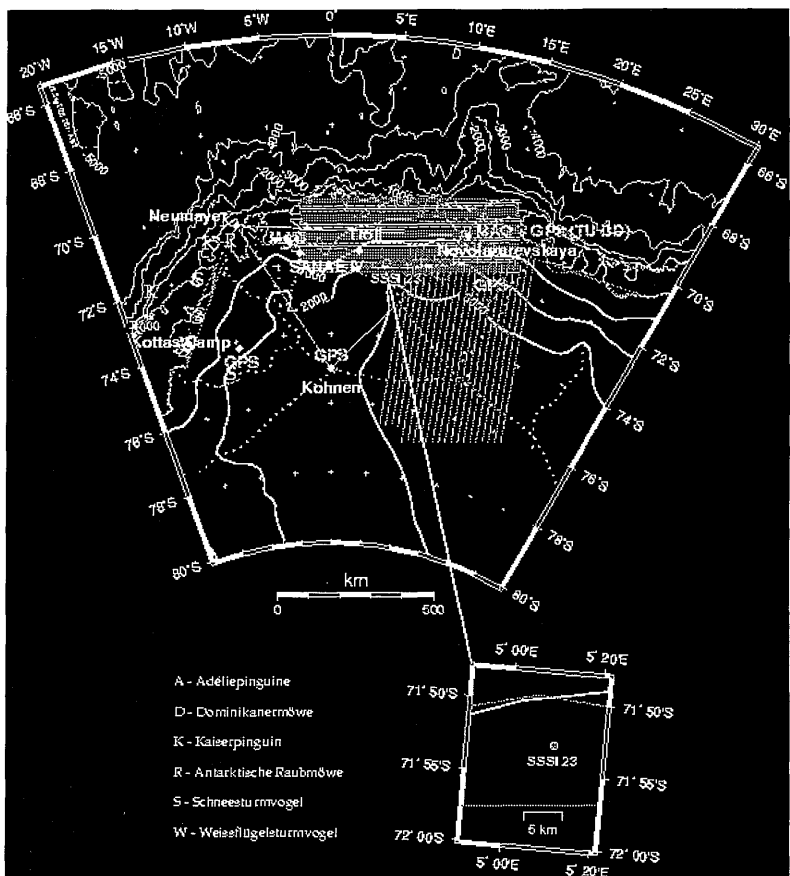


Abb. ABB-AERO: Aerogeophysikalische Programme 2003/04: SEAL - Fluglinien im Bereich der Aufsetzzone; VISA – Fluglinien südlich der Station Novolazarevskaya sowie zwischen SANAE IV und Novolazarevskaya. Anflüge sind hier nicht eingetragen.

Fig. ABB-AERO: Aerogeophysical programmes 2003/04: SEAL – flight lines in the vicinity of the grounding zone; VISA – flight lines south of Novolazarevskaya as well as between SANAE IV and Novolazarevskaya, connecting flights are not drawn.

Projekt CASE, Neumayer Station
(Sigrid Wuttke, Gunther Seckmeyer)

Institut für Meteorologie und Klimatologie, Universität Hannover (IMUK)

Kurzbeschreibung

Das DFG-finanzierte Projekt CASE soll ein verbessertes Verständnis der besonderen Strahlungsverhältnisse in polaren Regionen der Erde ermöglichen, um die Auswirkungen des zunehmenden Treibhauseffekts und des weiter voranschreitenden Ozonabbaus in Zukunft besser abschätzen zu können. Dafür wurde zur Charakterisierung der Einstrahlung ein Meßsystem zur Erfassung der spektralen Strahlendichte wie auch der spektralen Bestrahlungsstärke zwischen 290 und 1000 nm entwickelt. Für den Südsommer 2003/2004 ist beabsichtigt, eine Meßkampagne an der Neumayer Station durchzuführen. Die Ergebnisse werden mit aktuellen Strahlungstransfermodellen verglichen, um den Effekt der Oberflächenbeschaffenheit des Untergrundes zu untersuchen. Aufgrund der Vorerfahrungen in anderen Gebieten der Erde (u. a. in den Hochlagen der Alpen) ist damit zu rechnen, daß insbesondere das extrem hohe Reflexionsvermögen (Albedo) in Kombination mit Bewölkung und dem bedeutenden Ozonabbau im Frühling das Strahlungsfeld in der Antarktis wesentlich modifizieren.

Arbeitsprogramm und Zeitplan

Um die Meßanforderungen, die in der Antarktis gestellt werden, zu erfüllen, wird das vom IMUK gründlich charakterisierte und getestete Spektralradiometer eingesetzt werden. Während des gesamten Antarktisexperiments müssen Maßnahmen zur Qualitätskontrolle regelmäßig durchgeführt werden, um eine gleichbleibend hohe Datenqualität gewährleisten zu können. Diesen Maßnahmen umfassen

- den Vergleich der spektralen UV-Messungen mit erythemgewichteter UV-Strahlung, die mit einem Robertson-Berger-Meter gemessen wird
- Modellvergleiche der gemessenen Bestrahlungsstärken
- Regelmäßige Stabilitätstests durch Messung einer 100 W-Lampe
- Wellenlängentests mit SHICrvm
- die Bildung von Quotienten der an einem Tag gemessenen Spektren zum Mittagsspektrum
- Test des Tagesverlaufs von Bestrahlungsstärken bei ausgewählten Wellenlängen
- Vergleich von Tagesdosen von Tagen mit ähnlichen meteorologischen Bedingungen.

Zur Qualitätssicherung und als Vorbereitung auf die Meßkampagne an der Neumayer-Station hat das IMUK-Spektralradiometer an drei internationalen Meßgerätevergleichen teilgenommen.

Messungen der Bestrahlungsstärke und Strahldichte werden im Wechsel von Anfang November 2003 bis Anfang März 2004 an der Neumayer-Station durchgeführt. Ferner soll die spektrale Albedo bestimmt werden, da auch reflektierte, also aufwärtsgerichtete Bestrahlungsstärke gemessen werden kann. Zusätzlich zu den spektralen Strahlungsgrößen werden auch erythemwirksame Bestrahlungsstärke, Globalstrahlung und Ozonsäule in regelmäßigen Abständen gemessen. Ein Vergleich mit Messdaten innerhalb des *Baseline Surface Radiation Network* (BSRN) und mit dem Spektralradiometer der Firma Isitec, welches auf Neumayer steht, wird angestrebt.

