

Development of an

Action Plan

German-Indonesian Cooperation In Marine Sciences and Geosciences

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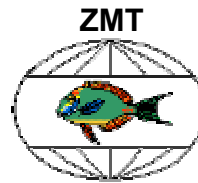


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Development of an 'Action Plan' for Marine Research in Indonesia

Project 'Action Plan'

I. Introduction

Because of its geographical location, its climatic and topographic characteristics, as well as its scientific and economic potential, Indonesia represents one of the strategically important partners of Germany in the tropics. An agreement on scientific and technological cooperation was signed between the two countries in 1979 and cooperative projects in various fields have been in place.

Partnership projects have received new impulses in the field of marine sciences and geotechnology since 1996. To a great extent this renewed interest is due to work carried out by German scientists on board of research vessels such as the SONNE and through the efforts of individual scientists and institutions supporting the marine sciences at various Indonesian universities.

Until recently projects related to marine sciences and resources were exclusively conducted by departments such as BPPT and LIPI of the Ministry of Research and Technology (RISTEK) and by the Ministry of Agriculture and Fisheries. Individual departments of several universities were also involved. The establishment of the Ministry of Maritime Affairs and Fisheries (DKP) has provided new, additional impetus to intensify the ongoing cooperation and to widen such cooperation to include new fields.

During bilateral workshops held in Hamburg (1998) and Serpong (1999), the International Bureau of the BMBF brought together interested scientists from both sides to present and discuss scientific proposals. Some of the projects discussed were taken up for implementation during the past two years.

In May 2000 a BMBF-delegation visited Indonesia to further develop the cooperation. The importance Indonesia attaches to cooperation with Germany was underscored by the attention given to its work by the three Indonesian ministries: Ministry of Research and Technology, Ministry of Maritime Affairs and Fisheries, as well as the Ministry of Education. The delegation also had the chance to visit several Indonesian research institutions and industrial enterprises dealing with marine science and technology as well as with geosciences. The visit also showed the existence of several institutions in Indonesia with the necessary infrastructure and qualified personnel to develop cooperation in marine sciences.

At the end of the delegation's visit, a joint steering committee was established to oversee the marine science cooperation. This steering committee provides a framework within which the cooperation can be developed. At this first meeting the Steering Committee decided to develop an Action Plan cooperation between Indonesia and Germany. The plan was to be developed by involving research institutions and universities, as well as representatives of the maritime industry in both countries over a period of 9 months. Several individual meetings, roundtable discussion and bilateral meetings were held to discuss project themes and activities to be included in the plan. Most German and Indonesian institutions involved in marine science and geotechnology were asked to contribute to the preparation of the Action Plan.

II. Schedule

September 01, 2000	Beginning of Project Action Plan
October – November 2000	Meetings with Research Institutions and Ministries in Germany and Indonesia Meeting with scientists at IOW, BGR, and University of Duesseldorf to discuss aspects of the Action Plan
November 12 – 17, 2000	First Bilateral Workshop at ZMT, Bremen Visit by Indonesian Delegation (VII.1) to Germany. Activities included visits to AWI – Bremerhaven (Mrs. Tan, Dr. v. Westernhagen), Cuxhaven (Mr. Baldwinsson from Hussmann & Hahn, Mr. Schmal from S.A.M GmbH, Mr. Mull from Dermalog, and Mr. Nagel), BGR in Hannover (Dr. Kudrass, Dr. Reichert, Dr. Buttkus), IOW in Warnemuende (Prof. Dr. v. Bodungen), the Institute of Pharmaceutical Biology of the University of Duesseldorf (Prof. Dr. Proksch), BMBF (Dr. Blaesing, Dr. Eggers, Dr. Kieffer) and DAAD (Dr. Rueland) in Bonn. During its visit the Indonesian delegation and German scientists and members of the industry (VII.2) had the chance to take part in further roundtable and individual discussions.
December – March, 2001	Additional Meetings with Scientists from Indonesia In January 2001 Dr. Indra Jaya from IPB (Bogor) and in March 2001 Dr. Bambang Herunadi (BPPT) visited Bremen. During their stay these scientists had the chance to visit e.g. the Federal Research Institute for Fisheries (Dr. Hubold), University of Kiel-Corelab (Prof. Dr. Mayerle), AWI-Bremerhaven (Dr. v. Westernhagen) and the University of Duesseldorf (Prof. Dr. Proksch).
March – May, 2001	Bilateral Workshop at UNSOED, Purwokerto March 25 until March, 29 2001 an Action Plan meeting was held jointly with a DAAD – Alumni Seminar. This meeting provided opportunities for Indonesian and German scientists and governmental representatives to establish new contacts and discuss possible future projects. Participants at the meeting (VII.3) presented project proposals and participated in working group discussions and in a field trip to Cilacap, Segara Anakan Conservation Project. The members of the German delegation met in May to exchange personal impressions of the Purwokerto workshop and to discuss the future development of joint projects.

III. Categories of Activities

Project suggestions by various German and Indonesian institutions (VII.) were grouped into three different categories of activities 1) Research and Development in Marine Sciences and Geosciences, 2) Innovation and Application, and 3) Accompanying Measures and were described briefly (III.2). These project themes were discussed during the Purwokerto Workshop and various meetings and are described below (III.1).

III.1 RESEARCH AND DEVELOPMENT IN MARINE SCIENCES AND GEOSCIENCES

III.1.1 Coastal Marine Ecosystems, Living Resources (including Fisheries and Aquaculture) and Management



The set of projects under this theme is directed towards the study of marine ecology and the interactions between various components of these systems that affect their resource potential.. These ecosystems include seagrass beds, coral reefs and mangrove forests.

Human activities are known to have an impact on such ecosystems. The study of trophic transfers within certain ecosystems and the relationship between primary production and economically important fish can contribute to a better understanding of this closely tied biological net. The increase in our knowledge about the resource potential and about their vulnerability to natural and anthropogenic interventions can aid in their sustainable management when linked to social and economic changes.

Additionally, these investigations will enable the identification of commercially important fish stocks and lead to further management strategies, including aqua- and mariculture.

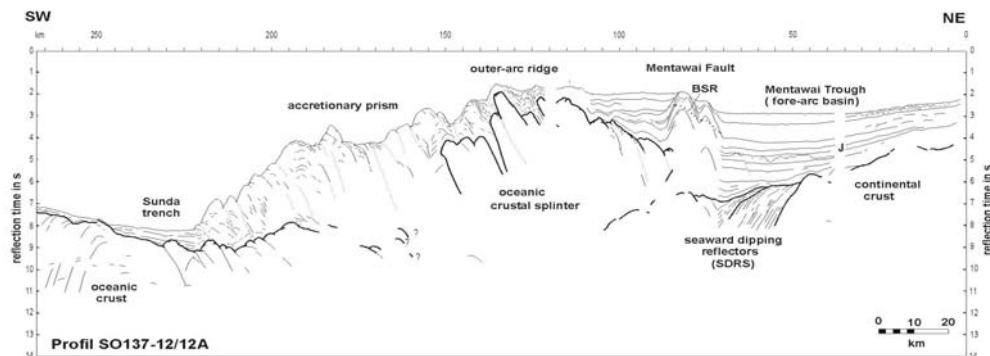
III.1.2 Marine Natural Products and Pharmacology

Natural products constitute an indispensable source of lead structures especially for the development of new pharmaceuticals and agrochemicals. Whereas traditional efforts to isolate and characterize new natural products have long been focused on terrestrial organisms (higher plants and microorganisms), increasing attention is now given to marine organisms due to their unique chemical structures not found elsewhere in nature and their high "hit rates" in screening efforts aiming at the discovery of new drugs from nature.

Indonesia with its long coastline and its exceptionally high marine biodiversity offers ideal opportunities for projects aiming at the discovery of new bioactive metabolites from the sea. This unique condition offers a challenge for natural products scientists from Germany and Indonesia to combine their efforts and to tap the vast potential of the Indonesian marine resources as outlined in the bilateral proposals listed below.



III.1.3 Hydrocarbon and Mineral Potential and Geohazards



This set of projects aims to estimate the hydrocarbon potential of the forearc basin and the volcanic geohazards of the Sunda Arc/ Sulawesi Sea. In addition, the potential of hydrothermal deposits will be explored in the Banda Sea. The projects will be carried out in close cooperation with Indonesian partners like BPPT and the Marine Geological Institute. The main German proponents are BGR and University of Berlin including partners from GEOMAR, Univ. of Bremen, Univ. of Hamburg, Univ. of Freiburg.

Cooperation with German and Indonesian industrial partners like PERTAMINA and LEMIGAS, and PREUSSAG Energie are anticipated for the hydrocarbon investigations to form "sandwich projects". Many of the projects will be performed in a two-step approach. In the first step an Indonesian research vessel like one of the BARUNA JAYA fleet or the GEOMARIN I is employed for the surface investigations and the general survey of the proposed area. Based on these results follow-up surveys will use SONNE to investigate the third dimension by seismic profiling and coring. The first SONNE cruises can be possibly performed at the end of 2003.

In general, the projects, which are mostly based on previous SONNE expeditions of BGR, will increase the understanding of the geological development of the Sunda Arc and the Sulawesi Sea and they will allow to estimate their hydrocarbon / hydrothermal and their geohazard potential. In addition, the data can be used to more precisely define the EEZ-borders of Indonesia. The close cooperation during the preparation, performance and evaluation will significantly strengthen the geoscientific capacity of the participating institutions.

The following projects are discussed and agreed upon during several bilateral meetings:

Bandamin:

Identification of the potential of hydrothermal mineral resources in the Banda Sea (A first cruise is planned in 2001 with the Baruna Jaya IV by Univ. Berlin and BBPT). Sunda Arc: Evaluation of the hydrocarbon potential including the gas hydrates in relation to structural inventories (Shallow and deep water investigations are anticipated with the Baruna Jaya fleet for bathymetric mapping, sediment echosounder profiling, surface sediment and water sampling as well as geothermal measurements, SONNE will be needed for multichannel seismic profiling, deeper sampling and or in very deep water: BGR, GEOMAR, Univ. Bremen, Univ. Hamburg, BBPT, MGI and industrial partners)

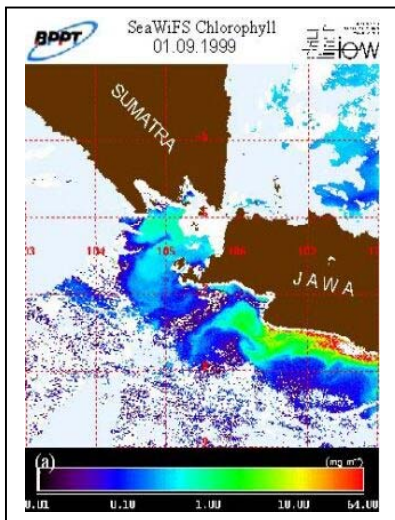
Volcanic Geohazards of the Krakatau and Toba:

Investigation of the effects and processes of these ancient eruptions in the marine environment (detailed bathymetric mapping and shallow seismic profiling of the Sunda Strait around the Krakatau could be performed with a Baruna Jaya vessel, deep coring and seismic profiling in deep water can be performed by SONNE, BGR, GEOMAR, Univ. Hamburg, BBPT, MGI).

Krakatau-Tomography:

Seismic and seismological investigation of the subvolcanic structure (to be carried out with the Indonesian research fleet, BBPT and BGR). Character of the oceanic crust of the Sulawesi Sea: Investigation of the origin of the Sulawesi Sea and its margins (SONNE proposal by BGR is submitted to perform multichannel, gravity and magnetic profiling).

III.1.4 Physical Dynamics in Indonesian Seas and Coastal Areas



From the point of view of oceanography, Indonesian waters belong to the most interesting areas of the world. From a large-scale perspective (ocean), the Indonesian through-flow plays a significant role in the global ocean circulation. Because of its major relevance to the global heat transport from the equatorial warm pool to the subtropics, the Indonesian waters have a strong impact on the global climate system, and thus play a major role in the consequences of climate change. From a medium-scale perspective (shelf), Indonesian waters comprise one of the world's largest shelf areas, i.e. the Sunda Shelf, enabling the most relevant shelf sea processes to be studied under the specific condition of an equatorial region. From a small-scale perspective (coastal), the increased urbanization and industrialization of the coastal zone and the large number of islands combined with a long coastline, leads to the destruction of habitats, wetlands areas, dunes and beaches that in turn have an impact on the shelf and ocean scales.

Investigations planned within this topic theme cover a number of aspects mentioned above and their interaction on a wide range of horizontal scales. On the ocean scale, the study focuses on the upwelling off the Indonesian coast, caused by anomalous westward winds correlated with non-ENSO type events.

On the shelf scale, three projects are proposed. The first one deals with the circulation structure and the variance spectrum in the Malacca Strait including the adjacent Andaman Sea where the relevance of the strait with respect to the global heat transport will be investigated for different temporal scales. The second project intends to study the thermal plumes and internal solitary waves generated in the Lombok Strait. Due to its unique topographic and hydrographic conditions it is an ideal domain to study such phenomena. The third project related to shelf processes is focussed on the application of satellite derived SST and ocean colour data of Indonesian waters in order to investigate the influence of upwelling, through-flow and coastal discharge on the composition of water constituents and on phytoplankton development to support fish stock assessment, validation of model simulations, coastal studies and management, and coral reef studies. The areas of investigation are the Java Sea, Sunda and Lombok Straits, and the upwelling region south of Java.

On a coastal scale, the hydrodynamics, sediment dynamics and morphodynamics of Jakarta Bay, including the Seribu islands, are intended to be studied. The aim is to improve knowledge of the region's conditions and on their interaction with shelf processes leading toward the development of tools to support management of the coastal area.

III.1.5 Ecosystem Response to Global Changes

In all parts of the world varying degrees of coastal contamination and pollution accompany concentrated settlement of people near the coast and their economic activities. The historical use of the coastal ocean as a waste disposal site is in permanent conflict with the use of the ocean as a food and mineral resource, as a transportation route, for recreation, and last but not least as a feeding and reproduction site for fish. The most significant classes of pollutants for the sensitive coastal ecosystems of Indonesia include the uncontrolled release of sewage and macronutrients which enhance algal



productivity and oxygen consumption, and the release of metals from harbour activities, sewage outfalls and mining. The discharge of petroleum hydrocarbons, polyaromatic hydrocarbons and (organochlorine) pesticides may be relevant for certain local sites.

In addition to these classical pollutants, adverse effects for the ecosystems of the coastal zone may also arise from (global) climate change and/or changing land use, possibly enhancing erosion and driving high amounts of suspended particles towards the sensible coastal environment. Thus, both coastal pollution and other anthropogenic impacts on the environment may be a threat for people and economic activities which are related to the Indonesian coastline and the coastal seas. Complicated examples are artificial fishponds which are sensitive to pollution from outside, but may also have adverse effects on the environment by themselves. For coastal zone management, all forms of anthropogenic (urban) impact on the coastal environment have to be analyzed and assessed.

There are several reasons why the measurement of pollution and the assignment of a certain pollution status is difficult. One of the most relevant reasons with regard to the release of both organic sewage and heavy metals is the complex interaction between natural biogeochemical cycles and their alteration by human activities. Thus the first step for joint activities should be: the assessment of the most relevant local pollutants and/or parameters of environmental change (organic matter, heavy/trace metals, petroleum hydrocarbons, PAH, possibly also organochlorine pesticides, terrigenous suspended particles from different sources), the development of concepts and sampling strategies, the evaluation of sedimentary records or other archives of pollution.

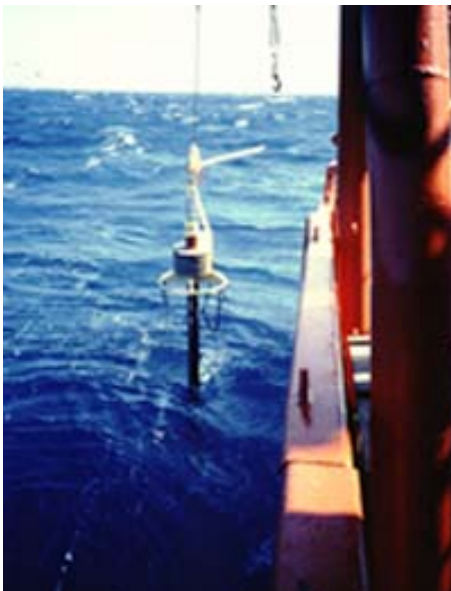
III.1.6 Paleooceanography and Paleoclimatology

The goal of suggested projects under this theme emphasize the reconstruction of past environmental conditions within the Southern Part of the Indonesian Archipelago. In particular the Indonesian-Australian Gateway, Arafura Shelf, Timor Island, Flores Island, Bali and Lombok were named as study sites, as well as Makassar Strait in North-Central Indonesia. In cooperation with Indonesian partners ancient sea-level changes, productivity fluctuations, the dynamics of the Indonesian through-flow, and the determination of influence of oceanographic processes on the geometry and carbonate production will be studied by sampling sediments and corals.



The information expected from these investigations will contribute to the understanding of global climate change and the ocean's role in long-term climate change. These paleorecords will provide data to test climate models and the effect on the intensity of the East Asian Monsoon, the variability of the West Pacific Warm Pool, as well as on El-Niño.

III.2 INNOVATION AND APPLICATION OF TECHNOLOGY



Project proposals under this theme are primarily oriented towards Indonesia's technological advancement in fields of ship technology and construction, alternative forms of energy production and storage, and the development of technology for environmental analysis and observations. Additionally, some proposed technologies are aimed at aiding management of fishery resources ranging from licensing to market analysis and product development, the basis of which is the formation of a national database for oceanography.