6 Beschreibung der Tätigkeit des Umweltbundesamtes „Besuch der Neumayer Station“ im Januar 2004 Visit to the Neumayer Station in January 2004 by the Federal Environmental Agency/Germany

Hintergrund: Das „Gesetz zur Ausführung des Umweltschutzprotokolls vom 4. Oktober 1991 zum Antarktis-Vertrag (Umweltschutzprotokoll-Ausführungsgesetz) vom 22. September 1994 (BGBl. I S. 2593), geändert durch Verordnung vom 21. September 1997 (BGBl. I S. 2390)“ bestimmt das Umweltbundesamt als die Behörde, die über die Erteilung der Genehmigungen zur Durchführung von Tätigkeiten, die von Deutschland aus organisiert werden, entscheidet. Dies schließt auch die Überwachung und Überprüfung der Einhaltung des Gesetzes und der erteilten Genehmigungen ein.

Background: According to the act implementing the Environmental Protection Protocol the responsible authority for approval of activities organised by Germany in the Antarctica is the Federal Environmental Agency. Additionally the Agency is obliged to control whether the treaty, the environmental protocol and the conditions described in the approval are adhered to. This also includes an evaluation of the impact of activities on the Antarctic environment.

Geplanter Stationsbesuch: Der Besuch soll vorrangig zur guten Vorbereitung der Durchführung der Zulassungsverfahren „Neubau einer deutschen Forschungsstation“ und „Rückbau der bestehenden Überwinterungsstation“ beitragen.

Der Stationsbau ist gemäß AUG eine Tätigkeit, die im Hinblick auf ihre Auswirkungen auf die antarktische Umwelt geprüft werden muss. Dazu soll eine Umweltverträglichkeitsprüfung durchgeführt werden. Erfahrungen mit vergleichbaren Projekten liegen im Umweltbundesamt bisher nicht vor.

Um nun seitens des Umweltbundesamtes eine sachgerechte Einschätzung aus Umweltsicht in Einklang mit den in der Antarktis vorherrschenden Witterungs- und Umweltbedingungen, aber auch unter Berücksichtigung der besonderen Arbeitsbedingungen vornehmen zu können, ist eine Inaugenscheinnahme der jetzigen Station und des Gebietes der geplanten Station wichtig.

Darüber hinaus hofft die mitreisende Vertreterin des UBA, möglichst viele Eindrücke und Erkenntnisse über weitere logistische Tätigkeiten zu erhalten. Beispielsweise interessieren die Besonderheiten der Forschungsflugzeuge Polar 2 und 4 sowie der an den Maschinen installierten Meßgeräte bis hin zur Durchführung von Meßflügen mit den Flugzeugen. Die Möglichkeit eines Besuchs der Kohnen-Sommerstation wäre ebenfalls sehr wünschenswert.

Planned visit: The visit is primarily for preparing the licensing procedure regarding "Constructing the new German research station" as well as "Dismantling the existing station".

According to the Environmental Protocol of the Antarctic Treaty the construction of a new station requires an environmental impact study. So far the Federal Environmental Agency has no experience with impact studies of such projects. During the visit basic information with respect to the impact study will be collected.

The representative of the Federal Environmental Agency also wants to get an overview on logistic activities. The features of research planes Polar 2 and Polar 4 including equipment and the flights themselves are of interest as well as the maintenance of the infra-sound station IS 27 etc.

If possible, visiting the Kohnen summer station would also be greatly appreciated.

7 European Project for Ice Coring in Antarctica (EPICA) an der Kohnen-Station (AWI, EPICA Partners)

Im Rahmen des European Project for Ice Coring in Antarctica (EPICA) werden zwei Eiskern Tiefbohrungen in der Antarktis durchgeführt. Die Analyse dieser Eiskerne soll weiteren Aufschluß über die Klimageschichte zurück bis 700 000 Jahre vor heute liefern. Die erste der beiden Bohrungen wird auf Dome C durchgeführt, die zweite in Dronning Maud Land (DML). Mit der Wahl zweier Bohrpunkte soll dem unterschiedlichen Luftmassen- und Feuchtetransport in die Antarktis aus dem indisch-pazifischen und dem atlantischen Raum, Rechnung getragen werden. Außerdem erlauben die unterschiedlichen Akkumulationsraten an beiden Bohrpunkten eine unterschiedliche zeitliche Auflösung der gewonnenen Meßdaten, wobei in DML mit einer langjährigen mittleren Akkumulationsrate von $64 \text{ kg m}^{-2} \text{ a}^{-1}$ eine höhere zeitliche Auflösung erreicht wird als bei Dome C, dafür reduziert sich das maximal erreichbare Eisalter auf ca. 200 000 Jahre. Die Bohrung in DML liefert den ersten tiefen Eiskern aus dem atlantischen Sektor der Antarktis. Sie ermöglicht den direkten Vergleich mit den grönländischen Eiskernen und gestattet Einblick in den zeitlichen Zusammenhang klimatischer Schwankungen in der Nord- und Südhemisphäre.

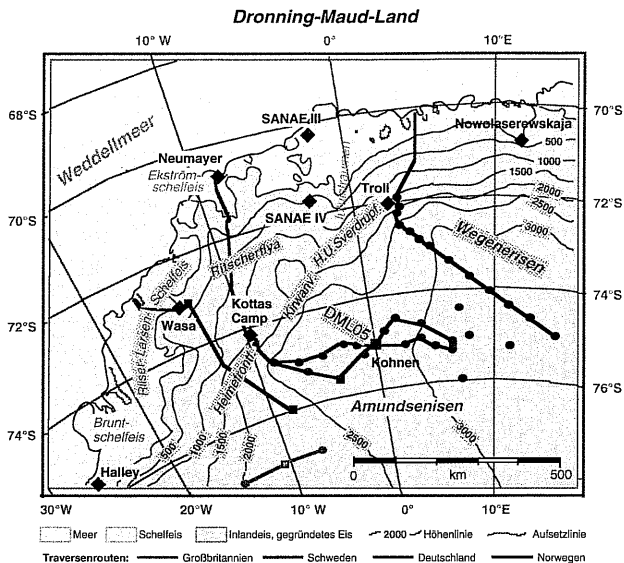


Abb.: Übersichtskarte Dronning Maud Land mit der Traversenroute von der Neumayer-Station auf das Plateau des Amundsenisen zum EPICA Bohrcamp (Kohnen-Station) bei $75^{\circ} 0.104' S$ und $0^{\circ} 4.07' E$, 2882 m Meereshöhe.