In close cooperation with the industry, these projects will contribute to the technological development within proposed fields, as well as of Indonesia and will form a foundation for future work in the fields of research, management and economy. Proposed study areas cover entire Indonesia and are submitted by FTZ, Abeking & Rasmussen, ZMT, Dermalog, Husmann & Hahn, Rogge Marine Consulting GmbH and S.A.M GmbH.

III.3 ACCOMPANYING MEASURES

Marine Science Education and Capacity Building forms the foundation for any type of sustainable development. Therefore, proposed projects aim at the education of students, technicians and scientists. In cooperation with Indonesian Universities and governmental institutions, ZMT and the University of Bremen have submitted various projects within the scope of this project theme.

Suggested projects within the fields of aqua- and mariculture aim at creating pilot plants and train Indonesian technicians and scientists in handling and maintenance techniques. Other project suggestions deal with education of students and are directed toward offering special scholarships in marine sciences, as well as establishing new education programs within this field.



Education and training of Indonesian and German interested parties, as well as the close cooperation with German and Indonesian industries will contribute to the sustainability of long-term cooperation between these countries and will aid in Indonesia's economical improvement within the field of marine resources.

IV. Submitted German Project Proposals (brief descriptions)

IV.1 RESEARCH AND DEVELOPMENT IN MARINE SCIENCES AND GEOSCIENCES

IV.1.1 Coastal Marine Ecosystems, Living Resources (including Fisheries and Aquaculture) and their Management

IV.1.1.1 Trophic Transfer in Tropical Seagrass Systems

Comparison of relevant pathways of material flows within different types of seagrass beds in temperate and tropic zones.

Due to anthropogenic influences, seagrass beds have declined all over the world and thereby negatively affected coastal fisheries. Latitudinal comparison of sink & source function for particulate matter and nutrients, of remineralization, nutrient turnover and regeneration, as well as comparison of role of grazing in sea grass beds will be part of this study to contribute to the understanding of their principal function (original project suggestion VII.1.1.1).

German Institution: AWI – Wadden Sea Station, Sylt; ZMT (Center for Tropical Marine Ecology)

Contact Person: Dr. H. Asmus, hasmus@awi-bremerhaven.de; Dr. R. Asmus, rasmus@awi-bremerhaven.de

IV.1.1.2 Development of Ecological Indicators of Ecosystem Health

Development of ecological indicators to monitor the ecological quality of coastal waters.

(financed by EU since February 2001)

German Institution: FTZ (Research- and Technology Centre Westcoast)

Contact Person: Prof. Dr. F. Colijn, colijn@ftz-west.uni-kiel.de

IV.1.1.3 Causative and Supporting Factors of Eutrophication in Coastal Indonesian Waters

Development of a decision support system for future reduction scenarios.
Investigation of nutrient transport and transformation and controlling factors of phytoplankton bloom dynamics in relation to physical forcing; as well as combined analysis of field measurements and modeling to identify key factors in the formation of primary organic matter from anthropogenic nutrient inputs to coastal seas and estuaries;
First focus is on Jakarta Bay.

German Institution: Research & Technology Centre Westcoast, University of Kiel; Coastal Research Laboratory, Institute of Geosciences; University of Kiel

Indonesian Institution: Center for Coastal and Marine Resources Studies, Faculty of Fisheries and Marine Sciences, Bogor Agricultural University

Contact Person: Prof. Dr. F. Colijn, colijn@ftz-west.uni-kiel.de; Dr. K.-J. Hesse, hesse@ftz-west.uni-kiel.de; Prof. Dr. R. Mayerle, rmayerle@corelab.uni-kiel.de

IV.1.1.4 East Indies Triangle – Center of Origin of Biodiversity?

Investigation of reasons for and effects of high biodiversity and suitability of biodiversity as a criteria for conservation and management.
In this project genetic diversity, relationships between speciation, dispersal modes, geographic distances, comparison of ecological functioning of species-rich vs. species-poor environments will be studied. Additionally, a survey will be conducted to assess and compare species richness, and identify locations of centers of origin

German Institution: ZMT (Center for Tropical Marine Ecology)

Contact Person: Dr. S. Dittmann, sabine.dittmann@zmt.uni-bremen.de

IV.1.1.5 Zooplankton – Linking Primary Production to Economically Important Pelagic Fish Stocks

Supplementing project estimates of potential primary production with measurements of grazing pressure and carbon transfer to zooplankton in order to assess the potential yield of pelagic fish stocks.
The project will involve identification of dominant zooplankton species (abundance, biomass), assessment of their regional and vertical distribution, study of their life-cycles and seasonal succession, identification of areas with high zooplankton abundance and production, as well as relevant enrichment mechanisms (e.g. monsoon-driven upwelling) (original project suggestion VII.1.1.2).

German Institution: University of Bremen – Marine Zoology

Contact Person: Prof. Dr. W. Hagen, whagen@uni-bremen.de

IV.1.1.6 Molecular Genetics as a Tool for the Management of Living Marine Resources in Indonesia

Research on gene flow and larval dispersal of coral reef organisms (fish and invertebrates) and investigations on the connectivity of coastal habitats (coral reefs, seagrass meadows, mangroves) to aid in the planning of marine reserves, as well as identification of commercially important fish stocks and gene flow and larval dispersal between fish stocks to aid in fisheries management (original project suggestion VII.1.1.3).

German Institution: ZMT (Center for Tropical Marine Ecology), University of Bremen – Biotechnology and Molecular Genetics (Prof. Blohm, Dr. Söller), UFT - Bremen

Contact Person: M. Kochzius, marc.kochzius@zmt.uni-bremen.de

IV.1.1.7 Vegetation Patterns and Stress Detection of Mangrove Systems using Remote Sensing

Large-scale measurement of water stress behavior of mangroves and measurement of land-use change, change in sediment and erosion patterns over time (original project suggestion VII.1.1.4)

German Institution: ZMT (Center for Tropical Marine Ecology), AWI (Alfred-Wegener Institute for Polar and Marine Research; Dr. A. Bochert), IOW (Baltic Sea Research Institute – Warnemuende), Prof. Dr. G. Krause

Contact Person: Ms. G. Krause, gesche.krause@zmt.uni-bremen.de

IV.1.1.8 Fish Stock Assessment

Complementing the Indonesian National Stock Assessment Program of KomNas (last survey in 1997)

German Institution: ZMT (Center for Tropical Marine Ecology), BfAFi (Federal Research Centre for Fisheries)

Indonesian Institution: DKP (Indonesian Ministry of Maritime Affairs and Fisheries), LIPI (Indonesian Institute of Sciences), CRIFI (Central Research Institute for Fisheries), BPPL (Research Institute for Marine Fisheries), UNHAS (Hasanuddin University – Padang), BHU (Padang University)

Contact Person: Dr. A. Kunzmann, andreas.kunzmann@zmt.uni-bremen.de

- IV.1.1.9 Marine Ecosystem Investigations: Biological, Biogeochemical and Socio-Economic Changes in the Segara Anakan Coastal Region (Java, Indonesia)**
- Study of effects of anthropogenic environmental changes on the ecology, economy and chemistry of the region in order to understand processes and interlinkages of coastal ecosystems described by intertidal mudflats, mangrove systems, salt water marshes and open sea (exploration of the bio-geo-socio background) and help to develop a strategy for sustainable management.
- Major components of the project will include the study of land-use changes over the past 50 years, as well as studies of socio-economic changes and changes in living communities. Further sub-projects will investigate changes in material flux and in long-term scales. The goal of the project is the generation of a scientific data base on coastal ecosystems to create a model for the development of future scenarios and therefore find guidelines for sustainable management strategies for the area (original project suggestion VII.1.1.5).
- German Institution:** ZMT (Center for Tropical Marine Ecology)
- Contact Person:** Dr. A. Kunzmann, andreas.kunzmann@zmt.uni-bremen.de; Dr. T. Rixen, tim.rixen@zmt.uni-bremen.de, MSc. K. Gaertner, karin.gaertner@zmt.uni-bremen.de; Prof. Dr. V. Ittekkot@zmt.uni-bremen.de
- IV.1.1.10 Mangrove Ecotones**
- Study the role of mangroves as ecotones in the Segara Anakan mangrove region in South Central Java.
- German Institution:** University of Oldenburg – TERRAMARE
- Contact Person:** Dr. G. Liebezeit, Gerd.Liebezeit@usa.net
- IV.1.1.11 Bioindicators for Coral Reef Health**
- Slopes of cross-shore gradients in plankton and nutrient distribution as potential indicators for reef health.
- Cryptofauna filter-feeders, abundant in highly oligotrophic waters within the reef matrix, are sensitive indicators of eutrophication. Novel endoscopic tools -the CaveCam- allow detection of changes in cryptofauna communities, long before community changes become visible in corals (original project suggestion VII.1.1.6).
- German Institution:** ZMT (Center for Tropical Marine Ecology)
- Contact Person:** Dr. C. Richter, crichter@uni-bremen.de

IV.1.1.12 Physical and Functional Integrity of Coral Reefs

Direct effects of physical disturbance (hurricanes, blast fishing, etc.) on coral reef structure and function.

Comparative study of the filtering ability of coral reefs subjected to various degrees of framework degradation using novel endoscopic tools with advanced modeling of flow through porous media (original project suggestion VII.1.1.7)

German Institution: ZMT (Center for Tropical Marine Ecology), MPI (Max-Planck-Institute for Marine Microbiology)

Contact Person: Dr. C. Richter, crichter@uni-bremen.de

IV.1.1.13 Coral Bleaching and Zooplankton

Investigation of possible mitigating effects of zooplankton feeding on zooxanthellae – host interaction in corals.

The study will compare spatial distribution patterns of zooplankton, temperature and bleaching and will involve field and laboratory experiments (original project suggestion VII.1.1.8).

German Institution: ZMT (Center for Tropical Marine Ecology), MPI (Max-Planck-Institute for Marine Microbiology)

Contact Person: Dr. C. Richter, crichter@uni-bremen.de

IV.1.2 Marine Natural Products and Pharmacology

IV.1.2.1 Marine Macroorganisms from Coral Reefs and Mariculture as Sources for New Bioactive Metabolites

Investigation of Indonesia's marine biodiversity for bioprospecting and aid in the creation and implementation of new and economically interesting fields of Mariculture.

The project will include bioprospecting of coral reef organisms for potential use in medicine and other fields, such as cosmetics by means of sensitive coupled analytical techniques and screening methods. Large scale maricultural production will be initiated with chemically interesting species (original project suggestion VII.1.2.1)

German Institution: Institute for Pharmaceutical Biology (University of Duesseldorf), ZMT (Center for Tropical Marine Ecology), Bayer AG

Indonesian Institution: Gadjah Mada University – Yogyakarta (Dr. Sudarsono), Andalas University – Padang (Dr. Dian Handayani), IPB – Bogor (Dr. Linawati Hardjito, PD Dr. Hary Palm), Universitas Indonesia – Jakarta (Prof. Sumali Wiryowidagdo, Dr. Budiawan), PT Indofarma (Indonesia), PT Martina Berto (Indonesia), BPPT (Dr. Listyani Wijayanti)

Contact Person: Prof. Dr. P. Proksch, prosch@uni-duesseldorf.de; Dr. R. Ebel, ebel@uni-duesseldorf.de

IV.1.2.2 Microorganisms from Mangrove Swamps as a new source for Drug Discovery

Study of metabolic properties of bacteria and fungi from the Mangrove area of Segara Anakan (Central Java) with regards to their biological activities in pharmacologically relevant screens and identification of possible lead structures aiming at the development of new pharmaceuticals (original project suggestion VII.1.2.2).

German Institution: Institute for Pharmaceutical Biology (University of Duesseldorf), AWI (Alfred-Wegener Institute; Dr. T. Tan, Dr. K. Schaumann), ZMT (Center for Tropical Marine Ecology), Zentaris AG

Indonesian Institution: UNSEOD (Jenderal Soedirman University – Purwokerto; Dr. Edy Yuwono), BPPT (Dr. Listyani Wijayanti), Gadjah Mada University (Dr. Sudarsono)

Contact Person: Prof. Dr. P. Proksch, prosch@uni-duesseldorf.de; Dr. R. Ebel, ebel@uni-duesseldorf.de

IV.1.2.3

Ecology of the Coral Reefs around Karimunjawa Islands, Java Sea, Indonesia: Microbial Biodiversity and Bioactive Compounds

Investigations on an intact coral reef community around Karimunjawa Islands to search for new bioactive compounds and new organic compounds, as well as to unfold its biochemical interactions and probable risks to such communities. The project will involve modern molecular biological methods as well as enrichment cultures and single cell isolation procedures (original project suggestion VII.1.2.3)

German Institution: AWI (Alfred-Wegener Institute for Polar and Marine Research, Dr. E. Helmke, Dr. L. Medlin, Dr. K. Schaumann, Dr. C. Schütt, Dr. R. Crawford, Dr. G. Kattner, Prof. F. Buchholz, G. J. F. Kaligis, Prof. C. Wiencke, Prof. H.-O. Pörtner), University of Bremen (Prof. G. O. Kirst), Institute for Pharmaceutical Biology (University of Duesseldorf, Prof. Proksch), University of Bremerhaven (Prof. H. G. Ebner)

Indonesian Institution: UNDIP (Diponegoro University, Semarang, A. B. Susanto), Gadjah Mada University (Yogyakarta, E. P. Setyowati, Dr. Sudarsono), UNSRAT (Sam Ratulangi University, Manado)

Contact Person: Dr. Tjhing-Lok Tan, ttan@awi-bremerhaven.de

IV.1.3 Hydrocarbon and Mineral Potential and Geohazards

IV.1.3.1 Research Cruise: Baruna Jaya - BANDAMIN

Geotechnological research to study the hydrothermalism and related mineralizations of the southeastern Banda Sea. The project will contribute to the identification of mineral resource potentials in Indonesia and will examine hydrothermal circulation processes in order to determine element and energy fluxes in geochemical systems leading to the formation of submarine mineralizations. Additionally, training of Indonesian scientists in various analytical and technical aspects is planned (original project suggestion VII.1.3.1)

German Institution: University of Berlin – Economic and Environmental Geology, GFZ Potsdam (GeoResearch Center)

Indonesian Institution: DKP (Ministry of Marine Affairs and Fisheries), BPPT (Agency for the Assessment and Application of Technology), MGI (Directorate General of Geology and Mineral Resources)

Contact Person: Prof. Dr. P. Halbach, hbrumgeo@zedat.fu-berlin.de

IV.1.3.2 Research Cruise: Baruna Jaya - Sunda Arc, Celebes Sea and Java Sea

Pre-site surveys for further projects to collect information on bathymetry, sediment-echosounding, CTD for methane and magnetometry

German Institution: BGR (Federal Institute for Geosciences and Natural Resources)

Indonesian Institution: BPPT (Agency for the Assessment and Application of Technology)

Contact Person: Dr. H. Kudrass, kudrass@bgr.de; Dr. C. Reichert, christian.reichert@bgr.de

IV.1.3.3 Research Cruise: Baruna Jaya - Sunda Arc (Pre-site Survey for Submersible Dives)

Pre-site survey for SHINKAI 6500 submersible dives on selected features in cooperation with Japan, Indonesia and Germany.

German Institution: BGR (Federal Institute for Geosciences and Natural Resources)

Indonesian Institution: BPPT (Agency for the Assessment and Application of Technology)

Contact Person: Dr. H. Kudrass, kudrass@bgr.de; Dr. C. Reichert, christian.reichert@bgr.de

IV.1.3.4 Sulawesi Sea (follow-up of GIGICS Project)

Investigation of the oceanic crust underlying the western Sulawesi Sea using seismic profiling combined with magnetic and gravity measurements. The study of the structure and age of the oceanic crust will contribute to the understanding of the origin of the Sulawesi Sea and its surrounding margins.

German Institution: BGR (Federal Institute for Geosciences and Natural Resources)

Indonesian Institution: BPPT (Agency for the Assessment and Application of Technology)

Contact Person: Dr. H. Kudrass, kudrass@bgr.de; Dr. C. Reichert, christian.reichert@bgr.de

IV.1.3.5 Volcanic Eruption and Sea Level Changes near Krakatau and Toba

Investigation of the effects of large late Quaternary volcanic eruptions of the Krakatau and Toba volcanoes on the forearc basins using swath bathymetry, high-resolution seismic profiling, geological and geochemical sampling. Sediment records of the slope and forearc basins off Sumatra and Java will be able to reveal slumps, slides, ash fall turbidity currents, release of methane below slumped gas hydrates and dating of former sea level stands.

German Institution: BGR (Federal Institute for Geosciences and Natural Resources)

Indonesian Institution: BPPT (Agency for the Assessment and Application of Technology)

Contact Person: Dr. H. Kudrass, kudrass@bgr.de; Dr. C. Reichert, christian.reichert@bgr.de

IV.1.3.6 Tomography of Krakatau

Investigation of the substructure beneath Krakatau and creation of a velocity model to localize sources of volcanic seismic events. For this project it is intended to install 10 seismometer stations on the Krakatau Island, including a broad band station at a center position, as well as ocean-bottom hydrophones/seismometers.

German Institution: BGR (Federal Institute for Geosciences and Natural Resources)

Indonesian Institution: BPPT (Agency for the Assessment and Application of Technology)

Contact Person: Dr. H. Kudrass, kudrass@bgr.de; Dr. C. Reichert, christian.reichert@bgr.de

IV.1.3.7 Sunda Arc (Follow-up of GINCO Project)

Investigation of the continental margin of Java and Sumatra by bathymetric and multichannel seismic profiling, gravity and magnetic measurements and geological-geochemical-geothermal sampling. Main interests of this project include the transition from normal subduction off Java to oblique subduction off Sumatra, as well as the relationship between subduction-controlled structures and high-risk volcanism.

German Institution: BGR (Federal Institute for Geosciences and Natural Resources)

Indonesian Institution: BPPT (Agency for the Assessment and Application of Technology)

Contact Person: Dr. H. Kudrass, kudrass@bgr.de; Dr. C. Reichert, christian.reichert@bgr.de

IV.1.3.8 Bathymetric Mapping of Sunda Strait/ Indonesia

Usage of a multibeam system onboard an Indonesian vessel (small research vessel or fishing vessel) for swathmapping surveys in the Indonesian EEZ (original project suggestion VII.1.3.2)

German Institution: GEOMAR Kiel (Research Center for Marine Geosciences)

Contact Person: Dr. W. Weinrebe, wweinrebe@geomar.de

IV.1.4 Physical Dynamics in Indonesian Seas and Coastal Areas

IV.1.4.1 Lombok Strait: Thermal Plumes and Waves

Investigations of the thermal plumes and internal solitary waves generated in the Lombok Strait by using SAR data.

This project will collect oceanographic measurements from ships and will make use of SAR data from ERS, ENVISAT and other satellites (original project suggestion VII.1.4.1)

German Institution: IfM (Institute of Oceanography) – University of Hamburg

Contact Person: Prof. W. Alpers, alpers@ifm.uni-hamburg.de

IV.1.4.2 Investigation of Circulation and Transport in the Malacca Strait and the Andaman Sea

Investigations based on a circulation model as well as on a frontal model with the goal to contribute to the understanding of the circulation structure and its variance spectrum in the Malacca Strait and Andaman Sea.

Activities of this project will include calculations and long-term investigation of circulation patterns, estimation of turn-over time for water masses of Malacca Strait, calculation of front distributions, identification of main locations of fronts and their temporal and spatial variability, and identification of the cause of fronts (temperature, salinity, tides, etc.) (original project suggestion VII.1.4.2)

German Institution: University of Hamburg – IfM (Institute of Oceanography)

Contact Person: Dr. P. Damm, damm@ifm.uni-hamburg.de; Prof. Dr. J. Sündermann, suendermann@ifm.uni-hamburg.de; Dr. T. Pohlmann, pohlmann@ifm.uni-hamburg.de

IV.1.4.3 Hydrodynamics, Sediment Dynamics and Coastal Erosion in Indonesian Coastal Areas

The aim of the project is to improve and extend the current knowledge on hydrodynamics, sediment dynamics and erosion mechanisms at selected coastal areas. It involves *in-situ* measurements, data processing and analysis, development of models for simulating water levels, waves, currents, sediment transport and the resulting coastal evolution as well as simulation runs for given scenarios.

Among the areas of interest is the Jakarta Bay and the Seribu Islands. The final decision on the domain(s) to be handled should be made in conjunction with the Indonesian partners.

German Institution: Coastal Research Laboratory (Corelab), Institute of Geosciences, Uni Kiel; Coastal Research & Management (CRM), Consulting Company Kiel

Indonesian Institute: Center for Coastal and Marine Resources Studies, Faculty of Fisheries and Marine Sciences, Bogor Agricultural University

Contact Person: Dr. R. Mayerle, rmayerle@corelab.uni-kiel.de; Dr. L. Piper, Dr. Indra Jaya, Dr. Trydoyo Kusumastanto and Dr. M. Purba

IV.1.4.4 Eastern Indian Ocean Boundary Circulation and Climate Variability

Investigation of the ocean's role in anomalous upwelling off Indonesia caused by anomalous westward winds and dry spells over Indonesia (non-ENSO-type events).

Research methods will involve moored stations and profiling floats obtaining current, temperature and salinity measurements (original project suggestion VII.1.4.3)

German Institution: IfM-Kiel (Institute for Marine Science, Kiel)

Contact Person: Prof. Dr. F. Schott, fschott@ifm.uni-kiel.de

IV.1.4.5 Remote Sensing Application

Research enables investigation of phytoplankton development in different water masses, influence of coastal and river discharge, as well as bio-optical classification of water masses for the identification and distinction of oligotrophic ocean, upwelling, through-flow and Java Sea waters.

Collected data will be obtained from CTD, fluorometer and radiometer measurements, as well as SeaWiFs data sets (original project suggestion VII.1.4.4).

German Institution: IOW (Baltic Sea Research Institute – Warnemuende)

Contact Person: Dr. H. Siegel, herbert.siegel@io-warnemuende.de

IV.1.5 Ecosystem Response to Global Changes

IV.1.5.1 Pollutants of Toxic Substances and Risk Assessment for Aquatic Environment

Defining current levels and effects of heavy metals, chlorinated hydrocarbons (organochlorines) and sewage on Bangka Strait, Eastern Sumatra to assess the impact on aquatic organisms (original project suggestion VII.1.5.1)

German Institution: University of Bremen – Faculty of Marine Chemistry

Indonesian Institution: Sriwijaya University at Palembang – Faculty of Agriculture (Dr. Arinafril)

Contact Person: Prof. Dr. W. Balzer, balzer@mch.uni-bremen.de

IV.1.5.2 Enhanced continental run-off of heavy metals and polycyclic aromatic hydrocarbons (PAH's) originating from changing land-use, biomass burning and increased erosion/weathering

Determination of total discharge rates from selected Indonesian rivers (e.g. North Java) to the coast by measuring the composition of the suspended particles and the dissolved concentrations in the estuary. Analysis of these samples has to be supplemented by measurements or compiling of river run-off data. Biomass burning, which produces carcinogenic PAH's, often accompanies the conversion of tropical rain forest into agricultural land: thus, the large-scale burning of wood with its PAH-emission (e.g. which occurred a few years ago) should be followed by signals of enhanced erosion. Regions, where such events took place recently, will be compared with quasi-pristine areas.

German Institution: University of Bremen –Marine Chemistry

Contact person: Prof. Dr. W. Balzer, balzer@mch.uni-bremen.de

IV.1.5.3 Hydrophobic organic pollutants in estuarine and coastal particulates of densely populated and/or industrialized (e.g. Jakarta Bay) and more agricultural regions of Indonesia.

All megacities of the world, such as Jakarta, act both as diffuse and point sources of organic pollutants to the coastal environment. Before actions or remedies can be elaborated, the most significant sources of pollution have to be identified in terms of the (eco-) toxic potential of the individual compounds, their concentration levels and their fluxes. However, to assess the risk certain local pollutant sources may contaminate a greater region, the fate of the pollutants and their transport by tidal and current action has to be known.

German Institution: University of Bremen –Marine Chemistry

Indonesian Institution: University of Indonesia – Center for Marine Study (Dr. Budiawan)

Contact Person: Prof. Dr. W. Balzer, balzer@mch.uni-bremen.de

IV.1.5.4 Coastal Pollution and Environmental Change: Present Status and Historical Evolution as recorded in Nearshore Sediments and/or Corals

Development of concepts, sampling strategies, and evaluation of sedimentary sinks for environmental pollutants (trace metals, petroleum hydrocarbons, PAH, and possibly organochlorine pesticides), as well as analysis of signals of environmental changes and of history of pollution utilizing corals as records.

German Institution: University of Bremen – Marine Chemistry

Contact Person: Prof. Dr. W. Balzer, balzer@mch.uni-bremen.de

IV.1.5.5 Impact Assessment of Contaminant Releases in Indonesian Coastal Areas

The aim of this project is to assess the impact of contaminant releases in selected Indonesian coastal areas. The project consists of *in-situ* measurements, data analysis and processing, development of numerical models for assessing the environmental impacts (due to organic and inorganic pollutants, sewerage and industrial releases, oil spills etc.), quantification of the cost of losses and the identification of cost effective remedial measures. Among the areas of interest is the Jakarta Bay and adjacent islands.

German Institution: Coastal Research Laboratory (Corelab), Institute of Geosciences, University of Kiel; Institute of World Economics, University of Kiel

Indonesian Institute: Center for Coastal and Marine Resources Studies, Faculty of Fisheries and Marine Sciences, Bogor Agricultural University; Department of Marine Science and Technology, Faculty of Fisheries and Marine Sciences – IPB, Bogor

Contact Person: Dr. R. Mayerle, rmayerle@corelab.uni-kiel.de; Dr. F. Foders; Dr. Indra Jaya; Dr. Trydoyo Kusumastanto; Dr. M. Purba

IV.1.5.6 Comparative Studies on Natural and Man Made Environmental Changes in Coastal Regions of Indonesia

Investigation of natural and anthropogenic environmental changes during pre-historical, historical and modern times emphasizing the affect on biogeochemical cycles and human living conditions.

Methods of this project will include high-resolution pollen and charcoal analysis, biogeochemical analysis (organic carbon, carbonate, nitrogen, amino acids stable isotopes of C and N, etc.), grain size and clay mineral distribution analysis, and radiocarbon dating of sediment cores (original project suggestion VII.1.5.2).

German Institution: ZMT (Center for Tropical Marine Ecology), University of Bremen

Contact Person: Dr. H. Behling, hbehling@zmt.uni-bremen.de

IV.1.5.7 Biogeochemical Fluxes in the Indonesian Seas

Studies of material fluxes using time-series instruments to record in situ physico-chemical and biological conditions to record the ocean's response to ENSO-type events (original project suggestion VII.1.5.3)

German Institution: ZMT (Center for Tropical Marine Ecology)

Indonesian Institution: BPPT (Agency for the Assessment and Application of Technology; Dr. Bambang Herunadi)

Contact Person: Dr. T. Rixen, tim.rixen@zmt.uni-bremen.de

IV.1.5.8 Impact of Land-Based Activities on Coastal Sea - Brams- 01: Brantas River – Madura Strait Biogeochemistry

Characterization of the response of ecosystems in the Brantas River catchment and the Madura Strait to climatic and related environmental change.

Objectives of this project include the synthesis of available information on the biogeochemistry of river inputs and the collection of data on the distribution of biogeochemical parameters in the Madura Strait (original project suggestion VII.1.5.4)

German Institution: ZMT (Center for Tropical Marine Ecology), University of Hamburg

Indonesian Institution: BPPT ((Agency for the Assessment and Application of Technology; Dr. Seno Adi)

Contact Person: Dr. T. Jennerjahn, tim.jennerjahn@zmt.uni-bremen.de

IV.1.6 Paleoceanography and Paleoclimatology

IV.1.6.1 Corals and Sclerosponges as Recorders of Climatic and Oceanographic Variability

Investigation of corals and sclerosponges to contribute to the study of Indonesian throughflow dynamics.

Proxies that will be used for this study include SST proxies, barium-calcium ratios and/or cadmium-calcium ratios (original project suggestion VII.1.6.4)

German Institution: GEOMAR Kiel (Research Center for Marine Geosciences), Hamburg University and Cambridge University (Prof. Dr. C. Betzler), University of Freiburg (P.D. Dr. A. Vecsei)

Indonesian Institution: Hasanuddin University – Radiation Chemistry Laboratory (Prof. Dr. Alfian Noor), LIPI (Institute of Science - Research and Development Centre for Oceanology; Dr. Ir.H. Ono K. Sumadhiharga), University of Jakarta (Dr. Hantoro)

Contact Person: Prof. Dr. W. -C. Dullo, cdullo@geomar.de; Dr. J.J.G. Reijmer, jreijmer@geomar.de; Prof. Dr. A. Eisenhauer, aeisenhauer@geomar.de

IV.1.6.2

Reef Geometries and Carbonate Production in the Makassar Strait

Investigation of the processes determining the development of fossil carbonate platforms in the Makassar Strait.

The installation of sediment traps to determine the correlation between present-day processes of paleo-oceanographic and paleo-climatic proxies, as well as high-resolution particle flux measurements integrated with the analysis of thermohaline structure of water masses and their nutrient contents to register steering processes of present-day sedimentation, will contribute to this project (original project suggestion VII.1.6.3).

German Institution: GEOMAR Kiel (Research Center for Marine Geosciences), Hamburg University and Cambridge University (Prof. Dr. C. Betzler), University of Freiburg (P.D. Dr. A. Vecsei)

Indonesian Institution: Hasanuddin University – Radiation Chemistry Laboratory (Prof. Dr. Alfian Noor), LIPI (Institute of Science - Research and Development Centre for Oceanology; Dr. Ir.H. Ono Kurnaen Sumadhiharga), University of Jakarta (Dr. Hantoro)

Contact Person: Prof. Dr. W. -C. Dullo, cdullo@geomar.de; Dr. J.J.G. Reijmer, jreijmer@geomar.de; Prof. Dr. A. Eisenhauer, aeisenhauer@geomar.de

IV.1.6.3

Reconstruction of Paleoenvironmental Conditions in the Southern Part of the Indonesian Archipelago

High resolution reconstruction of the regional paleoclimate and paleoceanography based on collected sediment cores and investigation of cold seeps along the active continental margin south of Java and Sumatra, reconstruction of shallow water sedimentation and shelf flooding in the Java Sea, and study of ancient coral growth and ecology.

German Institution: University of Bremen – Geosciences, BGR (Federal Institute for Geosciences and natural Resources), ZMT (Center for Tropical Marine Ecology)

Contact Person: Dr. D. Hebbeln, dhebbeln@uni-bremen.de

IV.1.6.4

Paleoceanography and Through-flow through the Indonesian-Australian Gateway over the last 150 000 Years - Biodiversity and Evolution of the Marine Fauna

Contribution to the understanding of the temporal and spatial variability of the West Pacific Warm Pool and the intensity of the East Asian Monsoon.

Investigations will emphasize productivity fluctuations in the eastern Indian Ocean with high stratigraphical resolution and usage of different carbon flux- and paleo-productivity proxies and testing of their significance. Hereby data will be collected on accumulation rates, diversity and species composition of benthic foraminifers, dinoflagellate assemblages, carbon isotopes of planktonic, epi- and endobenthic foraminifers, TOC- and chlorine accumulation rates and biogenic barium (original project suggestion VII.1.6.2).

- German Institution:** GEOMAR Kiel (Research Center for Marine Geosciences), Hamburg University and Cambridge University (Prof. Dr. C. Betzler), University of Freiburg (P.D. Dr. A. Vecsei), IfG Kiel (Institute for Geosciences Kiel; Prof. Dr. W. Kuhnt)
- Indonesian Institution:** Hasanuddin University – Radiation Chemistry Laboratory (Prof. Dr. Alfian Noor), LIPI (Institute of Science - Research and Development Centre for Oceanology; Dr. Ir.H. Ono K. Sumadhiharga), University of Jakarta (Dr. Hantoro)
- Contact Person:** Prof. Dr. W. Kuhnt, wk@gpi.uni-kiel.de; Prof. Dr. W. -C. Dullo, cdullo@geomar.de

IV.1.6.5

Eustatically Controlled Changes in the Indonesian-Australian Gateway during the last Glacial Cycle and Fluctuations in Terrigenous Sediment Flux

Reconstruction of the sea-level fall at the beginning of the last glacial maximum and investigation of the late glacial and post-glacial sea level rise in the Indonesian-Australian gateway.

Research will include parasound profile mapping of the paleo-coastline and high resolution AMS-14C dating of sediment cores (original project suggestion: VII.1.6.1)

- German Institution:** GEOMAR Kiel (Research Center for Marine Geosciences), Hamburg University and Cambridge University (Prof. Dr. C. Betzler), University of Freiburg (P.D. Dr. A. Vecsei), IfG Kiel (Institute for Geosciences Kiel; Prof. Dr. K. Stattegger)
- Indonesian Institution:** Hasanuddin University – Radiation Chemistry Laboratory (Prof. Dr. Alfian Noor), LIPI (Institute of Sciences - Research and Development Centre for Oceanology; Dr. Ir.H. Ono K. Sumadhiharga), University of Jakarta (Dr. Hantoro)
- Contact Person:** Prof. Dr. K. Stattegger, ks@gpi.uni-kiel.de; Prof. Dr. W. -C. Dullo, cdullo@geomar.de

IV.2 INNOVATION AND APPLICATION OF TECHNOLOGY

IV.2.1 Energy Conversion Project

Research on storage of wind energy as hydrogen gas after electrolysis of seawater, as well as production of clean drinking water.

German Institution: FTZ (Research- and Technology Centre Westcoast)

Contact Person: Prof. Dr. F. Colijn, colijn@ftz-west.uni-kiel.de

IV.2.2 Use of Automatic Instrumentation on board Ferries to study Environmental Conditions and Compound Transport through Sunda Strait.

Frequent and regular measurements of phytoplankton biomass, algal group composition, nutrients and chemical compounds to monitor water quality on board ships-of-opportunity (original project suggestion VII.2.1).

German Institution: FTZ (Research- and Technology Centre Westcoast)

Indonesian Institution: LIPI (Institute of Science – Research and Development Centre for Oceanology; Dr. Ir.H. Ono Kurnaen Sumadhiharga)

Contact Person: Prof. Dr. F. Colijn, colijn@fzt-west.uni-kiel.de

IV.2.3 Construction of Research Vessels and Rotor Blades for Wind Energy

The company designs, builds, retrofits and repairs navy and coastguard ships, special ships up to a length of 75m, as well as high-performance yachts. Other products include rotor blades for wind energy.

German Institution: Abeking & Rasmussen

Contact Person: Ms. R. Koch-Painter

IV.2.4 National Data Base of Oceanography and Living Resources

Creation of a national data base in oceanography and living resources of Indonesia.

German Institution: ZMT (Center for Tropical Marine Ecology)

Indonesian Institution: DKP (Indonesian Ministry of Maritime Affairs and Fisheries; Dr. Soesilo)

Contact Person: Dr. A. Kunzmann, andreas.kunzmann@zmt.uni-bremen.de

IV.2.5 Development of information tools and decision support systems for enhancing the management of Indonesian coastal areas and islands.