Fig.: Map of Dronning Maud Land showing the AWI traverse route from Neumayer station to the EPICA drill camp (Kohnen-Station) at $75^{\circ} 0.104' S$ und $0^{\circ} 4.07' E$, 2882 m a.s.l on Amundsenisen.

Wie in der vorhergehenden Saison wird das für die Bohrung und den Betrieb der Station notwendige wissenschaftliche und technische Personal aus Kapstadt eingeflogen, um die Bohrsaison deutlich zu verlängern und damit einen optimalen Bohrfortschritt zu ermöglichen. Dazu kommen sowohl ein Transportflugzeug für den Transport von Kapstadt nach Novolazarevskaya wie auch die Polarflugzeuge (Polar 2 und Polar 4) für den Transport aufs Eis zum Einsatz, unterstützt von einer Twin Otter des British Antarctic Survey. Zusätzlich werden zwei Traversen von der Neumayer-Station zum EPICA-Bohrcamp (Kohnen-Station) durchgeführt, um technisches Gerät, Treibstoff, Ausrüstung für die wissenschaftlichen Arbeiten und Material zum Unterhalt der Station zu transportieren. Die Traverse wird entlang der bereits in den Vorjahren benutzten Route über Ritscherflya, Kottasberge und Amundsenisen fahren.

Bohrprogramm, EPICA

Zu Beginn der Saison muß das Bohrsystem wieder in Betrieb gesetzt werden. Die Bohrung wird dann von der im letzten Jahr erreichten Tiefe von 1564 m aus fortgesetzt und soll ca. 1000 weitere Kernmeter erbohren. Es wird mit

Stützflüssigkeit gebohrt, um dem hydrostatischen Druck des umgebenden Eises entgegenzuwirken. Die Kernlänge pro Bohrlauf beträgt jeweils bis zu 3,5 m.

Der erbohrte Kern (Durchmesser 98 mm) wird im Science Trench nach Länge und Durchmesser vermessen, protokolliert und in 1 m lange Stücke zersägt, an denen anschließend kontinuierlich und mit 3 mm Tiefenauflösung die elektrische Leitfähigkeit (DEP) gemessen wird. An ausgewählten Tiefenabschnitten werden Probenstücke zur Bestimmung der physikalischen Eigenschaften des Eiskerns abgetrennt, bevor die vermessenen Stücke, eingehüllt in PE-Schlauchfolie, in PP-Kisten (jeweils 6 m Kern) verpackt werden. An den abgesägten Längsstreifen dieses frisch gebohrten Eises werden unter dem Mikroskop die Korngrenzen und Klathrate videografisch dokumentiert. Aus dem Vergleich mit späteren Aufnahmen sollen Rückschlüsse auf den Relaxationsprozess im Eis gewonnen werden. Weiterhin werden an ausgewählten Tiefen He-Proben genommen und in evakuierten Edelstahlbehältern aufbewahrt. Die Kisten mit den Eiskernen werden zur Neumayer Station geflogen und dort für den weiteren Transport in Kühlcontainer eingestaut. Alle weiteren Probennahmen und Analysen am DML Eiskern werden in Bremerhaven oder den entsprechenden Labors in Europa durchgeführt.

Glaziologische Messungen (AWI)

Auf der Strecke zwischen der Neumayer-Station und den Kottasbergen wird das vorhandene Messnetz zur Akkumulationsbestimmung nachgemessen. En route und im weiteren Umfeld von DML05 werden alle Vermarkungen mit GPS eingemessen, insbesondere die in der Saison 1999/2000 ausgesteckte, auf das EPICA Bohrloch zentrierte Verformungsfigur (strain net).

European Project for Ice Coring in Antarctica (EPICA), EPICA

In the framework of the European Project for Ice Coring in Antarctica (EPICA) two deep ice cores are drilled. The main goal of EPICA is to gain more knowledge about the climatic history up to 700,000 years back in time. The first deep ice core is drilled at Dome C, the second in Dronning Maud Land (DML). The different origin of air masses and moisture transported to Antarctica either from the Indic-Pacific or from the Atlantic region should be reflected in the climate records at the two drill locations. Furthermore, the different snow accumulation rates at both sites will yield different time resolution of the measured parameters. The core from DML, where the long term mean accumulation rate amounts to $64 \text{ kg m}^{-2} \text{ a}^{-1}$, will show higher time resolution, however, the maximum age of the ice at the glacial bed will be only about 200,000 years. The drilling in DML provides the first long record from the Atlantic sector of Antarctica and, accordingly, represents the first direct southern hemispheric counterpart to the Greenland ice core records. Therefore, it is expected to be especially suited to gain insight into the coupling of climatic variations in the northern and southern hemispheres.

Like in the previous season, scientific and technical personnel required for the drilling and the maintenance of the station will fly to Antarctica. In this way a significantly prolonged drilling season and therefore an optimum drilling progress is ensured. This is made possible using a large transport aircraft for the flight from Cape Town to Novolazarevskaya and the Polar 2 and Polar 4 aircraft for the put in at Kohnen station. British Antarctic Survey will assist with a Twin Otter aircraft. In addition, two traverses will lead from Neumayer station to the EPICA drill camp (Kohnen-Station) to carry technical equipment, fuel, scientific equipment and material to maintain the base. The traverse route will be the same as in the past years. It leads across Ritscherflya, passes the mountain range Kottasberge and ends at Kohnen station on the Amundsenisen.

Drilling programme, EPICA

At the beginning of the season the drill will be reinstalled. The drilling will then continue from the drill depth of 1564 m reached in the previous season for another approx. 1000 m. The hole has to be filled with a drilling liquid to compensate for the hydrostatic pressure of the surrounding ice. Each run will recover up to 3.5 m of ice core.