The integration of numerical models into more general information systems provides an added value to the output of these systems and may be used directly in the decision process. The aim of this project is the development of dedicated models tailored to domains and conditions of interest. *In-situ* training to potential users of the systems are offered.

German Institution: Coastal Research Laboratory (Corelab), Institute of Geosciences, University of Kiel

Contact Person: Prof. Dr. R. Mayerle, rmayerle@corelab.uni-kiel.de

IV.2.6 Indonesian Fishery License Control System

Establishment of secure fishing licenses based on non-copyable processor chip cards using finger printing

German Institution: DERMALOG

Contact Person: Mr. G. Mull, mull@dermalog.de

IV.2.7 Value Adding to Shark Meat

Testing of Indonesian marine resources for possible product development and of European market for selling of products

German Institution: Hussman&Hahn

Contact Person: Mr. J. Nagel

IV.2.8 Marine Consulting

The company is involved in research, planning and development, engineering, implementation and start-up operations, institution building, restructuring and privatization, training and man-power development, as well as management information systems.

German Institution: Rogge Marine Consulting GmbH

Contact Person: Mr. C. Rogge, roggemarine@t-online.de

IV.2.9

Ship Technology

The company develops ship technology and is involved in system and machine building with its specialty in planning, construction and building of high-speed catamarans.

German Institution: S.A.M. GmbH

Contact Person: Mr. W. Schmal, wschmal@aol.com

IV.3 ACCOMPANYING MEASURES

V.3.1

Aquaculture

Establishment of a training program for 2-4 Indonesian technicians and 1 scientist in laboratory methods, handling, maintenance, repair etc. for water quality control and disease treatment, and establishment of small demo plots for the mariculture of high-priced fish species, production of phyto- and zooplankton, hatchery units

German Institution: ZMT (Center for Tropical Marine Ecology)

Indonesian Institution: DKP (Indonesian Ministry of Maritime Affairs and Fisheries), LIPI (Indonesian Institute of Sciences), CRIFI (Central Research Institute for Fisheries), UNSRAT (Universitas Sam Ratulangi – Manado)

Contact Person: Dr. A. Kunzmann, andreas.kunzmann@zmt.uni-bremen.de

IV.3.2

Tropical Mariculture: Pilot Plant for the Production of Marine Ornamentals (Corals, other Reef Invertebrates and Fish)

Establishment of a 3-6 month training program for 2-4 Indonesian technicians at German SMEs, including 1-3 months on site visits of German Universities and SME experts in Indonesia (original project suggestion VII.3.1).

German Institution: ZMT (Center for Tropical Marine Ecology), BfAFi (Federal Research Centre for Fisheries)

Indonesian Institution: DKP (Indonesian Ministry of Maritime Affairs and Fisheries), LIPI (Indonesian Institute of Sciences), CRIFI (Central Research Institute for Fisheries), BPPL (Research Institute for Marine Fisheries), UNHAS (Hasanuddin University – Padang), BHU (University of Padang)

Contact Person: Dr. C. Richter, crichter@uni-bremen.de

IV.3.3 Tropical Mariculture: Pilot Plant for the Production of Grouper, Snapper and Napoleon Wrasse for Consumption

Establishment of a 3-6 month training program for 2-4 Indonesian technicians at German SMEs including 1-3 months on site visits of German Universities and SME experts in Indonesia (original project suggestion VII.3.1).

German Institution: ZMT (Center for Tropical Marine Ecology), SMEs, IfM Kiel (Institute for Marine Science, Kiel)

Indonesian Institution: DKP (Indonesian Ministry of Maritime Affairs and Fisheries), LIPI (Indonesian Institute of Sciences), CRIFI (Central Research Institute for Fisheries), UNSRAT (Universitas Sam Ratulangi – Manado), DAAD/IPB Bogor (Dr. H. Palm)

Contact Person: Dr. C. Richter, crichter@uni-bremen.de

IV.3.4 Young Scientists Joint Research Program

Establishment of research programs in marine sciences for qualified young Indonesian and German Graduates and Postgraduates.
The program will be conducted at German and Indonesian Institutions.

German Institution: Action Plan Coordinator, Germany

IV.3.5 Special Scholarship Programs

Establishment and/or Continuation of research-related special scholarships in marine sciences for talented Indonesian and German Students.

German Institution: Action Plan Coordinator, Germany

IV.3.6 Joint Tropical Ecology Center

Establishment of pilot joint centers to conduct research on coastal systems, foster education and training, facilitate contact with the industry and to sustain long-term cooperation.

Institution: ZMT (Center for Tropical Marine Ecology), Action Plan Coordinators, UNSOED (Jendral Soedirman University)

IV.3.7

Marine Science Education – The Sea and its Resources

Education will involve marine systems and their functioning, tools and infrastructures for sea exploration, coastal ecosystem resources and management, as well as availability and vulnerability of resources.

Lectures will be given by members of German universities and advanced training courses will be offered in Germany.

German Institution: ZMT (Center for Tropical Marine Ecology), Faculty of Biology and Chemistry of the University of Bremen, Indonesian Universities

V. Indonesian Contributions Matching German Projects

RESEARCH AND DEVELOPMENT

Theme 1: Coastal Marine Ecosystems, Living Resources, and Their Management (including Fisheries and Aquaculture)

		Germany	Proposing Institutions	Indonesia	Proposing Institutions
I.1	Development of Ecological Indicators of Ecosystem Health	X	FTZ		
I.2	Causative and Supporting Factors of Eutrophication in Coastal Indonesian Waters	X	Univ. of Kiel, FTZ	X	IPB
I.3	East Indies Triangle: Center of Origin of Biodiversity	X	ZMT		
I.4	Zooplankton - Linking Primary Production to Economically Important Pelagic Fish Stocks	X	Marine Zoology – Univ. of Bremen		
I.5	Molecular of Genetics as a Tool for the Management of Living Marine Resources in Indonesia	X	ZMT		
I.6	Vegetation Pattern and Stress Detection of Mangrove System using Remote Sensing	X	ZMT		
I.7	Fish Stock Assessment	X	ZMT, IOW	X	LIPI, IPB, BPPL, UNHAS, CRIFI, BHU
I.8	Marine Ecosystem Investigations along the Coast of SC Java: Biological, Biochemical and Socio-Economic Changes in the Segara Anakan Coastal Region	X	ZMT, Univ. of Bremen, Univ. of Kiel, Univ. of Hamburg, IOW, Univ. of Oldenburg, Univ. of Duesseldorf, AWI		UNSOED, IPB, UI, UGM, UNDIP, UNHAS, BHU, LIPI
a.	<i>The Nursery System for Segara Anakan Crab</i>				
b.	<i>Research on Reproductive Aspect of Mud Crab in Segara Anakan</i>				
c.	<i>Community Based Coastal Resources Management on Mud Crab Production and Conservation in Segara Anakan</i>				
d.	<i>Biological Fisheries and Aquaculture Aspects of Mud Crab (Sylla Serrata at Segara Anakan, Cilacap)</i>				
e.	<i>The Use of Local Materials Available for Artificial Feeds in Culturing Cud Crab in Segara Anakan, Cilacap</i>				
f.	<i>Silvo-Aquaculture Technology Development in Segara Anakan</i>				

Theme 1 cont.: Coastal Marine Ecosystems, Living Resources, and Their Management (including Fisheries and Aquaculture)

		Germany	Proposing Institutions	Indonesia	Proposing Institutions
g.	<i>Biodiversity and Population Dynamic of Eel in Segara Anakan, Cilacap</i>				
h.	<i>Biological Aspects and Aquacultural Studies of Eel (Anguilla sp) in Segara Anakan Estuarine Waters, Cilacap</i>				
i.	<i>The Ecology of Mangrove Vegetation and Common Asiatic Clam (Geloina ingens) in Segara Anakan, Cilacap</i>				
j.	<i>Fisheries Resources Management based on Community of Segara Anakan, Cilacap</i>				
k.	<i>Study on Dstribution and Maximum Utilization of Shrimp Resources for Conservation of Segara Anaka, Cilacap</i>				
l.	<i>Economic Benefits of Segara Anakan: An Environmental Economics Analysis</i>				
m.	<i>The History and Social Value Characteristics of Kampung Laut Segara Anakan, Cilacap Community</i>				
n.	<i>Implementing of Integrated Coastal Management Model in Small Islands Development in Kepulauan Seribu based on Co-management Approach</i>				
o.	<i>Function and Benefits of Segara Anakan Studies on Environmental and Socio Economics Aspect</i>				
I.9	Mangrove as Ecotones	X	Univ. of Oldenburg		
I.10	Ecosystem of Reef and Seagrass Functioning and Resources Potential, and Human Interventions	X		X	
a	<i>Trophic Transfer in Tropical Seagrass Systems</i>	X	AWI		
b	<i>New Tools and Bioindicators for Assessing and Managing Coral Reef Health</i>	X	ZMT		
c	<i>Physical and Functional Integrity of Coral Reefs</i>	X	ZMT		
d	<i>Coral Bleaching and Zooplankton</i>	X	ZMT		
I.11	Studies on Nutritional and Environmental Aspects of Breeding Several Mollusc and Seashell Species in Indonesia	X	Univ. of Bremen & AWI	X	Univ. Airlangga
I.12	Restocking Program to Increase Shrimp Production and Fishermen Income			X	IPB

Theme 1 cont.: Coastal Marine Ecosystems, Living Resources, and Their Management (including Fisheries and Aquaculture)

		Germany	Proposing Institutions	Indonesia	Proposing Institutions
I.13	Diseases and Parasites of Shrimp and Fin Fish as a Major Obstacle for further Development of Indonesian Mariculture			X	IPB
I.14	Development and Promotion of Fishing Gear and Methods Supporting Sustainability of Capture Fisheries in Coral Reefs and Adjacent Waters			X	IPB
I.15	Exploration of Bacterial Diversity in Indonesian Coral Reefs : Genetic Diversity and Screening of Novel Hydrolytic Enzymes			X	IPB
I.16	Development of Organic Fertilizer using Industrial Fish Waste			X	IPB
I.17	Center for Marine Product Quality Assurance (CMPQA)			X	IPB
I.18	Center for Coastal and Marine Resources Studies			X	IPB
I.19	Three Dimensional Simulation of Seasonal Water Circulation around Indonesian Waters to Predict Upwelling Region and its Relation to Locations of Fishing Ground			X	ITB
I.20	The Strait of Malacca Ecosystem Study			X	UNRI
I.21	Replanting of Mangrove Belt as a Buffer Zone to Enhance the Shrimp Pond Productivity			X	IPB
I.22	Artificial Upwelling to Improve Marine Fish Production through Floating Net Cage and Pond Aquaculture in Declining Coastal Waters			X	LIPi
I.23	Role of Estuarine Hydrodynamics on the Retention and Settlement of Mero planktonic Larvae	X	Univ. of Kiel		
I.24	Spatial and Temporal Patterns in the Structure of Coastal Macrobenthos of Manado Bay, Sulawesi	X	Univ. of Kiel		
I.25	Role of Abiotic and Biotic Factors Affecting Palagic Fish Stock to Develop a Concept for Sustainable Management of Marine Living Resources	X	Univ. of Bremen, IOW, ZMT		

Theme 2: Marine Natural Products and Pharmacology

		Germany	Proposing Institutions	Indonesia	Proposing Institutions
2.1	Marine Microorganism as Newly Emerging Source of Bioactive Metabolites from the Sea Biotechnological Applications	X	Univ. of Duesseldorf	X	BPPT
2.2	Microorganism from Mangrove Swamps as a New Source for Drugs Discovery	X	Univ. of Duesseldorf	X	
2.3	Ecology of Coral Reefs around Karimunjaya Islands. Indonesia: Microbial Biodiversity and Bioactive Compounds	X	AWI, Univ. Bremen, Univ. Duesseldorf, Univ. Bremerhaven	X	UNDIP, UGM, UNSRAT
2.4	Drugs and Bioactive Substances from Marine Ecosystems (Coral Reefs, Sponges, Seagrasses and Mangrove)				
a.	<i>Bioactive Compounds from Marine Macro-Organisms as New Pharmacological Lead Structures and Molecular Probes</i>	X	Univ. of Duesseldorf	X	BPPT
b.	<i>Chemical Warfare in Tropical Marine Ecosystems (Coral Reefs and Mangrove Areas)</i>	X	Univ. of Duesseldorf		
c.	<i>Genetic Engineering and Drugs from the Sea: Using Molecular Biology for Recombinant Expression of Bioactive Marine Metabolites and Combinational Biochemistry</i>	X	Univ. of Duesseldorf		
d.	<i>Mariculture of Marine Intervertebrates and Algae as a New Approach in Large Scale Supply of Selected Marine Metabolites</i>	X	Univ. of Duesseldorf		
e.	<i>Anti-infective and Cytotoxic Effect of Several Sponges from Menjangan Island, Bali</i>	X	Univ. of Duesseldorf	X	UGM
f.	<i>Mariculture of Vertebrates and Invertebrates</i>	X	Univ. of Duesseldorf	X	IPB
g.	<i>Investigation of Biologically and Pharmacologically Active Marine Natural Products for Pharmaceuticals in Indonesia</i>	X	Univ. of Duesseldorf	X	UI
h.	<i>Pharmaceutical and Chemical Studies of Bioactive Natural Products from Marine Invertebrates in Sumatra</i>	X	Univ. of Duesseldorf	X	Univ. Andalas
i.	<i>Refinement of Raw Materials of Marine Origin for the Use in Cosmetics: Substances from Sea Weed</i>	X	Univ. of Duesseldorf, Univ. of Bremen, Univ. of Tübingen, Univ. of Münster	X	Martina Berto, ITB, UGM

Theme 3: Hydrocarbon and Mineral Potential and Geohazards

		Germany	Proposing Institutions	Indonesia	Proposing Institutions
3.1	Research Cruise Baruna Jaya : Bandamin	X	Univ of Berlin, ZMT	X	DKP, BPPT
3.1	Research Cruise Baruna Jaya : Sunda Arc, Celebes Sea and Java Sea	X	BGR	X	BPPT
3.3	Research Cruise Baruna Jaya : Sunda Arc - Submersible Dives	X	BGR	X	BPPT
3.4	Sulawesi Sea (follow up of GIGICS project)	X	BGR	X	BPPT
3.5	Volcanic Eruption and Sea Level Changes near Krakatau and Toba	X	BGR	X	BPPT
3.6	Tomography of Krakatau	X	BGR	X	BPPT
3.7	Sunda Arc (follow up of GINCO Project)	X	BGR	X	BPPT
	Bathymetric Mapping Sunda Strait / Indonesian EEZ	X	GEOMAR Kiel	X	BPPT
	Marine Biogenic Gas Exploration as the New Energy Resources Discovery in Madura Strait, East Java			X	MGI
	Coastal and Marine Geosience Study for Coastal Zone Management Approach			X	MGI
	Preliminary Study of Gold Resources in Western Sumatra Coastal Waters			X	MGI

Theme 4 : Physical Dynamics in Indonesian Seas and Coastal Areas

		Germany	Proposing Institutions	Indonesia	Proposing Institutions
4.1	Lombok Strait Thermal Plumes and Waves / Study of the Dynamics of the Lombok Strait by Remote Sensing, Numerical Modeling, and In-Situ Observation	X	IfM Hamburg	X	BPPT, IPB
4.2	Circulation and Transport in the Malacca Strait and Andaman Sea / Study of Water Mass Exchange in Malacca Strait and Andaman Sea using 3-D Hydrodynamics Model	X	IfM Hamburg, BPPT, Unsyiah	X	ITB
4.3	Hydrodynamics, Sediment Dynamics and Coastal Erosion in Indonesian Coastal Areas	X	Univ. of Kiel, CRM	X	MGI, IPB
4.4	Eastern Indian Ocean Boundary Circulation and Climate Variability / Variability of Eastern Indian Ocean Water Masses, Boundary Circulation in relation to Climate and its Impact on Resource Variability	X	IfM Kiel	X	BPPT
4.5	Remote Sensing Application	X	IOW		
4.6	Evaluation and validation of satellite derived data by optical investigation to support fish stock assessment / Remote Sensing Application to Support Marine Environment Monitoring	X	IOW	X	BPPT

Theme 5 : Ecosystem Response to Global Changes

		Germany	Proposing Institutions	Indonesia	Proposing Institutions
5.1	Pollutants of Toxic Substances and Risk Assessment for Aquatic Environment	X	Univ. of Bremen	X	UnSri - Palembang
5.2	Enhanced Continental Run-Off of Heavy Metals and Polycyclic Aromatic Hydrocarbons (PAH's) Originating from Changing Land-Use, Biomass Burning and Increased Erosion / Weathering	X	Univ. of Bremen		
5.3	Hydrophobic Organic Pollutants in Estuarine and Coastal Particulates of Densely Populated and / or Industrialized (e.g. Jakarta Bay) and more Agricultural Regions of Indonesia	X	Univ. of Bremen	X	UI
5.4	Coastal Pollution and Environmental Change : Present Status and Historical Evolution as Recorded in Nearshore Sediment and / or Corals	X	ZMT		
5.5	Impact Assessment of Contaminant Releases in Indonesian Coastal Areas	X	Univ. of Kiel	X	IPB
5.6	Comparative Studies on Natural and Man Made Environmental Changes in Coastal Regions of Indonesia	X	ZMT		
5.7	Biogeochemical Provinces and Fluxes in Indonesian Seas	X	ZMT, Univ. of Hamburg	X	BPPT
5.8	Impact of Land-Based Activities on Coastal Sea Brams 01: Brantas River – Madura Strait Biogeochemistry	X	ZMT, Univ. of Hamburg,	X	ITS, UI, UNDIP
	Impact of the Closure of Indonesian Seaways to Global Change, Climatic Change and Marine and Terrestrial Biodiversity			X	LIPI