Length and diameter (98 mm) of each core piece will be measured and carefully archived, then the cores will be cut into 1 m pieces. Afterwards continuous, high resolution (3 mm steps) dielectric profiling (DEP) is performed. On selected depth intervals 1 m long and 1 cm thick strips of ice will be cut from the core to be used for physical property measurements. These include visual stratigraphy and videographic documentation of grain boundaries and clathrates with the aid of a microscope. Planned remeasurements in the lab will prove the influence of relaxation processes on the ice crystal size. Furthermore He samples are cut at selected depth intervals and stored in evacuated stainless steel containers. The cores sealed in PE bags will be packed into well-insulated PP-boxes for aircraft transport to Neumayer and further ship transport in frozen state to Bremerhaven. All other samplings and analyses on the DML ice core will be carried out at Bremerhaven or in the respective labs in Europe.

Glaciological field work, AWI

Along the traverse route from Neumayer station to the south of the mountain range Kottasberge the established stake net will be reread for accumulation studies. En route and in the vicinity of point DML05 all marked points will be resurveyed by GPS, especially the strain net installed in the 1999/2000 season around the drilling site.

8 VISA – Feldkampagne 2003/04

Dr. Mirko Scheinert, TU Dresden, Institut für Planetare Geodäsie

Wissenschaftliche Zielsetzung

VISA (Validierung, Verdichtung und Interpretation von Satellitendaten zur Bestimmung von Magnetfeld, Schwerfeld, Eismassenhaushalt und Krustenstruktur in der Antarktis unter Nutzung flugzeuggestützter und bodengebundener Messungen) ist ein durch die DFG gefördertes, gemeinsames Forschungsprojekt der TU Dresden und des AWI Bremerhaven. Die Projektleiter sind R. Dietrich (TUD) und W. Jokat (AWI).

Im Gesamtsystem „Erde“ nehmen die Polargebiete und insbesondere die Antarktis mit ihrem Eisschild eine Schlüsselstellung ein. Die Wechselwirkungen des antarktischen Eises mit der Atmosphäre, dem Weltozean und auch mit der festen Erde prägen ganz wesentlich globale Prozesse wie das Klima oder Veränderungen des Meeresspiegels. Die exakte Kenntnis darüber, welche Veränderungen sich gegenwärtig am antarktischen Eisschild vollziehen, ist daher von hoher, disziplinübergreifender Relevanz. Alle Änderungen des antarktischen Eisschildes stellen ihrerseits Massenverteilungen dar, die zeitliche Änderungen des Erdschwerfelds bewirken. Das schließt auch die Massentransfers zwischen dem Eis und dem Weltozean sowie die Massenbewegungen der festen Erde wegen wechselnder Auflasten ein.

Diese temporären Variationen des Erdschwerfelds sollen durch neue Satelliten mit Missionszeiten von bis zu 5 Jahren bestimmt werden, wobei auch konkrete Aussagen zum Status des antarktischen Eisschildes erwartet werden. Die Schwerfeldmissionen CHAMP (Start 15. Juli 2000), GRACE (Start 17.03.2002) und GOCE können in den Polarregionen allerdings nur ein integriertes Schweresignal erfassen, das auch durch Faktoren, die nichts mit der Massenbilanz der Eisschilde zu tun haben, beeinflusst wird. Das sind vor allem Bewegungsvorgänge in der Lithosphäre aufgrund postglazialer Ausgleichsbewegungen und tektonischer Prozesse sowie Trendänderungen in der Verteilung des Atmosphärendrucks.

Die möglichst genaue Erfassung und Quantifizierung aller Signale in der Gravimetrie ist erforderlich, um masseninduzierte Effekte bestimmen zu können und somit Fehler bei der Berechnung der Massenbilanz für den Eisschild zu minimieren. Daher sollen die zu erwartenden Ergebnisse der CHAMP, GRACE und GOCE Missionen im VISA-Projekt durch wiederholte boden- und flugzeuggestützte Messungen validiert werden. Nur derartige ergänzende und verdichtende bodennahe Messungen in der Antarktis werden wissenschaftlich gesicherte Aussagen über die aktuelle Massenbilanz des antarktischen Eisschildes erlauben.

Für diese Validierung sollen im Dronning-Maud-Land in der Antarktis in entsprechender räumlicher und zeitlicher Auflösung geophysikalische, geodätische und glaziologische Messungen durchgeführt werden. Bereits durchgeführte Flugkampagnen in dieser Region bilden eine solide Grundlage für das in dieser Saison durchzuführende VISA-Flugprogramm.

Bodenmessungen erfolgen entlang von Traversen sowie in Testarealen von jeweils ca. 2500... 5000 km² Größe.

Geplante Arbeiten

In der Saison 2003/04 bildet das Gebiet Schirmacheroase – Wohlthatmassiv das erste Testgebiet. Zur Validierung der o. g. Signale sollen neben den flugzeuggestützten terrestrische Messungen durchgeführt werden, die zur detaillierten Untersuchung von Höhe-, Schwere- und Masseänderungen (insbesondere Ablations-/Akkumulationsmuster) genutzt werden sollen:

- Geodätische Messungen (statisches und kinematisches GPS, Präzisionsgravimetrie)
- Glaziologische Messungen (Bohrung von Firnkernen, Schneegruben)
- Geophysikalische Messungen (EMR)

- Für die Untersuchung der Lithosphärendynamik werden folgende Meßverfahren eingesetzt:

- Geodätische Messungen (GPS und Gravimetrie: Höhe- und Schwereänderungen auf Fels)
- Geophysikalische Messungen (Seismologie: Abschätzung der Seismizität und Ableitung von Herdmechanismen)

Als primäres Testgebiet dient der Bereich Schirmacheroase bis zum Nordrand des Wohlthatmassivs (vgl. Abbildung). Dieses Gebiet ist durch geodätisch-glaziologische Traversen bereits erschlossen (Untersee traverse: Schirmacheroase – Untersee im nördlichen Grubergebirge; Inseltraverse: Schirmacheroase – Nordrand des Humboldtgebirges). Optional soll ein Testgebiet südlich des Wohlthatmassivs gemessen werden.

Zur Durchführung der Messungen wird eine VISA-Feldgruppe von sechs Wissenschaftlern von Feldcamps aus operieren. Diese Gruppe setzt sich wie folgt zusammen: TUD – zwei Wissenschaftler (Geodäsie), AWI – zwei Wissenschaftler (Geophysik), Aeorogeodeziya – zwei Wissenschaftler (Geodäsie, davon ein Wissenschaftler permanent auf Novolazarevskaya), Russische Akademie der Wissenschaften – ein Wissenschaftler (Glaziologie). Leiter dieser Gruppe ist M. Scheinert (TUD). Die Arbeiten werden in der Zeit von Anfang November 2003 bis Ende Januar 2004 durchgeführt.

Für die logistische Absicherung zeichnet das AWI in Zusammenarbeit mit der Russischen Antarktisexpedition (AARI/RAE) verantwortlich. Eine entsprechende Kooperationsvereinbarung existiert. Als Basis steht die russische Antarktisstation Novolazarevskaya (Novo) bzw. das Sommercamp am Flugfeld nahe Novo zur Verfügung. Der Transport in die Antarktis und zurück (Personal, Ausrüstung) erfolgt vorrangig im Rahmen des DROMLAN-Flugprogramms.

8 VISA field campaign 2003/04

Dr. Mirko Scheinert, TU Dresden, Institut für Planetare Geodäsie

Scientific Goals

VISA (Validation, Densification and Interpretation of Satellite Data for the Determination of Magnetic Field, Gravity Field, Ice Mass Balance and Structure of the Earth Crust in Antarctica, Utilizing Airborne and Terrestrial Measurements) is a mutual scientific project of TU Dresden and AWI Bremerhaven, funded by the German Research Foundation. R. Dietrich (TUD) and W. Jokát (AWI) are the principal investigators.

The polar regions and especially Antarctica with its ice sheet play a key role in the complex system "Earth". The interactions of the Antarctic ice sheet with the atmosphere, the world ocean and the solid earth significantly influence global processes like climate and changes of the global sea level. Therefore, the detailed knowledge of recent changes of the Antarctic ice sheet is of crucial, interdisciplinary importance. All changes of the ice sheet have also to be regarded as mass changes, which yield temporal changes of the gravity field of the Earth. Hereby, mass transfers between the ice and the ocean as well as mass changes of the solid Earth due to load changes are included.

Such temporal variations of the Earth's gravity field should be determined by new satellite missions with a life time of up to five years. Hereby, one awaits also detailed statements on the status of the Antarctic ice sheet. The gravity field missions CHAMP (launched July 15, 2000), GRACE (launched March 17, 2002) and GOCE are capable to measure only an integrated gravity signal, which is also influenced by factors other than the mass balance of the ice sheet. Those factors are for example: changes in the lithosphere caused by postglacial rebound and tectonic processes as well as long-term changes in the atmospheric pressure variation.

It is necessary to record and to quantify all gravimetric signals in order to determine mass-induced effects and thus to minimize errors while calculating the mass balance of the ice sheet. Therefore, the results of the CHAMP, GRACE and GOCE missions should be validated by repeated airborne and terrestrial observations. Only such additional and densifying measurements in Antarctica will allow to make scientifically proven statements on the topical mass balance of the Antarctic ice sheet.

With an appropriate local and temporal resolution, geophysical, geodetic and glaciological observations should be carried out in Dronning Maud Land, Antarctica, for the purpose of the described validation. Airborne campaigns which have already been carried out are a sound basis for the flight programme to be carried out this season. Terrestrial observations are planned along (already known) geodetic-glaciological traverses as well as within test areas of a size of 2,500 ... 5,000 km².

Planned Work

The region Schirmacher Oasis – Wohlthat Massif is the first test area in the season 2003/04. Besides the airborne measurements the following terrestrial observations are planned to be carried out, which will be used for the detailed investigation of height changes, gravity changes and mass changes (and especially of the ablation/accumulation pattern):

- Geodetic measurements (static and kinematic GPS, precise gravimetry)
- Glaciological measurements (shallow firn cores, snow pits)
- Geophysical measurements (EMR)

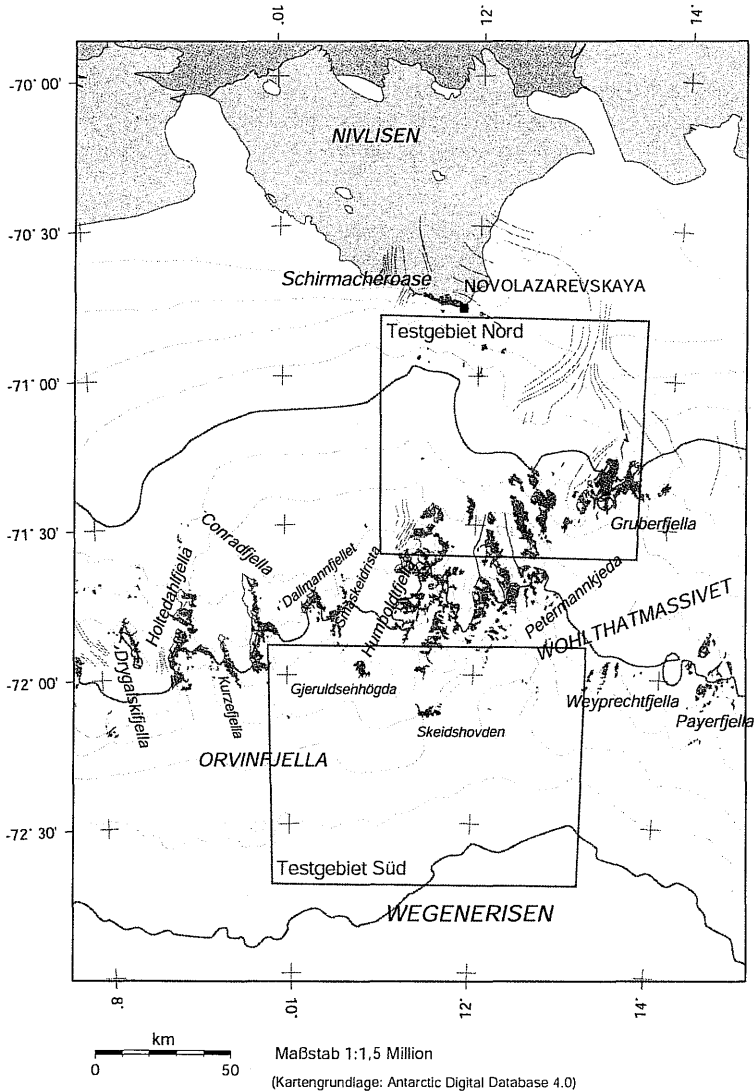
- In order to investigate the dynamics of the lithosphere, the following techniques should be applied:
 - Geodetic measurements (GPS and gravimetry on bedrock: height and gravity changes)
 - Geophysical measurements (seismology: estimation of the seismicity and focal mechanisms)

The region between Schirmacher Oasis and northern Wohlthat Massif is chosen to be the primary test area (cf. figure). This region is partly known because of earlier reconnaissances and measurements, especially along geodetic-glaciological traverses (“Untersee” traverse: Schirmacher Oasis – lake Untersee in the northern Gruber mountains, “Insel” traverse: Schirmacher Oasis – northern Humboldt mountains). Due to the present planning a test area south of the Wohlthat Massif would be an option.