Theme 6 : Paleoceanography

		Germany	Proposing Institutions	Indonesia	Proposing Institutions
6.1	Corals and Sclerosponges as Recorders of Climatic and Oceanographic Variability	X		X	UNHAS, LIPI, UniJa
6.2	Reef Geometries and Carbonate Production in the Makassar Strait	X	GEOMAR		UNHAS, LIPI, UniJa
6.3	Reconstruction of Paleoenvironmental Conditions in the Southern Part of the Indonesian Archipelago	X	Univ. of Bremen		
6.4	Paleoceanography and Through-flow of the Indonesian- Australian Gateway over the last 150.000 years – Biodiversity and Evolution of the marine Fauna	X	GEOMAR		UNHAS, LIPI, UniJa
6.5	Eustatically Controlled Changes in the Indonesian-Australian Gateway during the last Glacial Cycle and Fluctuations in Terrigenous Sediment Flux	X	GEOMAR		UNHAS, LIPI, UniJa
	Artificial Reefs in Indonesia	X	ZMT	X	BPPT

INNOVATION AND APPLICATION OF TECHNOLOGY

		Germany	Proposing Institutions	Indonesia	Proposing Institutions
1	Energy Conversion Project	X	FTZ		
2	Use of Automatic Instrumentation On-Board Ferries to Study Environmental Conditions and Compound Transport through Sunda Strait	X	FTZ	X	LIPI
3	Construction of Research Vessels and Rotor Blades for Wind Energy	X	Abeking and Rasmussen		
4	National Data Base of Oceanography and Living Resources	X	ZMT	X	DKP
5	Development of Information Tools and Decision Support Systems for Enhancing the Management of Indonesian Coastal Areas and Islands	X	Univ. of Kiel		
6	Indonesian Fishery License Control System	X	Dermalog		
7	Value Adding to Shark Meat	X	Hussmann & Hahn		
8	Marine Consulting	X	Rogge Marine Consulting GmbH		
9	Ship Technology	X	SAM GmbH		
7	Development of Automatic Measuring Systems On- Board Ships of Opportunity	X	FTZ		
9	Study on Efficient Small Scale Ship-Yard to Repair Wooden Boats			X	UNHAS

ACCOMPANYING MEASURES

		Germany	Proposing Institutions	Indonesia	Proposing Institutions
1	Aquaculture	X	German Industries and ZMT		
2	Tropical Mariculture: Pilot Plant for the Production of Grouper, Snapper, and Napoleon Wrasse for Consumption	X	SMEs, Univ. of Kiel, ZMT		
3	Tropical Mariculture : Pilot Plant for the Production of Marine Ornamentals	X	SMEs and ZMT		
4	Young Scientist Joint Research Program	X	ZMT	X	DKP, KMNRT
5	Special Scholarship Program	X	ZMT	X	DKP, KMNRT
6	Joint Tropical Ecology Center	X	ZMT	X	DKP, KMNRT
7	Marine Science Education: The Sea and its Resources	X	ZMT, Univ. of Bremen	X	DKP, KMNRT

V. Recommendations

It was generally agreed that activities within the bilateral cooperation in marine sciences and geosciences should include measures that would facilitate training, education and capacity building, as well as the participation of the major players of the maritime sector.

Accordingly, three groups of activities were suggested:

- Research and Development in Marine Sciences and Geosciences
- Innovation and Application of Marine and Geotechnology
- Accompanying Measures

Under the first category: “**Research and Development in Marine Sciences and Geosciences**” following project themes for possible cooperation were identified:

Coastal marine ecosystems, living resources (including fisheries and aquaculture), and their management:

- Investigations to improve our understanding of tropical coastal marine ecosystems such as mangrove forests, coral reefs, seagrass meadows and their interactions
- Estimating their resource potential and their vulnerability to natural and anthropogenic interventions and changes
- Indicators of ecosystem health, use of biodiversity as management tools
- Linking social and economic changes and ecosystem vulnerability
- Identification and investigation of commercially important fish stocks and management strategies
- Aqua- and mariculture

Regions suggested:

Segara Anakan, South Java, Jakarta Bay, Makassar, Sumatra

Marine natural products and pharmacology:

- Microbial biodiversity in mangroves, coral reefs and seagrass ecosystems
- Prospecting for new bioactive compounds, bacteria and fungi associated with coral reefs, mangroves and seagrass ecosystems for the use in pharmacology and cosmetics
- Suitability of microorganisms for mariculture and their impact on ecosystems

Regions suggested:

Segara Anakan (Central Java), Karimunjawa Islands (Java Sea), Seribu Islands

Hydrocarbon and mineral potential and geohazards:

- Hydrocarbon potential of the forearc basin
- Hydrothermal deposits
- Identification of geohazard potential
- Bathymetric mapping, seismic profiling and coring

Regions suggested:

Banda Sea, Sunda Arc, Sunda Strait, Celebes Sea, Java Sea, Sulawesi Sea, Toba, Krakatau

Physical dynamics in Indonesian Seas and coastal areas:

- Hydrodynamics, sediment dynamics and erosion mechanisms to investigate coastal evolution and to create simulation models
- Water mass characterization (using bio-optical methods) and changes due to river input
- Circulation structure and variance spectrum (e.g. thermal plumes, internal solitary waves)
- Ocean circulation and climate variability

Regions suggested:

Lombok Strait, Malacca Strait, Andaman Sea, Jakarta Bay, Seribu Islands, upwelling off, South Sumatra and S. Java

Ecosystem responses to global changes:

- Pollutant distribution, transport pathways, dispersal and deposition
- links to anthropogenic changes
- Large-scale land-based alterations and ecosystem response
- Biotic response to pollution, changes in material fluxes in coastal and offshore area
- Construction of ecological and sedimentological models

Regions suggested:

Bangka Strait, Eastern Sumatra, Jakarta Bay, Brantas River, Madura Strait

Paleoceanography and Paleoclimatology:

- Use of proxies and paleorecords to construct past ocean circulation, depositional events, monsoon and sea level change in Indonesian Seas

Regions suggested:

Makassar Strait, South Java, South Sumatra, Indonesian-Australian Gateway,

Under **“Innovation and Application of Marine Technology”** are projects for cooperation involving the Private Sector. They include:

- Development and deployment of automated monitoring systems at land-based stations, on board regular research vessels and on ships of opportunity (ferry boats),
- Development of expertise and installations for quality control in fisheries and aquaculture,
- Design and development of ships and ship technology,
- Installation of fisheries control system
- Establishment of a National Oceanographic and Fisheries Data Base

“Accompanying Measures” include programs for human resource development in the marine sector.

- Development of joint marine science curricula
- Special scholarship programs for Indonesian and German students
- Establishment of joint research centers for the advancement of marine research and education
- Young scientists joint research programs.
- Training on board research vessels and aquaculture installations.
- Organization of bilateral workshops, seminars and summer schools

In general, a step by step development and intensification of the cooperation is recommended. In many cases, a preparatory phase for project development seems appropriate.

Appendix

VII. Submitted German Project Suggestions (extended version)

VII.1 RESEARCH AND DEVELOPMENT IN MARINE SCIENCES AND GEOSCIENCES

VII.1.1 Coastal Marine Ecosystems, Living Resources (including Fisheries and Aquaculture) and their Management

VII.1.1.1

Material Fluxes and Trophic Transfer in Tropical and Temperate Seagrass Systems- a Latitudinal Comparison

Dr. Ragnhild Asmus and Dr. Harald Asmus
Alfred-Wegener-Institute (AWI), Wadden Sea Station Sylt

Introduction

Importance of Seagrass Beds in the Ecosystem

Seagrass beds are important coastal communities which exist all over the world except for the arctic and antarctic region. In general they show a net accumulation of carbon and nitrogen and thereby increase nutrient dynamics of the environment. As a consequence seagrass systems are characterised by a high productivity as well as species diversity of associated organisms. Among coastal communities seagrass beds play a dominant role as a nursery for young fishes and crabs, particularly of economically important species and are the feeding grounds for specialised macro-grazers like some fish, green turtles, geese and ducks, dugongs and manatees. Also for young stages of reef fishes seagrass beds are alternative feeding grounds. Additionally, intertidal seagrass beds play an important role as roosts for migratory birds. Animal migrations from seagrass beds to adjacent reefs are special mechanisms of material and energy transport between these communities. A further characteristic of these beds is their outstanding role in processing material fluxes and energy flow within coastal communities of most biogeographical regions of the world. Additionally, there is strong evidence that seagrass beds are significant for sediment stability and retention of particles since the canopy of leaves diminishes currents and wave energy. In fringing reef systems, seagrasses may buffer siltation which may be harmful to coral reefs. Combining all these ecosystem services, it is evident that seagrass beds play a key role within coastal regions world-wide.

Seagrass Beds and Human Environment

Since seagrasses are strongly dependent on shallow coastal waters, human impact has led to the loss of these communities in many areas, deteriorating the ecosystem services for the ambient coastal zone. Seagrass beds are sensitive indicators for environmental changes. Therefore they are especially threatened by impacts altering material cycling and biogeochemical properties in this community. Changes of land use, e.g. deforestation in the tropics, has increased particle input to the coastal zone by river runoff affecting the growth of seagrasses by decreasing light conditions, siltation and burial. Eutrophication has also impaired conditions for seagrass growth since an increase in water column nutrients promotes phytoplankton, epiphytes and macroalgae. Above a certain threshold, ammonium and nitrate will have a toxic effect on seagrasses.

State of the Art of Comparative Research on Material Cycling in Seagrass Beds

The appearance of seagrass communities in most parts of the world makes them an ideal object for comparing relevant ecological processes at a latitudinal or global scale. Especially the comparison of particular processes of material cycling between seagrass systems in different climatic zones may help to carefully predict the consequences of climate change to this community and the ambient coastal zone. Additionally, it may show differences in the relative importance of certain processes between these systems.

Nutrient and particle fluxes in seagrass beds are well studied, especially on the level of the different seagrass species from the temperate zone to the tropics. Further investigations are necessary to understand the often complex interactions between a changing environment and the seagrass system considering material fluxes and trophic transfer on the ecosystem level, including the associated animal community as well as higher trophic levels. A major gap in our knowledge concerns the development of carbon and nutrient pools in oligotrophic tropical seagrass meadows. Regarding the seasonally more stable climate and the low nutrient and particle levels in the water column, we expect fundamental differences in the elemental dynamics between tropical and temperate meadows (e.g. nitrogen fixation by bacteria and blue-green algae). Key ecosystem functions (e.g. nutrient exchange) are dependent on the number of species present in the community. It should therefore be considered whether the efficiency of material cycling is higher in a system of low (temperate seagrass bed) compared to high biodiversity (tropical seagrass bed).

Objectives:

A project comparing material fluxes and trophic transfer of temperate and tropical seagrass beds will focus upon the following topics:

A comparison of sink and source functions for particulate matter and nutrients between several types of temperate and tropical seagrass beds is necessary to understand differences between the systems. This implies the comparison of allochthonous versus autochthonous material input. Seagrass beds in temperate regions are part of detritus driven ecosystems, while in tropical seagrass beds detritus import is often low, but material turnover seems to be high and most material is stored in living biomass. Autochthonous detritus production should be therefore more important in the latter system. Additionally to the understanding of these basic processes, the investigation of particle flow may help us to predict the role of increased particle loads from human activity (e.g. deforestation, altered land use) for the material and energy flow of coastal systems.

A comparison of remineralisation, nutrient turnover and regeneration between tropical and temperate seagrass beds should further reveal whether these processes are more effective when driven by a high diversity compared to a low diversity guild (bacteria, micro- and macrofauna, fishes).

The role of grazing (macro-grazers and micro-grazers) for nutrient fluxes and pools in temperate and tropical seagrass beds should be investigated. Grazers remove nutrients fixed in plants (epiphytes, algae and seagrass leaves) from the leaf zone and partially transport these nutrients by excretion and defecation to the sediment. The relative importance of this process in different seagrass beds should be compared and the relevance of this process for enlarging the nutrient pool in the sediment should be proven.

Advanced Aspects of the Project:

Human impact has caused a severe decline of seagrass beds all over the world, especially in temperate regions. Increasing development of agriculture, industry and tourism may lead to the same negative trend in tropical regions where this is already visible at a local scale. A possible loss of tropical seagrass beds may be followed by heavy draw backs in coastal fisheries (prawns, molluscs, fish and turtles). Also biodiversity will be reduced drastically in seagrass beds and in adjacent coral reefs or mangrove areas because of the lack of essential nursery areas for the fishes and crustaceans of these systems. The actual economic value of nutrient cycling of seagrass beds is estimated to rank second among a variety of ecosystems. On a global scale seagrass beds together with macroalgal beds are an important carbon sink. Most of the biomass produced by seagrasses ends up as refractory detritus. As a result, the quantity of seagrass carbon available to be stored in the sediments is estimated to be large, representing 12% of the carbon storage in the ocean.

Aim of the project

It is the aim of the project to compare relevant pathways of material flows within different types of seagrass beds in the temperate and the tropic zone. This will contribute to the understanding of the principal function of these communities and will evaluate the role of different material inputs to the elemental cycling. It will be tested whether system biodiversity will have an influence on the efficiency of material cycling as well as on the trophic transfer.

Expertise, Co-operation and Logistics

To answer these questions a joint seagrass research group will be established consisting of scientists from the Centre for Marine Tropical Ecology in Bremen and the Alfred-Wegener-Institut for Polar and Marine Research, Wadden Sea Station Sylt. This group has expertise in the ecology of seagrass communities and their role in material fluxes in the temperate and tropical zones.

The tasks of this project will be conducted in joint co-operation with scientific partners in Europe and in Tropical countries. A vivid exchange of experience and knowledge is necessary and the logistics for such an exchange is available at the ZMT as well as at the Wadden Sea Station, Sylt (-where rooms for seminars, research vessels and field sites for joint experiments are available).

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Zooplankton – Linking Primary Production to Economically Important Pelagic Fish Stocks

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Abstract

The proposed JIGSE and JIGMER projects will focus on marine ecosystems and associated fisheries resources in Indonesian seas. A central issue will be the role of abiotic and biotic factors affecting pelagic fish stocks in order to develop a concept for a sustainable management of marine living resources (Kunzmann 2000). Since the majority of economically important pelagic fish species, such as anchovies and mackerels, are planktivorous, herbivorous zooplankton represents an important link between primary production and pelagic fish stocks. On the other hand, carnivorous zooplankton organisms, such as chaetognaths and predatory copepods, may prey on fish larvae and therefore negatively influence the recruitment success of commercially important fishes (Bailey & Yen 1983, Yen 1987). Thus, zooplankton abundance and composition may strongly affect recruitment processes and fisheries' yield.

During the JIGSE/JIGMER project estimates of potential primary production will be supplemented by measurements of grazing pressure and carbon transfer to zooplankton in order to assess the potential yield of pelagic fish stocks (Kunzmann 2000). Whereas the intended "fisheries resources evaluation" will investigate commercially important species in relation to dynamic aspects of oceanography, the proposed zooplankton studies will provide information on biotic factors determining pelagic fish abundance.

Pelagic fisheries play an essential role both for Indonesia's national economy and as an important source of protein for the human population mainly living in the coastal region (Brandt & Lohmeyer 1995). Marine fish production in Indonesian seas is enhanced by local upwelling processes around the islands as well as by additional nutrients supplied by the extensive river run-off into the shallow semi-enclosed shelf areas of the Java, Flores, Banda, and Arafura Seas (Maack 1996). Due to the lack of trawlable fishing grounds along the western coast of Sumatra (narrow shelf, deep trench between Sumatra and the island chain 100 km off the coast, steep continental slope towards the Indian Ocean), pelagic fisheries play an even greater role along the western seaboard of Indonesia (Bailey et al. 1987).

According to annual landings the most important genera of pelagic fish in Indonesian waters are anchovies *Stolephorus* spp. (96,147 t) and Indo-Pacific mackerels *Rastrelliger* spp. (84,485 t), together contributing more than 26% to the total pelagic catches (Bailey et al. 1987, Rohdenburg 1995). Among the larger piscivorous pelagic fishes Eastern little tunas *Euthynnus* spp. (66,582 t) and Skipjack tunas *Katsuwonus pelamis* (42,834 t) were caught most often. In waters off western Sumatra *Rastrelliger* spp., *Stolephorus* spp. and *Euthynnus* spp. accounted for 19.3%, 15.8% and 14.3%, respectively, of the pelagic landings; thus comprising nearly half of the total pelagic catches. *Katsuwonus pelamis* followed contributing 8.5% to the pelagic landings (Bailey et al. 1987). Studies on by-catches of the anchovies' fishery off Padang (western Sumatra) revealed that the small planktivorous tuna species *Auxis thazard* was also a common component of the pelagic fish community in coastal areas (Ortmann 1995).

To the best of our knowledge, investigations on zooplankton composition in Indonesian waters have been mainly restricted to the Banda and Arafura Seas east of Sumatra. Arinardi (1991) identified the calanoid copepods *Calanoides philippinensis*, *Rhincalanus nasutus*, *Eucalanus dentatus*, *E. mucronatus*, *Candacia phachydactyla*, *Euchaeta marina*, *Scolecithrix danae*, and *Pleuromamma abdominalis* as dominant zooplankton components and studied their vertical distribution. Other studies on the occurrence and vertical distribution of different zooplankton taxa in the Banda Sea focused on diel and seasonal vertical migrations as well as on monsoon-driven up- and downwelling phenomena (Baars et al. 1990, Schalk et al. 1990). Almost nothing is known about zooplankton composition and the life-cycles of dominant species in other parts of the Indonesian archipelago.

In spite of the great commercial interest in pelagic fish species, data on their diet composition and main prey items are scarce. In order to evaluate the effects of biotic factors, such as food supply and predation, on planktivorous pelagic fish stocks and to develop strategies for the sustainable management of marine living resources, sound knowledge about the roles of important prey and predatory species, factors determining their regional and vertical distribution and about their life-cycles is essential. The proposed project will address these issues. It is planned to identify those zooplankton species that play key roles in the energy and carbon transfer from primary production to pelagic fish stocks; thus tracing major trophic pathways within the pelagic ecosystem.

Aims of the Project:

The aims of this project are to identify dominant zooplankton species in terms of abundance, biomass and as important prey items for pelagic fish; assess their regional and vertical distribution, especially with respect to the determining biotic and abiotic factors; study their life-cycles and seasonal succession (during JIGMER) in order to characterise potential biotic factors influencing the recruitment of pelagic fish stocks; identify areas with high zooplankton abundance or production and assess the relevant plankton enrichment mechanisms (e.g. monsoon-driven upwelling, topographic effects) together with ZMT. These data may help to identify important feeding grounds for pelagic fish that should be included in fisheries' management concepts.

Planned Investigations:

Zooplankton sampling by closing net hauls along transects off western Sumatra and southern Java. On the narrow and shallow shelf zooplankton will be collected by Nansen net hauls, whereas a Multinet will be applied in deeper areas off the Indian Ocean. The net samples will be analysed with regard to total zooplankton biomass and used to identify dominant zooplankton species.

Individuals of the dominant taxa will be collected for gut content and biochemical analyses in order to assess their diet composition and trophic level.

Specimens of the important pelagic fish genera *Stolephorus*, *Rastrelliger*, *Auxis*, and *Euthynnus* will be sampled for stomach and gut content studies, as well as for biochemical analyses (trophic biomarkers: fatty acids, stable isotopes). Fish samples may be collected either by hauls from the research vessel or may be provided by local fishermen on the western coast of Sumatra.

In addition, specimens of some copepod species, e.g. *Rhincalanus nasutus*, *Pleuromamma abdominalis*, *Euchaeta marina*, etc.) will be collected for molecular genetic studies. The material will supplement investigations focusing on population genetics and gene flow of these species in the western Indian Ocean (Red Sea, Arabian Sea).

Co-operation

We are strongly interested to establish co-operations with different Indonesian partners, especially with scientists from BPPT (Nani Hendiarti) and LIPI working on remote sensing of primary production and fish stock assessment, respectively.

The proposed zooplankton research will need supplementary data on primary production in order to evaluate energy and carbon fluxes through the food web. Similarly, remote sensing depends on field data of chlorophyll a concentration and/or primary production for ground-truthing. Besides the common interests for supplementary abiotic and biotic data, remote sensing offers the opportunity to integrate point measurements conducted during the expedition into wider temporal and spatial scales. This is especially important in areas characterised by highly variable environmental factors such as upwelling, eddies, and advection processes.

The proposed studies focus on zooplankton as the little understood link between primary production and pelagic fish stocks. Therefore, a co-operation with Indonesian institutes performing fish stock assessments would be very advantageous. Zooplankton studies would provide data on biotic factors affecting pelagic fish stocks, i.e. prey abundance, recruitment processes and the predation on fish eggs and larvae. On the other hand, our research could

benefit from the fish stock assessment by estimating predation rates and by providing specimens for gut content and biochemical analyses, thus facilitating the identification of important zooplankton species in the food web. Thus, the proposed zooplankton research might foster the development of sustainable management strategies for marine living resources in Indonesian seas.

Leading Institutes:

UniHB - Identification of key zooplankton species & tracing of important trophic pathways from phytoplankton via zooplankton to important pelagic fish stocks;

ZMT – Zooplankton enrichment and depletion processes & exchange via Sunda Strait;

AWI – Zooplankton composition.

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VII.1.1.3

Molecular Genetics as a Tool for the Management of Living Marine Resources in Indonesia

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Living marine resources in Indonesia are under a high utilisation pressure, because millions of fishermen and their families depend on them for their livelihood. Therefore conservation, management and sustainable use of these resources are very important for the future of Indonesia. The establishment of marine reserves and fishery management are valuable tools for this task.

Sustainable use of fishery resources needs a stable recruitment to the exploited stock. It is proposed that marine reserves have a function as a source of larvae and recruits for the re-colonisation of adjacent, exploited habitats. Therefore marine reserves have a key role in the maintenance of a stable spawning population. Marine reserves themselves also need recruits from other areas to keep this stable spawning stock. A network of protected areas is very important to ensure a constant supply of larvae and recruits to exploited as well as protected areas. Otherwise the source population in the marine reserve could become extinct in the course of time.

Coastal ecosystems such as coral reefs, seagrass meadows and mangroves are patchy, fragmented habitats on a regional scale. Human disturbance leads to partial destruction and further fragmentation of these coastal habitats. The planktonic larval phase of marine organisms enables them to cope with this patchiness, but they need undisturbed areas as “stepping stones” for a re-colonisation of damaged habitats. Habitat connections are important to enable dispersal and re-colonisation. Marine reserves as a source of larvae and recruits can be regarded as habitat connections for disturbed coastal habitats such as coral reefs, seagrass meadows and mangroves. Therefore knowledge about larval dispersal and gene flow is very valuable for effective planning of protected areas and their spatial distribution.

Stock identification is an important task for fisheries management. A proper management is only possible with knowledge about the structure of the exploited stock.

New molecular biological techniques can provide the tools for studying population genetics in marine organisms and can answer questions of larval dispersal and fish stock identification. Beside the applied scientific aims, capacity building and transfer of knowledge in molecular genetics is an important part of this project.

Research Objectives

- Marine reserves
- Gene flow and larval dispersal of coral reef organisms (fish and invertebrates such as corals - and crustaceans)
- Investigations on the connectivity of coastal habitats (coral reefs, seagrass meadows and mangroves)
- Fishery management
- Identification of commercially important fish stocks
- Gene flow and larval dispersal between fish stocks

Expected Results

- Information on larval dispersal of coral reef organisms for the planning of marine reserves and their spatial distribution
- Information about the connectivity of coastal habitats, such as coral reefs, seagrass meadows and mangroves
- Information on the structure of exploited fish stocks in Indonesia
- >> Valuable information for fisheries and marine reserve management

Sampling Methods

Catch of commercial fish species and/or collection from fishermen

Collection of coral reef organisms by SCUBA diving and/or collection from fishermen

Molecular Biology Methods

- Analysis of molecular markers ("fingerprinting")
- PCR-RFLP (Polymerase Chain Reaction-Restriction Fragment Length Polymorphism) or sequencing (mitochondrial DNA and nuclear genes)
- microsatellites

Potential Partners

- Institute for Biotechnology and Molecular Genetics, University of Bremen (Prof. Blohm and Dr. Söller)

No Indonesian partner for the moment, but open for co-operation

VII.1.1.4

Vegetation Patterns and Stress Detection of Mangrove Systems using Remote Sensing (Colour Line Scanner and Infrared Line Scanner)

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Background:

In the light of global climate change, an array of modifications within the natural environment will take place. One crucial question is how different ecosystems will respond to alterations in global oceanographic wave climates, temperature variations, stronger variations in rain and dry seasons, and more. This global climate change will cause a large set of secondary effects such as different sedimentation and erosion patterns along the coasts of the world. To forecast and quantify the effect and extend of climatic impact on coastal resources is of major importance to sustainable resources management.

Mangrove ecosystems are affected by a wide range of natural and anthropogenic stress factors. However, little is known about the impact on and reaction strategies of mangroves to stress input within their natural system (e.g. water deficiency, excessive sedimentation, etc.) In conjunction with global change issues, the capability of mangroves to resist a certain amount of natural induced changes is of major interest. Questions include: Up to which degree mangroves are capable of balancing out certain natural modified environmental conditions, such as higher water levels over a longer period of time, response to the increase in water temperature? What strategies are deployed to resist changes over longer time frames? How high is the sediment deposition capacity of mangroves? Do they differ between species?

In order to predict future scenarios and possible changes of these coastal ecosystems qualitative and quantitative analyses must be carried out.

As tool to illuminate these questions, remote-sensing application can be implemented. Besides traditional satellite imagery, detailed aerial surveys from selected target sites can produce more quantitative information on the scope of natural impact over time. New technology, such as the colour line scanner and the infrared line scanner, both instruments developed at the AWI, provide useful tools to address e.g. water stress behaviour of mangroves on a larger scale. In addition, by repeating aerial surveys over time, changes in land use or sediment and erosion patterns can be detected.

Project 1:

Vegetational patterns of the coastal area (Mangroves):

- Species and Degree of Activity

Equipment:

- Colour Line Scanner as a NDVI (Normalised Difference Vegetation Index) Sensor
- aeroplane and pilot for aerial survey
- GIS

Time Period:

- possibly dry season
- 1 week aerial survey
- 1 week data processing

Project 2:

Vegetational patterns and water stress rates of mangroves of the study site:

- Species, Degree of Activity and Water Stress Rates of Mangroves

Equipment:

- Colour Line Scanner as a NDVI (Normalised Difference Vegetation Index) Sensor
- Infrared Line Scanner
- Aeroplane with a 50x50 cm gap in the floor
- GIS

Time Period:

- 1 week survey (possibly also several times during a tidal cycle)
- 2 weeks data processing

Possible German Partners:

ZMT, AWI (Dr. Axel Bochert – inventor of above mentioned scanners; Prof. Gunther Krause – external consultant), IOW

Further possible external partners:

Prof. Ernesto Medina

Marine Ecosystem Investigations: Biological, Biogeochemical and Socio-Economic Changes in the Segara Anakan Coastal Region

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Introduction

Continental margins are highly important areas for ecological as well as for economic reasons. Particularly in the tropics, the coastal zone harbors a diversity of fragile ecosystems as well as the majority of the population, which mainly depends on resources of the coastal region. Coral reefs, seagrass meadows and mangroves are abundant fragile ecosystems along tropical coasts, which are major repositories of genetic and biological diversity as well as of high economic value. As such they are highly sensitive to human activities which provide short-term income to the population, but on the long-term have deleterious effects on both their economic and ecological functions. Human activities endangering these fragile ecosystems are of particular importance in Asia where a major part of the world population lives, i.e. 3.6 billion people, two thirds of the 45000 dams worldwide are operated here, 85 % of the water consumed annually is used for irrigation, and 22 % and 47 % of the annual water respectively sediment input occurs into the ocean (Milliman & Meade, 1983; Milliman et al., 1995; World Resources Report 1998-99, 1998; The World Commission on Dams, 2000).

Indonesia, with about 225 million people among the countries with the largest population in Asia and the world, has experienced severe changes in land use in the past decades. Its cropland area, for instance, increased by 20 % to 31×10^6 ha since 1984 (World Resources Report 1998-99, 1998). The Javanese Cimanuk River discharging into the Java Sea, for instance, has undergone major changes in the past century. Human activities like meander cutting, deforestation and land clearing in conjunction with the usually high precipitation in tropical countries led to a sediment yield of the river of $6,350 \text{ t km}^{-2} \text{ yr}^{-1}$ which is among the highest reported worldwide (Ludwig et al., 1998). The river is now heavily degraded and serves mainly as a drain for eroded soil and human waste (Wolanski & Spagnol, 2000). As a consequence, unsustainable land-use practices can lead to environmental degradation of coral reefs, seagrass meadows and mangroves.

Segara Anakan, a mangrove surrounded lagoon at the south coast of central Java, deviates partly from this general trend. Here, changes in land-use lead to aggradation and the mangrove area increases by approximately 500% from 1900 until 1980 (White et al., 1989). On the other hand, older mangroves have been replaced e.g. by rice fields so that the total area of the lagoon shrank by about 41%, with the most dramatic decrease in the late 70s. Human activities in the past century have thus, strongly altered the distribution of its subsystems and its biological, biogeochemical and geological functions which in turn had consequences for the economic potential of the region and its population (White et al., 1989). Besides its ecological importance Segara Anakan has a high economic potential in serving as a source of fish and crustaceans as well as wood used for construction and firewood.

An interdisciplinary study was performed in the 1980's to evaluate the ecological and economic properties of Segara Anakan in order to develop management strategies for a sustainable development of the region (White et al, 1989). It reveals that among the major rivers (Cikonde, Cibeureum, Cikujang, and Citanduy) draining into the lagoon, the Citanduy is the most important source for sediments. Although its annual sediment discharge is with $14.4 \text{ Mill t yr}^{-1}$ low compared to that of the major world rivers, its sediment yield is with $3228.7 \text{ t km}^{-2} \text{ yr}^{-1}$ among the highest reported worldwide. However, only 20% of Citanduy sediment discharge remains in the lagoon and 80% reach the adjacent coastal ocean. Environmental degradation by increased suspension loads is a major threat to coastal zones by smothering phytoplankton, coral reefs and sea grass and thereby lowering productivity (Ayukai & Wolanski, 1996; Fabricius & Wolanski, 2000; Onuf, 1994). Increased muddiness of coastal waters may also affect biological properties of the water as well as the benthic food chain as described for tropical river deltas of Australia

(Alongi & Robertson, 1995). Therefore a consulting company recently suggested a diversion of the Citanduy River to direct its high sediment load directly to the adjacent coastal ocean.

Our project is designed to study processes controlling sediment discharge, biological productivity and diversity in the lagoon and the adjacent coastal ocean. Furthermore, it will emphasize the interaction between humans and their environment. This aims to develop strategies for a sustainable management of Segara Anakan, which is in concert with former programs. This project has the unique advantage to build up on excellent results obtained by preceding projects. Available long-term records will allow to investigate the biological, biogeochemical and socio-economic changes of the Segara Anakan lagoon and the adjacent coastal ocean brought about by human activities in the past century. Furthermore, the application of newly developed techniques together with an interdisciplinary approach will enable us to counter known and still unsolved environmental problems in Segara Anakan. For example airborne mapping tools combined with ground truth validation and times-series stations will provide information for both biogeochemical and ecological studies. Process studies will be integrated to display linkages between processes, organisms and environmental factors and paleorecords will be deciphered from sediment cores to differentiate between natural and human induced processes. For developing sustainable management strategies it is of great importance to combine scientific results with those obtained by socio- economics studies which are part of this project. Due its interdisciplinary approach, this project is divided into six separate but interrelated sub-projects, which will be introduced in the following chapters.

Rationale:

Study effects of anthropogenic environmental changes on the ecology, economy and chemistry of the region.

Aim:

understand processes and interlinkages of the lagoon and adjacent coastal systems (explore bio-geo-socio background) and help to develop a strategy for sustainable management of the region

Major Components (Teilprojekte)

A) changes in Land-use-pattern of past 50 years

Geographic, geomorphologic/soil science, geological evaluation of land-use changes in project area with the help of GIS thematic maps; changes of catchment area and general water regime – coastline development

Mapping of phytoplankton blooms and suspension load in coastal waters (remote sensing, airborne scanners) – changes as function of tides, seasons etc. (toxic blooms)

[Geographer/Soil Scientist]

B) Socio-Economic Changes

Population, income-generation, fisheries, use of mangrove and reef amenities, profession-development, administrative and local political changes (rapid rural appraisals, participatory rural appraisals etc.)

Effects of changes on fisheries, tourism, ecosystem condition etc.;

Official landing statistics vs. subsistence landings, import/export of marine products etc.

Evaluation of the influence of several former projects ? (on science, on living conditions, on income)

[Socio-economist]

C) Changes in Living Communities

Inventory and characterization of living communities (mangroves, coral reefs plankton benthos). Range from freshwater to continental shelf (river, lagoon, sea),

Assess status-quo and understand functions and interlinkages (food web, trophic links – production and biomass, energy and material flow),.

Compare with records (WB survey 1985, fisheries landings statistics, short cores) from 15-20 years ago, mapping of ecosystems with remote sensing and airborne radar and line scanners (extent, condition, changes in percentage cover etc.)

Identify suitable indicators for environmental changes, protected species ?

[two Biologists]

D) Changes in Flux

Identification and quantification of material flow (nutrients, carbon), water samples and cores from all compartments (river, mangrove, lagoon, sea – porewater, sediments, trees)

Flow of minerals, distribution of grain size (changes in past 50 years, cores); transformation processes in the mangroves/lagoon mediating transport into the ocean and into the atmosphere

Coupling of changes in land-use and biogeochemical fluxes

[two biogeochemists]

E) Changes in Long-Term Scales

Reconstruction of historical, pre-historical and modern times (vegetation, land-use, settlement)

(Pollen, spores, charcoal, carbonized particles and other human indicators),

high-resolution analysis of biological and geochemical parameters

[Paleobotanist]

F) Changes for the Future?

Develop scenarios for the future of the region, come up with guidelines for a sustainable management of the coastal resources and systems

Offer alternative income sources for people (eco-tourism, farming of mollusks and corals, bioactive substances, brick project*)

[all involved scientists]

Some of the subprojects require investigation of the coastal seas up to the continental shelf, therefore shipborn operations are necessary approx. 1-2 times per year (Baruna Jaya & sediment trap maintenance, Sonne ?)

Two (minimum) long-term scientists (socio-economist, bio/geo scientist) will establish the network for all sub-projects and compose multi-disciplinary working plans for short-term visits by experts and for Ph.D. and MSc. Candidates. Each subproject should have at least one Ph.D. candidate.

* brick project: extract sediments from river in order to produce bricks

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VII.1.1.6

Bioindicators of Coral Reef Health

Dr. Claudio Richter
Center for Marine Tropical Ecology (ZMT)

Cryptofauna filter-feeders, abound in highly oligotrophic waters within the reef matrix, are sensitive indicators of eutrophication. Novel endoscopic tools -the CaveCam- allow detection of changes in cryptofauna communities, long before community changes become visible in corals.