Comprising six scientists, the VISA field group will operate on basis of field camps. The group is formed as follows: TUD – two scientists (geodesy), AWI – two scientists (geophysics), Aerogeodeziya – two scientists (geodesy, one of them permanently at Novolazarevskaya station), Russian Academy of Sciences – one scientist (glaciology). M. Scheinert (TUD) is the leader of the field group. The work is planned for the period of the beginning of November 2003 to the end of January 2004.

Logistics will be provided by AWI in cooperation with the Russian Antarctic Expedition (AARI/RAE). A respective cooperation agreement has been signed. As a base the Russian Antarctic station Novolazarevskaya (Novo) and the summer camp at the air field near Novo can be used. Transport to/from Antarctica (personnel, equipment) will be provided within the framework of the DROMLAN flight program.

VISA-Feldkampagne – Übersichtskarte des Untersuchungsgebietes
 VISA field campaign – Overview of the area under investigation



VISA-Seismologie 2003/04

Im Rahmen des VISA-Projektes sollen in der Saison 2003/04 im Bereich des Wohlthat-Massivs (östliches Dronning Maud Land, DML) fünf seismologische Meßstationen ausgebracht werden. Diese sollen gemeinsam mit den GPS-Empfängern auf Fels installiert werden und während der gesamten Saison kontinuierlich registrieren. Die seismologischen Registrierungen im Arbeitsgebiet sollen ergänzend zu den GPS-Messungen neue Erkenntnisse über neotektonische Deformationsprozesse und über das vorherrschende Spannungsfeld liefern. Insbesondere steht hier im Vordergrund die Erfassung der lokalen Seismizität. Wie aus den Registrierungen des seismologischen Netzwerkes an Neumayer Station und dem Array bekannt, existieren im westlichen DML vor allem im Bereich des Jutulstraumen Gletschers und vor Kapp Norvegia Regionen erhöhter seismischer Aktivität. Diese Ereignisse weisen geringe Magnituden auf, so daß sie nur lokal registriert werden können. Ebenso ist von der japanischen Station Syowa bekannt, daß auch hier im Küstenbereich schwache, lokale Erdbeben auftreten, deren Ursachen mit postglazialen Entlastungsbewegungen erklärt werden.

Das für die Saison 2003/04 geplante temporäre Netzwerk soll aus insgesamt 5 Seismometern bestehen. Es ist geplant, ein Seismometer an der Station Novolazarevskaya und 2 weitere Stationen ebenfalls nördlich des Wohlthat-Massivs sowie 2 südlich davon zu betreiben. Alle Stationen sollen, soweit möglich, zusammen mit den GPS-Empfängern auf anstehendem Gestein installiert werden.

Im Untersuchungsgebiet des Wohlthat-Massivs soll nun untersucht werden, ob auch hier erhöhte seismische Aktivität vorliegt. Aus den beobachteten Seismizitätsmustern und, wenn möglich, der Bestimmung der Herdmechanismen charakteristischer Beben sollen Spannungs- und Bewegungsrichtungen abgeleitet werden. Diese sollen gemeinsam mit geodätischen Höhenänderungen und Schweremessungen interpretiert werden. Insbesondere interessiert hier die Frage, ob eine Korrelation zwischen Zonen Seismizität und ausgezeichneten geologischen Strukturen existiert.

Zusätzlich soll aus geeigneten Bebenregistrierungen über die Modellierung von „Receiver Functions“ die Krustendicke abgeschätzt werden. Da in dieser Region über Krustendicken noch nichts bekannt ist, werden diese Ergebnisse zum Verständnis der Struktur der Kruste und des oberen Mantels beitragen. Insbesondere können so mögliche Blockstrukturen der Kruste erkannt werden. Diese Ergebnisse sollen dann zusammen mit den Potentialfelddaten interpretiert werden.

Die Registrierung geeigneter S-Wellen teleseismischer Beben erlaubt die Kartierung seismischer Anisotropie im oberen Mantel unterhalb der Registrierstationen. Seismische Anisotropie wird erzeugt durch vergangene und/oder rezente Deformationsprozesse im oberen Mantel. Diese Methode erlaubt die Abbildung geologischer Strukturen im tieferen Untergrund und gibt somit weitere Einblicke in die Geodynamik dieser Region.

VISA-Seismology 2003/04

In the frame of the VISA project, five seismological stations will be deployed during the field campaign 2003/04 in the region of the Wohlthat Massif (eastern Dronning Maud Land, DML). These seismological stations are planned to be deployed together with the GPS-receivers on solid rock and will record data continuously. In addition to the GPS-measurements, the seismological recordings will contribute to a better understanding of neotectonic deformation processes and the dominating stress field in this region. One of the main goals is the mapping of seismic activity. As known from detections of the Neumayer seismological network and array, an increased seismic activity is observed in the coastal regions of western DML, especially in the regions of the Jutulstraumen glacier and offshore Kapp Norvegia. Due to the weak magnitudes of these events, they cannot be recorded on a global scale. Also in the coastal region of the Japanese Syowa station, weak local earthquakes were identified which are explained by postglacial rebound processes.

For the 2003/04 temporary field experiment, five seismometers will be deployed. From preliminary plans, one seismograph will be deployed at Novolazarevskaya Station, two seismographs also north of and two south of Wohlthat Massif. As far as possible, all stations will be deployed together with the GPS-receivers on outcrops.

The search for regions of increased seismic activity will contribute to a better understanding of geodynamic processes in the research area of the Wohlthat Massif. From the observed patterns of seismicity as well as from focal mechanisms of characteristic earthquakes, stress and deformation directions will be retrieved. These may be interpreted together with the observations of geodetic height changes and gravity measurements. In particular, correlations between regions of increased seismicity and geologic structures may be investigated.