Healthy reefs cause strong cross-gradients in plankton and nutrient distributions. The slopes of these parameters are potential indicators for reef health.

VII.1.1.7

Physical and Functional Integrity of Coral Reefs

Dr. Claudio Richter
Center for Marine Tropical Ecology (ZMT)

The direct effect of physical disturbance (hurricanes, blast fishing, etc.) are evident in coral reef structure. Less evident is the effect of physical disturbances on coral reef function. We propose a comparative study of the filtering ability of coral reefs subjected to various degrees of framework degradation (intact framework - rubble field), using novel endoscopic tools with advanced modelling of flow through porous media.

VII.1.1.8

Coral Bleaching and Zooplankton

Dr. Claudio Richter
Center for Marine Tropical Ecology (ZMT)

Global warming is a major concern for coral reefs. Temperature increases as little as 1°C above average maximum may induce coral (and other invertebrate) bleaching in 'ocean hotspot' areas, impairing or killing the organisms. The adverse temperature effects may however be mitigated by alternative sources of nutrition for corals, notably zooplankton. We propose a large-scale investigation to map 'zooplankton cold spots' (e.g. in the seasonal upwelling off S. Java/W. Sumatra) as an important potential mitigating factor. Large-scale zooplankton data shall be complemented with historical records and compared to existing temperature and bleaching data from other sources. Complementary feeding experiments are needed to verify the hypothesized mechanism.

VII.1.2 Marine Natural Products and Pharmacology

VII.1.2.1

Marine Macroorganisms from Coral Reefs and Mariculture as Sources for New Bioactive Metabolites

Prof. Dr. Peter Proksch, Dr. Rainer Ebel
University of Duesseldorf – Institute for Pharmaceutical Biology

Marine macroorganisms (invertebrates and algae) are a unique source of bioactive metabolites. Several natural products are currently in clinical trials or have been used as lead structures for the development of synthetic analogues that are currently available as drugs on the market. In addition to the importance as drugs, marine compounds are currently utilized as ingredients of skin care products in the field of cosmetics.

Indonesia with its long coastline and steeming biodiversity, found especially on coral reefs, offers ideal conditions for bioprospecting. However, sustainable supply of interesting marine invertebrates or algae in view of limited resources is a severe problem that often hampers efforts aiming at commercial utilization. As a possible solution, directed efforts to implement Mariculture for a large scale supply of chemically interesting invertebrates and algae are urgently needed.

Giving credit to the needs of an ecologically sound and responsible bioprospecting that nevertheless takes full advantage of the available marine biodiversity, our proposed project includes two major aspects:

Bioprospecting of coral reef organisms for potential use in medicine and other areas such as cosmetics, using sensitive coupled analytical techniques (e.g. LC-MS) and screening methods utilizing reduced sample sizes taken from nature.

Once chemically interesting species have been identified, large scale production of the respective organisms by Mariculture, as a feasible alternative to collections from the wild, will be initiated using currently available technology developed for other fields of Mariculture (e.g. shrimps and fishes).

This project will take full advantage of the marine biodiversity of Indonesia for bioprospecting. At the same time it will help to create and implement new and economically interesting areas of Mariculture in Indonesia that can offer alternative sources of income as compared to already existing efforts of Mariculture. At the same time, this project can make important contributions for the clinical development of marine natural products to guarantee a steady and reliable supply of compounds.

Possible Partners from Academia:

ZMT (Bremen, Germany)

Dr. Listyani Wijayanti (BPPT, Jakarta, Indonesia)

Dr. Sudarsono (Gadjah Mada University, Yogyakarta, Indonesia)

Dr. Dian Handayani (Andalas University, Padang, Indonesia)

Dr. Linawati Hardjito, PD Dr. Hary Palm (IPB, Bogor, Indonesia)

Prof. Sumali Wiryowidagdo, Dr. Budiawan (Universitas Indonesia, Jakarta, Indonesia)

Possible Partners from Industry:

Bayer AG (Germany)

PT Indofarma (Indonesia)

PT Martina Berto (Indonesia)

VII.1.2.2

Microorganisms from Mangrove Swamps as a New Source for Drug Discovery

Prof. Dr. Peter Proksch, Dr. Rainer Ebel
University of Duesseldorf – Institute for Pharmaceutical Biology

Marine bacteria and fungi are presently receiving considerable attention due to the presence of unique secondary metabolites that are unprecedented in terrestrial microorganisms. Current efforts of marine microbiologists and natural products chemists concentrate largely on the isolation of microbes from marine sediments and marine filter feeders (e.g. sponges). Mangrove swamps on the other hand, have so far largely been neglected by bioprospectors even though the unique environmental conditions of this ecosystem (e.g. variation of salinity, desiccation in combination with increased UV radiation during low tide conditions) constitute severe stress factors that are likely to select for unique microbial communities that are not present in other marine ecosystems. It is our hypothesis that these ecological factors have also shaped the secondary metabolism of the respective microorganisms, thereby giving rise to new bioactive compounds that are of interest for drug discovery.

It is therefore the aim of this collaborative project to study the metabolic properties of bacteria and fungi from the Mangrove area of Segara Anakan (near Cilacap, Central Java) with regard to their biological activities in pharmacologically relevant screens, and to identify possible lead structures aiming at the development of new pharmaceuticals.

Possible Partners from Academia:

Dr. T. Tan, Dr. K. Schaumann (AWI, Bremerhaven, Germany)
ZMT (Bremen, Germany)
Dr. Edy Yuwono (Genderal Soedirman University, Purwokerto, Indonesia)
Dr. Listyani Wijayanti (BPPT, Jakarta, Indonesia)
Dr. Sudarsono (Gadjah Mada University, Yogyakarta, Indonesia)

Possible Partners from Industry:

Zentaris AG
PT Indofarma (Indonesia)

VII.1.2.3

Ecology of the Coral Reefs around Karimunjawa Islands, Java Sea, Indonesia: Microbial Biodiversity and Bioactive Compounds

Dr. Tjhing-Lok Tan
Alfred-Wegener Institute (AWI)

Hypothesis: The decline of Coral Reefs is caused by an increase of temperature, nutrients and heterotrophic microorganisms through anthropogenic inputs

Objectives, project description:

The Coral Reefs around Karimunjawa Islands (5° 45' S; 110° E) in the Java Sea are almost undisturbed and free from anthropogenic influences. Therefore, investigations on the intact community of a tropical Coral Reef should be conducted in the near future by cooperations between the Diponegoro University (UNDIP) in Semarang, the Gadjah Mada University in Yogyakarta (Central-Java), the Sam Ratulangi University (UNSRAT) in Manado, North-Sulawesi and German partners. For this purpose an expedition with an Indonesian research vessel should be organized in the coming years, 2002 or 2003.

The microbial community structure and biodiversity will be studied by means of modern molecular biological methods as well as enrichment cultures and single cell isolation procedures. After cultivation of the microorganisms in the laboratory, an intensive screening program for the search of new bioactive compounds has to be done. It can be expected that new chemical structures will also be among the discovered organic compounds. The overall results will give indications about the biochemical interactions among the Coral Reef community and more understanding about the probable risks menacing their existence.

Working plan:

In the years 2001 and 2002, young Indonesian scientists (S 1 and S 2) should be trained in the respective working groups at AWI and the universities of Bremen and Düsseldorf. A research proposal should be worked out by Indonesian and German scientists this year.

The expedition "Karimunjawa" with RV "Baruna Jaya" (?) should be conducted in spring 2002 or 2003. It will last 6 weeks, which are needed for getting the biological and chemical samples. To describe the hydrochemical and hydrological habitat of the Coral Reef, the concentrations of inorganic nutrients (nitrate, nitrite, ammonium, phosphate and silicate) as well as temperature, salinity, dissolved oxygen concentration, turbidity, light penetration depth (Secchi-disk, or more precise measurements), pH- and rH-value should be analysed. The microbial and molecular biological research programs consist of determining the total counts and biomass by fluorescence microscopy and colony forming units as well as by community structure analyses by means of DGGE and SSU rRNA gene sequence comparisons. Besides that isolations of microorganisms by means of enrichment cultures and single-cell isolation procedures as well as the interactions between micro and macro-organisms will be investigated.

Scientists involved with the planning:

Dr. T. L. Tan, Dr. E. Helmke, Dr. L. Medlin, Dr. K. Schaumann, Dr. C. Schütt, Dr. R. Crawford, Dr. G. Kattner, Prof. F. Buchholz, G. J. F. Kalgis, M. Sc. (UNSRAT), Ph. D. student, Prof. C. Wiencke, Prof. H.-O. Pörtner

Cooperations:

Prof. G. O. Kirst, Universität Bremen, A. B. Susanto, M. Sc. (UNDIP), Ph. D student, Universität Bremen; Prof. H. G. Ebner, Hochschule Bremerhaven; Prof. P. Proksch, Universität Düsseldorf; E. P. Setyowati, M. Sc. und Dr. Sudarsono, Universitas Gadjah Mada, Yogyakarta.

VII.1.3 Hydrocarbon and Mineral Potential and Geohazards

VII.1.3.1

Research Cruise: Baruna Jaya – BANDAMIN

Prof. Dr. Peter Halbach
Free University of Berlin

Geotechnological research to study the hydrothermalism and related mineralizations of the southeastern Banda Sea (Indonesia)

Geological Setting

Southern Indonesia is characterized by a large island-arc subduction and collisional system (Sunda-Banda-island-arc), respectively, which results from the complex merging of three major tectonic plates (Pacific, Eurasian, and Indo-Australian Plate). Prominent geological differences exist between the eastern and western parts of Indonesia: The south of West-Indonesia is dominated by tectonics, through which the crust of the Indian Ocean is subducted under the island-arc in the Sunda graben, while Southeast-Indonesia is governed by the collision tectonics of the Eurasian and Indo-australian plates. Here, the continental crust of Australia moves towards the southeastern island-arc and leads to a collision of the plates because of the lower density of the continental rocks.

The Sunda-Banda island-arc represents the southern and eastern edge of the Banda Sea, which is a relatively young marginal continental back-arc basin with an extension to the E/SE. The inner island-arc shows an intensive subrecent to recent calcalkaline volcanism. Generally, the age and the size of the volcanic islands of the inner arc decreases from W to E. The southeastern section of the volcanic Sunda-Banda-arc is also characterized by a strong curvature towards the north. The island-arc itself is displaced by several obliquely striking fault systems east and west of Wetar and close to Nila. The tectonic situation of this region, thus, produces a geologic setting that results in increased tectonic stress, multiple magma production, and hydrothermal heat removal, which together constitute a favourable environment for hydrothermal circulation and the respective formation of mineral deposits. Obviously related to a similar geologic setting, several fossil massive sulfide and epithermal gold deposits (Miocene/Pliocene) occur on some of the islands of the southern and western arc sections.

Aims of the Study

It is a major aim of the BANDAMIN Project to examine such cross-cutting tectonic systems (arc/fault) and related submarine volcanoes in order to search hydrothermal activity, indicative alteration patterns of rocks, and related mineral deposition. Until now, a comparable research has not been made in Indonesia and, thus, it is also of economic importance for Indonesia to recognize a geological potential for mineral deposits.

The planned German-Indonesian co-operation in the BANDAMIN Project thereby provides an important contribution, both, to identify mineral resource potentials in Indonesia and to examine hydrothermal circulation processes in order to determine element and energy fluxes in geochemical systems, leading to the formation of submarine mineralizations, and driven by the heat dissipation from the mantle to the crust. This research - merged in a bilateral framework - shall promote a better understanding of such systems. It is based on the favourable situation that the German partners contribute a lot of experience in hydrothermal research and the Indonesian side provides the very important local knowledge. Another crucial aspect is the training of Indonesian Scientists in modern marine geologic methods.

Work Schedule

The first expedition is planned for August/September 2001 on board the Indonesian RV BARUNA JAYA IV. Important aspects of this cruise are the bathymetric mapping of the target areas to explore the tectonic situation of submarine volcanism/hydrothermalism and the sampling of fluids/solids to identify mineralization sites. The collected data and samples will jointly be analyzed by both partners; it is planned to train young Indonesian scientists in various analytical (scientific) and technical (ship-oriented) aspects. A second cruise, probably with the German RV SONNE, is planned in case of a successful voyage of the BARUNA JAYA IV.

Principal Project Partners

Germany:

Freie Universität Berlin, Fachrichtung Rohstoff- und Umweltgeologie (FUB),
GeoForschungszentrum Potsdam (GFZ).

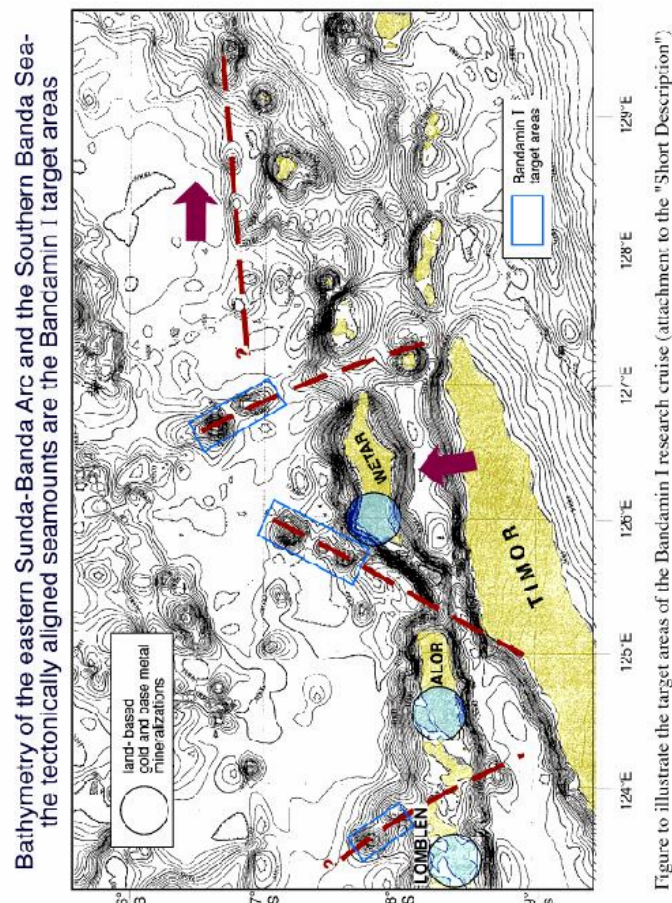
Indonesia:

Ministry of Marine Affairs and Fisheries (DKP),
Agency for the Assessment and Application of Technology (BPPT),
Directorate General of Geology and Mineral Resources (MGI).

Co-ordinators

Prof. Dr. Peter Halbach
Prof. Dr. Burhanuddin Safri

Berlin, March 2001



VII.1.3.2

Bathymetric Mapping of Sunda Strait / Indonesian EEZ using GEOMAR Portable Multibeam System

Dr. Wilhelm Weinrebe
GEOMAR - Kiel

The need for accurate global and regional bathymetry has greatly increased in the past decade. Mapping of national Exclusive Economic Zones (EEZ), identification of geological hazards, environmental management near metropolitan areas, and finding optimum cable and pipeline routes are increasingly addressed with swath bathymetry. However, current multibeam systems capable of mapping in water depths below 100 m have to be permanently installed on large survey vessels. That makes swathmapping an expensive tool.

Since about 10 years GEOMAR has gained a lot of experience in multibeam bathymetry. Large areas in the Pacific, the Atlantic, and around Indonesia (GINCO project) have been mapped with the Hydrosweep system onboard RV SONNE and RV METEOR. In order to be able to do swathmapping surveys, using smaller ships or «ships of opportunity», GEOMAR started to work with portable multibeam systems. In 1998 an ELAC 50 kHz Bottomchart system was temporarily installed onboard RV POSEIDON and used to map Greenlandic fjords. Based on experiences gained during that cruise a portable towed system was used on board a Russian ship in the Sea of Okhotsk in 1999. Swathmapping was successfully accomplished up to water depths of 2800 m. In 1999 GEOMAR purchased their own multibeam system for intermediate water depths (up to 3000 m). In summer 2000 we constructed a dedicated tow body to use with this multibeam system. Test surveys in Kiel bay in September 2000 were successful and promising.

This portable, towed multibeam system can be operated with any ship available, which is able to tow a floating vehicle like a small boat. Only basic requirements have to be met:

- Power supply
- able to go continuously at slow speed (2.5 – 4 kn)
- if working far out: a crane to launch and recover the tow body,
- if working near shore the tow body can be launched and recovered in port

The multibeam system on the tow body is fully equipped with motion sensor and GPS receiver, and suited for swathmapping operations in water depths up to 3000 m.

We propose to use this system onboard an Indonesian vessel (small research vessel, fishing vessel or appropriate) for a swathmapping survey in Indonesian EEZ. As a first target area we propose to map Sunda Strait, which would continue our work of GINCO project.

Within six weeks a considerable area of Sunda Strait could be mapped. The acquisition work could simultaneously be used to train Indonesian scientists to operate such a system. Furthermore, the processing of the data should be done in cooperation with Indonesian scientists in Indonesia. In 1998 GEOMAR offered a training course for bathymetry data processing. We could offer similar training courses for Indonesian partners.

The acquired data could considerably extend the area of Indonesian EEZ to be mapped for UNCLOS. Simultaneously, the data will expand our knowledge on the morphological units in the area surveyed during the GINCO project and will be essential for further understanding of the geodynamic setting.