In addition, crustal thicknesses will be determined by modelling receiver functions from appropriate earthquake recordings. Since there is no knowledge about crustal thicknesses in this region, these results will contribute to a better understanding of the structure of crust and upper mantle. In particular, possible block structures of the crust may be recognized. These results will be discussed jointly with the potential field data.

The analysis of suitable teleseismic S-waves allows the mapping of seismic anisotropy in the upper mantle beneath the recording stations. Seismic anisotropy originates from past and/or recent deformation processes in the upper mantle. Thus, this method allows the mapping of geologic structures in the deeper interior and gives new insights into geodynamic processes in this region.

preliminary plan date: 25. September 2003

arrival/departure with:	date:			arrival	departure
Ilyushin 76 (IL1-D)	06.11. - 08.11.2003		CPT - Novo - CPT	3 pax	nil
Ilyushin 76 (IL 2-D)	10.11. - 12.11.2003		CPT - Novo - CPT	4 pax	nil
Ilyushin 76 (IL 3-D)	27.11. - 29.11.2003		CPT - Novo - CPT	11 pax	nil
Ilyushin 76 (IL 4-D)	03.12. - 05.12.2003		CPT - Novo - CPT	39 pax	1 pax
Ilyushin 76 (IL 5-D)	25.01. - 31.01.2004		CPT - Novo - CPT	8 pax	18 pax
Ilyushin 76 (IL 6-D)	10.02. - 15.02.2004		CPT - Novo - CPT	nil	34 pax
Polarstern - ANT XXI/2	17.11. - (27.11.-10.12.)2003		Cape Town - Neumayer	4 pax	nil
S.A. Agulhas	06.03. - 19.03.2004		Neumayer - Cape Town	nil	17 pax

name	first name	institute/firm	stay	profession	arrival	departure
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Logistics (Neumayer-Station)

Janneck	Jürgen	AWI-logistics	Neumayer	Field Operator, engineer	Polarstern	Agulhas
Ahammer	Heinz	AWI-logistics	Neumayer	engineer	Polarstern	Agulhas
Witt	Ralf	AWI-logistics	Neumayer	technician, maintenance (IS27)	Polarstern	Agulhas
Kretschmann	Rolf-Paul	maintenance company	Neumayer	technician (Aufstock.)	Polarstern	15.02 /IL76

Service:

Hofmann	Jörg	FIELAX	Neumayer	scientist, IT maintenance	25.01 /IL76	31.01 /IL76
NN	NN	Uni-Hannover (Schenke)	Neumayer	student, side survey NM III	03.12/IL76	Agulhas

Maintenance team:

Sulzbach	Frank	maintenance company	Neumayer	technician (Aufstock.)	03.12/IL76	15.02 /IL76
Hartmann	Marcel	maintenance company	Neumayer	technician (Aufstock.)	03.12/IL76	15.02 /IL76
Pyrskalla	Boleslaw	maintenance company	Neumayer	technician (Eisdecke)	03.12/IL76	15.02 /IL76
NN	NN	maintenance company	Neumayer	technician (Eisdecke)	03.12/IL76	15.02 /IL76
Spinkel	Andre	maintenance company	Neumayer	technician (Eisdecke)	03.12/IL76	15.02 /IL76
Suhl	Dennis	maintenance company	Neumayer	technician (IS27)	03.12/IL76	15.02 /IL76
Thierbach	Olaf	maintenance company	Neumayer	technician (IS27)	03.12/IL76	15.02 /IL76

Inspection:

Gerandt	Hartwig	AWI-logistics	NM /Kohnen	NM station visit /inspection	25.01 /IL76	31.01 /IL76
Wagner	Eberhard	GL representative	Neumayer	engineer, NM inspection	25.01/IL76	31.01 /IL76
Ross-Reginek	Ellen	Umweltbundesamt (UBA)	Neumayer	NM station visit /inspection	25.01 /IL76	31.01 /IL76

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name	first name	institute/firm	stay	profession	arrival	departure
Science (Neumayer-Station)					number of participants:	16
König-Langlo	Gert	AWI-climate system	Neumayer	meteorologist	03.12 /IL76	31.01 /IL76
NN	NN	AWI-geosystem	Neumayer	geophysicist	03.12 /IL76	15.02 /IL76
Bassus	Rainer	BGR	Neumayer	engineer, maintenance IS27	03.12 /IL76	15.02 /IL76
Henger	Manfred	BGR	Neumayer	scientist	25.01 /IL76	15.02 /IL76
Hartmann	Gernot	BGR	Neumayer	scientist	25.01 /IL76	15.02 /IL76
Seckmeyer	Gunther	Uni Hannover	Neumayer	scientist, CASE radiation measur.	06.11 /IL76	05.12 /IL76
Wuttke	Sigrid	Uni Hannover	Neumayer	scientist, CASE radiation measur.	06.11 /IL76	Agulhas
Möller	Hans-Joachim	DWD	Neumayer	weather forecaster	06.11 /IL76	31.01 /IL76
Brauner	Ralf	DWD	Neumayer	weather forecaster	25.01 /IL76	15.02 /IL76
					number of participants:	9
EPICA (Kohnen-Station)						
Science team:						
Kipfstuhl	Sepp	AWI-geosystem	Kohnen	scientist, phys. prop 1	03.12 /IL76	15.02 /IL76
Grigoriev	Dimitri	London, UK	Kohnen	phys. prop 2	03.12 /IL76	15.02 /IL76
Hamann	Ilka	AWI-geosystem	Kohnen	scientist, logging	03.12 /IL76	15.02 /IL76
Lambrecht	Anja	AWI-geosystem	Kohnen	geophysicist, DEP 1	03.12 /IL76	15.02 /IL76
Faria	Sergio	Brazil	Kohnen	DEP 2	03.12 /IL76	15.02 /IL76
Marino	Federica	Italy	Kohnen	packing	03.12 /IL76	15.02 /IL76
Drilling team:						
Wilhelms	Frank	AWI-geosystem	Kohnen	scientist, chief driller	03.12 /IL76	15.02 /IL76
Sheldon	Simon	Denmark	Kohnen	technician, driller mechanic	03.12 /IL76	15.02 /IL76
Lawer	Gunther	AWI-geosystem	Kohnen	technician, driller	03.12 /IL76	15.02 /IL76
Frenzel	Andreas	AWI-geosystem	Kohnen	scientist, driller	03.12 /IL76	15.02 /IL76
Hörnby	Kerstin	Sweden	Kohnen	technician, driller	03.12 /IL76	15.02 /IL76
Lambrecht	Astrid	AWI-geosystem	Kohnen	scientist, driller	03.12 /IL76	15.02 /IL76
Schmitt	Jochen	Norway	Kohnen	technician, driller	03.12 /IL76	15.02 /IL76
Hofmann	Georg	Saclay, France	Kohnen	technician, driller	03.12 /IL76	15.02 /IL76
Fritsche	Dietrich	AWI-Potsdam	Kohnen	scientist, driller	03.12 /IL76	15.02 /IL76
Kacsmarska	Marcena	NP, Norway	Kohnen	technician, driller	03.12 /IL76	15.02 /IL76
Renke	Marcus	AWI /Laeisz	Kohnen	technician, driller	03.12 /IL76	15.02 /IL76
Logistics:						
Drücker	Cord	AWI-logistics	Kohnen	technician, leader logistics	27.11 /IL76	Agulhas
Weynand	Markus	AWI-logistics	Kohnen	technician	27.11 /IL76	Agulhas
Stoof	Guenther	AWI-Potsdam	Kohnen	technician	27.11 /IL76	31.01 /IL76

Brehme	Andreas	AWI /Laeisz	Kohnen	technician	27.11 /IL76	Agulhas
Krischat	Joachim	AWI /Laeisz	Kohnen	technician	27.11 /IL76	Agulhas
Wauer	Ulrike	AWI	Kohnen	physician	27.11 /IL76	Agulhas
Ackermann	Adolf	AWI /Laeisz	Kohnen	cook	27.11 /IL76	Agulhas
Normann	Martin	Kässbohrer	Kohnen	technician, vehicles	27.11 /IL76	Agulhas
Miller	Heinrich	AWI-geosystem	Kohnen	scientist, station visit /inspection	25.01 /IL76	15.02 /IL76
				number of participants:		28
Wintering Team 2003 (Neumayer-Station)						
Kapieske	Uwe	AWI	Neumayer	physician, stationleader	2002	31.01 /IL76
Ramson	Wolfgang	AWI /Laeisz	Neumayer	engineer	2002	Agulhas
Müller	Ulf	AWI /Laeisz	Neumayer	electrician	2002	Agulhas
Riess	Felix	AWI /Laeisz	Neumayer	IT, radiooperator	2002	31.01 /IL76
Schumann	Holger	AWI /Laeisz	Neumayer	cook	2002	31.01 /IL76
Käßbohrer	Johannes	AWI	Neumayer	airchemist	2002	Agulhas
Bayer	Bettina	AWI	Neumayer	geophysicist	2002	31.01 /IL76
Lange	Dietrich	AWI	Neumayer	geophysicist	2002	31.01 /IL76
Konantz	Bernd	AWI	Neumayer	meteorologist	2002	31.01 /IL76
Weber	Ina	AWI	Neumayer	meteorologist, technician	2002	31.01 /IL76
				number of participants:		10
Wintering Team 2004 (Neumayer-Station)						
Müller	Anna	AWI	Neumayer	physician, stationleader	03.12 /IL76	2005
Penske	Armin	AWI /Laeisz	Neumayer	engineer	03.12 /IL76	2005
Kühl	Uwe	AWI /Laeisz	Neumayer	electrician	03.12 /IL76	2005
Peters	Frank	AWI /Laeisz	Neumayer	IT, radiooperator	03.12 /IL76	2005
Wagner	Klaus	AWI /Laeisz	Neumayer	cook	03.12 /IL76	2005
Richter	Astrid	AWI	Neumayer	airchemist	03.12 /IL76	2005
Ehlers	Birte-Marie	AWI	Neumayer	geophysicist	03.12 /IL76	2005
Waich	Gertrud	AWI	Neumayer	geophysicist	03.12 /IL76	2005
Wohanka	Karolina	AWI	Neumayer	meteorologist	03.12 /IL76	2005
				number of participants:		9
Aircraft Program (Neumayer-Station)						
Steinhage	Daniel	AWI-geosystem	Neumayer	scientific leader	27.11 /IL76	15.02 /IL76
Radke	Chris	Optimare	Neumayer	aero-geophysicist	03.12 /IL76	15.02 /IL76
Lampert	Phillip	Optimare	Neumayer	aero-geophysicist	03.12 /IL76	15.02 /IL76

name	first name	institute/firm	stay	profession	arrival	departure
Grillenbeck	Stefan	DLR	Neumayer	chiefpilot	Dornier	Dornier
Weber	Philip	DLR	Neumayer	pilot	Dornier	Dornier
Schirmer	Frank	DLR	Neumayer	technician	Dornier	Dornier
Knüppel	Andreas	DLR	Neumayer	pilot	Dornier	Dornier
Otto	Wolf-Christian	DLR	Neumayer	pilot	Dornier	Dornier
Meinecke	Dirk	DLR	Neumayer	technician	Dornier	Dornier
				number of participants:		9
VISA (Novo station)						
Scheinert	Mirko	TU Dresden	Novo	scientist, geodesy	10.11 /IL76	31.01 /IL76
Roemer	Swen	TU Dresden	Novo	scientist, geodesy	10.11 /IL76	31.01 /IL76
Anschütz, Mrs.	Helgard	AWI-geosystem	Novo	scientist, geophysics / glaziology	10.11 /IL76	31.01 /IL76
Rotschky, Mrs.	Gerit	AWI-geosystem	Novo	scientist, geophysics / glaziology	10.11 /IL76	31.01 /IL76
(NN)	(NN)	St. Petersburg	Novo	scientist, aerogeodeziya, geodesy	(10.11 /IL76)	(31.01 /IL76)
(NN)	(NN)	St. Petersburg	Novo	scientist, aerogeodeziya, geodesy	(10.11 /IL76)	(31.01 /IL76)
(Moskalevsky)	(Maxim)	Moscow	Novo	scientist, Russian Academy of Science	(10.11 /IL76)	(31.01 /IL76)
				number of participants:		4
				Logistics (Neumayer-Station):		16
				Science (Neumayer-Station):		9
				EPICA (Kohnen-Station):		28
				Overwintering Team 2003 (Neumayer-Station):		10
				Overwintering Team 2004 (Neumayer-Station):		9
				Aircraft Program (Neumayer-Station):		9
				VISA (Novo station):		4
				Total number of participants:		85