VII.1.4 Physical Dynamics in Indonesian Seas and Coastal Areas

VII.1.4.1

Study of the Dynamics (Throughflow) of the Lombok Strait by Remote Sensing, Numerical Modeling, and in-situ Observation

Prof. Dr. Werner Alpers
University of Hamburg – Institute of Oceanography (IfM)

Short Project Description:

Recently, synthetic aperture radar images acquired over the Lombok Strait have revealed the existence of frontal plumes and internal waves that are generated in the Lombok Strait(see the recent paper by Mitnik and Alpers,2000). These features contain information on the flow dynamics through the strait, which is of great relevance for global climate studies as well as for local biological studies(mixing, upwelling).

We want to study the hydrodynamics in the Lombok Strait further by merging satellite observations with numerical modeling and in-situ measurements from ships.

In the future we shall use synthetic aperture radar data from the European satellite ENVISAT (presently the launch is scheduled for August 2001) as well as ocean color and infrared data from Envisat and other satellites, among them with SeaWiFS. The data interpretation will be carried out under the guidance of Prof. Werner Alpers of the University of Hamburg, preferably jointly with an Indonesian scientist.

The modeling will be carried out by Dr. Rubino of the University of Hamburg , preferably also jointly with an Indonesian scientist.. Dr. Rubino has much experience in modeling plumes and internal wave (see home page of the Institute of Oceanography, University of Hamburg: <http://www.ifm.uni-hamburg.de>).

The data collection in the Lombok Strait and the adjacent waters will be carried out by Indonesian colleagues.

German Partner

Institute of Oceanography, University of Hamburg (<http://www.ifm.uni-hamburg.de>)
Prof. Werner Alpers (analysis and interpretation of satellite data)
Managing Director, Head of Remote Sensing Group

Dr. Angelo Rubino (numerical modeling)
Assistant Professor

Indonesian Partner:

Department of Marine Science and Technology, Faculty
of Fisheries and Marine Sciences, Bogor Agricultural University
Prof. Bonar P. Pasaribu

VII.1.4.2

An Investigation of the Circulation and the Transport in the Malacca Strait and the Andaman Sea

Prof. Dr. Juergen Suendermann, Dr. Thomas Pohlmann, Dr. Peter Damm
University of Hamburg – Institute of Oceanography (IfM)

Two numerical models are used:

1. 3D-Circulation model (HAMSOM) (available at G and IDAC)
2. 3D-Frontal model (available at G)

Necessary data:

1. Topography (available at G)
2. Distribution of the grain size at the ocean bottom
3. Salinity field (available at G = Levitus-data)
4. Temperature field (available at G = Levitus-data)
5. Air pressure field (available at G = ECMWF)
6. Wind stress field (available at G = ECMWF)
7. Tides for open boundary condition (G = Zahel, model / G = Putri, observations)
8. Measured time series of current, fronts etc. (??)

Goals of the Bilateral Project:

General:

The main goal is to get a closer understanding of the circulation structure and its variance spectrum in the area of interest. Two parts of investigations will be made. The first one is based on a circulation model, the second one on a frontal model.

Circulation Model:

1. Calculations of circulation pattern in the area of interest
 - a) for a summer monsoon
 - b) for a winter monsoon
2. Long-term (10 years) investigation of circulation patterns in the area of interest
3. an estimation of the turn-over time for the water masses of the Malacca Strait

Frontal Resolving Model

1. Calculation of the distribution of fronts in the area of interest
 - a) for tides only
 - b) for the summer monsoon
 - c) for the winter monsoon
2. Identify the main locations of fronts and their variability in time and space
3. Identify the cause of the fronts (temperature, salinity, tides etc.)

Work and Time Schedule

3D-Circulation Model

1. Implementation of:
 - a) Topography 2 months
 - b) salinity / temperature fields 2 months
 - c) Meteorological forcing 2 months
 - d) tidal boundary condition 2 months
2. Model calibration, test runs 3 months
3. Design of graphic tools for model results 1 month
4. Calculation of the seasonal circulation pattern 6 months
5. Analysis of the seasonal circulation pattern 3 months
6. Calculation of the long-term investigation 6 months
7. Analysis of the long-term investigation 3 months
8. Writing of final report, papers, (dissertation) 6 months

3D-Front Model

1. Implementation of:
 - a) Topography 2 months
 - b) salinity / temperature fields 2 months
 - c) Meteorological forcing 2 months
 - d) tidal boundary condition 2 months
2. Model calibration, test runs 3 months
3. Design of graphic tools for model results 1 month
4. Calculation of the tides and seasonal fronts distribution 6 months
5. Analysis of the seasonal fronts distribution 3 months
6. Identification of the main locations of fronts 3 months
7. Analysis of the variability in time and space 3 months
8. Identification of the cause of each special front 3 months
9. Writing of final report, papers, (dissertation) 6 months

Foreign Partner:

Universitas Syiah Kuala
Dekan of Mathematics and natural Sciences Faculty
Dr. Syamsul Rizal
Darussalam – Banda Aceh 23111
Indonesia/ Sumatra

Last Five Publications in the Research Field of the Proposal

- Jian, W., Th. Pohlmann, J. Sündermann, Shizuo Feng, 2000. A modelling study of SPM transport in the Bohai Sea. *Journal of Marine System*. 24 (2000), 175-200
- Rizal, S. and Sündermann, J., 1994. On the M2 tide of the Malacca Strait: a numerical investigation, *Deutsche Hydrographische Zeitschrift – German Journal of Hydrography*, 46(1), 61-80
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- Sündermann, J. (ed.), 1994. *Circulation and contaminant fluxes in the North Sea*, Springer – Verlag, 654 pages
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VII.1.4.3

Eastern Indian Ocean Boundary Circulation and Climate Variability

Dr. Friedrich Schott
University of Kiel – Institute of Marine Science (IfM)

The Scientific Problem and Challenge

In the past few years significant climate anomalies have been identified in the Indian Ocean which are apparently not „slave modes“ of the Pacific ENSO phenomenon but are unique to the Indian Ocean (e.g., Saji et al., 1999; Webster et al., 1999). They are marked by anomalous upwelling off Indonesia, caused by anomalous westward winds, and dry spells over Indonesia. Such anomalies occurred in 1991, 1994 and 1997.

The role of the ocean in these anomalies is judged to be important but still unclear. What is known, mostly from model simulations (e.g., Schott and McCreary, 2001), is that the equatorial zone strongly interacts with the eastern boundary and with the Throughflow through the Indonesian Passages from the Pacific to the Indian Ocean. One mechanism of this interaction is through long equatorial waves with periods of weeks to months which are generated in the interior Indian Ocean by the winds and arrive at the eastern boundary, from where they continue onwards, even into the Indonesian passages, where Sprintall et al. (2000) could show the propagation of the equatorial anomaly signal of 1997 as far as the Makassar Straits. Further, very little is known from observations on the means and variations of the circulation along the eastern boundary off Sumatra and Java..

While at the western boundary, the seasonal cycle and fluctuations of the Somali Current have been studied quite extensively, no prior sustained observations really exist along the eastern equatorial boundary off Sumatra that would allow derivation of the cross-equatorial exchange or of the interaction between the tropical zone and the eastern boundary. It is proposed here to initiate such an ocean-climate study on a German-Indonesian cooperative basis.

Proposed Cooperative Observations for an Eastern Equatorial Boundary Experiment (EEBEX)

Figure 1 shows a schematic presentation of the monsoon circulation of the Indian Ocean during the Southwest Monsoon, including the Throughflow from the Pacific that extends across the entire Indian Ocean in the 10-20S latitude range. It is proposed to carry out a 2-year long study with moored stations, shipboard observations and profiling floats in the 2002-2003 time frame at the eastern boundary of the equatorial Indian Ocean. Such a program, as marked by a box in Fig.1, should include the following observational components:

a) Moored stations: 3 moorings with current meters (Doppler profilers for the near-surface layer) and temperature-salinity recorders (seacats) in the boundary current off Sumatra near the equator;

b) Repeated shipboard surveys of the boundary current regime between the equator and 12°S in different monsoon seasons;

c) Deployment of profiling floats: Profiling floats are an excellent means to pursue water masses as they propagate from one region to another.

The program could interact with and benefit from other proposed field studies discussed for the eastern Indian Ocean at the „Sustained Observations of the Climate of the Indian Ocean (SOCIO)“ Workshop in Perth (Nov. 2000). Of particular relevance are plans by Japan to moor two ATLAS buoys, i.e. the type used in the Pacific Tropical Atmosphere-Ocean (TAO) array, in the eastern equatorial Indian Ocean. These could provide information on equatorial winds and current signals propagating toward the eastern boundary from the west.

Within the German national ocean- climate research, such a program would fit well into the ongoing CLIVAR/ocean program.

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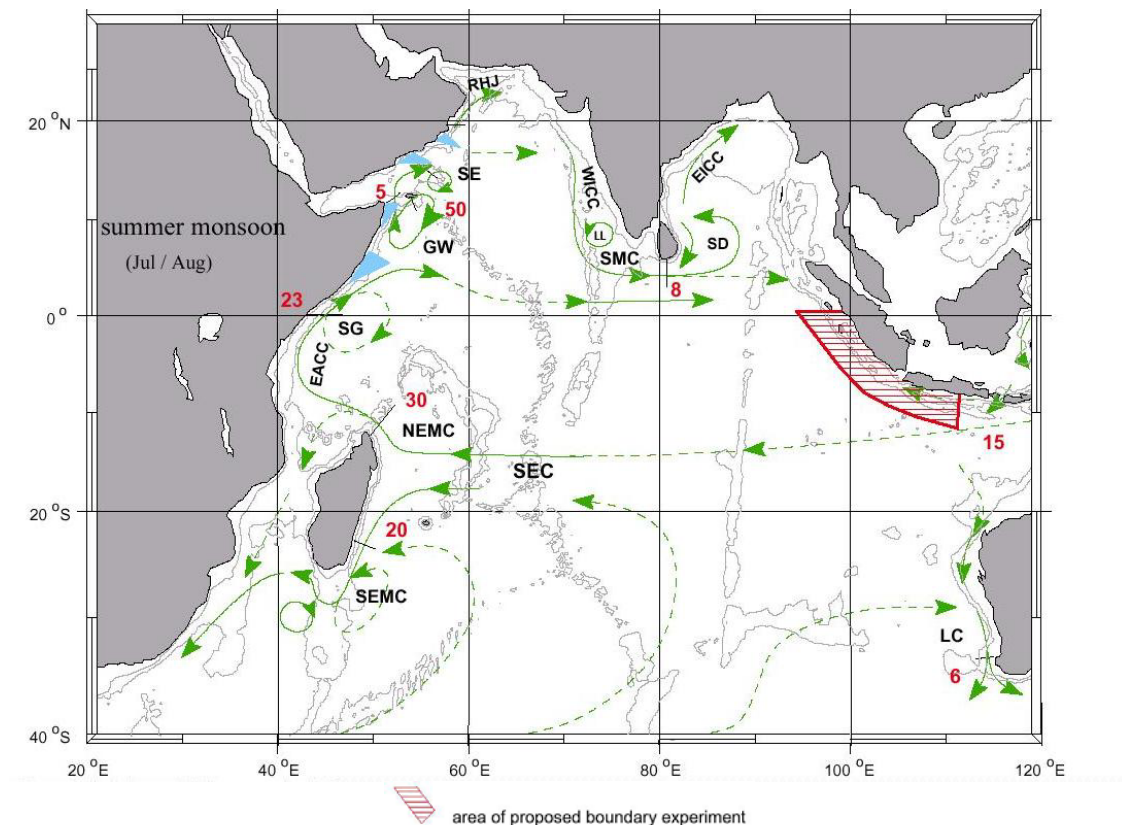


Fig.1: Schematic representation of known circulation branches (green) of the Indian Ocean during the Southwest Monsoon (July/August), transport numbers (red) are in $10^6 \text{ m}^3/\text{s}$. Porposed work area is hatched in red along eastern boundary.

VII.1.4.4

Evaluation and Validation of Satellite Derived Ocean Colour Data by Optical Investigations to Support Fish Stock Assessment

Dr. Herbert Siegel
Baltic Sea Research Institute – Warnemuende (IOW)

Introduction

The Indonesian waters are characterized by different water masses due to the dynamical processes and the geo-location, as oligotrophic ocean, upwelling, through-flow and Java Sea waters. These water masses differ in the hydrographic parameters but also in the composition of optically active water constituents influencing the optical properties as absorption and scattering and by that the ocean colour.

Main Objectives

Identification and distinction of the different water masses by satellite data in the VIS and infrared spectral ranges, oceanographic and optical data
Composition of optically active water constituents in the different water masses
Development of phytoplankton in the different water masses and particularly in relation to the upwelling cells
Influence of coastal and river discharge
Bio-optical classification of water masses for the identification and distinction of oligotrophic ocean, upwelling, through-flow and Java Sea waters.

Methodical Aspects

Derivation of distinctive characteristics in oceanographic data, water constituents and optical parameters as spectral reflectance and inherent optical properties
Test of the applicability of the standard algorithm for the evaluation of ocean colour data (SeaWiFS, MODIS, MERIS)
Compilation of a data base for the check and development of regional algorithms
Continuation of investigation in the IOW on regional difference in the reflectance

Methods

CTD + fluorometer (IOW or other group)
Satlantic profiling radiometer and TRIOS radiometer to measure L_u , E_d above and below the sea surface
Perkin Elmer Lambda 2 Spectrophotometer to measure a_y , a_p in the lab
Filtration of samples for suspended matter, fluorometric Chla determination and at selected stations HPLC Pigments

VII.1.5 Ecosystem Response to Global Changes

VII.1.5.1

Pollutants of Toxic Substances and Risk Assessment for Aquatic Environment

(Case Study: Bangka Strait)

Prof. Wolfgang Balzer and Dr. Arinafril,
University of Bremen – Marine Chemistry

Much attention is currently being focused on assessing pollution in the aquatic environment or aquaculture. These studies will be aimed at defining the current levels and effect of heavy metals, chlorinated hydrocarbons (organochlorines) and also sewage and conducted in Bangka Strait, Eastern Sumatra, Indonesia.

In general, heavy metals and chlorinated hydrocarbons in waters, sediments and organisms are variable with high levels found near population centers, river outflows and industrial areas.

Most potentially toxic metals occur naturally in the aquatic environment at parts of billion concentrations or less, however, the anthropogenic flux of many of these metals via industrial run-off or atmospheric fallout may alter these levels in certain localized area. Serious problems as a result of their presence in the aquatic environment can occur at concentrations well above the natural values and / or when the distribution over the various chemical forms in which an element can occur is different from the natural situation. Human activities may thus cause changes in natural cyclic process with possible long-term effects.

Probably most synthetic organic compounds have not been present in nature before their synthesis by man. Serious interference with natural processes in the biotic and abiotic environment result from the introduction of compounds of this type. A large group of compounds is biodegradable. However, some compounds, being stable in the environment, having detrimental effects on organisms and produced in large quantities during several decades, have been detected in practically all parts of the aquatic environment, even in the most remote areas, as a result of their use on land. Several organochlorines belong to this group, in particular a number of pesticides such as DDT and its metabolites, dieldrin et cetera, and the group of polychlorinated biphenyls (PCB).

Aquatic organisms (planktons, fishes, mussels, et cetera) are affected by dissolved and particulate pollutants either directly or through accumulation of hazardous substances in their tissues from water or sediment and from their food sources.

VII.1.5.2

Comparative Studies on Natural and Man Made Environmental Changes in Coastal Regions of Indonesia

Dr. Hermann Behling
Center for Tropical Marine Ecology (ZMT)

Natural and human related environmental changes shall be studied in different coastal regions of Indonesia by an interdisciplinary high resolution analysis of relevant biological and geochemical parameters (pollen, spores, carbonised particles, grain size, clay minerals, organic carbon, carbonate, nitrogen, amino acids, stable carbon, and other) using marine and terrestrial sediment cores. Sediment cores can be collected in key regions from the continental shelf and from coastal lake, lagoon and river deposits in key regions of Indonesia.

Such an approach will help to understand natural environmental changes (e.g. coastal dynamics, ecosystem dynamics, climate variability, sea-level changes) and man made environmental changes during pre-historical, historical and modern times. Human impact on coastal regions and their effects on biogeochemical cycles and on human living conditions shall be analysed in detail. The socio-economic and socio-cultural consequences of future scenarios of natural and human related environmental changes can be studied. Concepts of future sustainability, water supply and food security, environmental protection, prevention of possible consequences of environmental change, can be determined for responsible politicians.

Research themes in brief:

- Comparative studies of natural and man made environmental changes in selected coastal regions of Indonesia
- Land – ocean interactions
- Role of sea-level changes
- Development and dynamics of coastal regions and of coastal ecosystems (e.g. mangroves, salt marshes)
- Human impact on coastal ecosystems
- Role of natural and man made related fires and their effects on ecosystems
- Climate change
- Variability and intensity of ENSO (El Niño Southern Oscillation) events
- Biogeochemical cycles
- Patterns of human adaptations to environmental change

Research methods in brief:

- High resolution pollen and charcoal analysis of sediment cores
- Biogeochemical analysis (organic carbon, carbonate, nitrogen, amino acids, $\delta^{13}\text{C}_{\text{org}}$, $\delta^{15}\text{N}$, and other) of sediment cores
- Analysis of grain size and clay mineral distribution of sediment cores
- Establishment of detailed time scale by AMS radiocarbon dating
- Statistical analysis of the pollen analytical and biogeochemical dates

Co-operation partners:

Germany: Center for Marine Tropical Ecology (ZMT)
University of Bremen

Indonesia:

VII.1.5.3

Biogeochemical Fluxes in the Indonesian Seas – I

Dr. Tim Rixen
Center for Tropical Marine Ecology (ZMT)

The oceans will respond to global environmental changes in ways that will affect many of their regulatory and socio-economic functions (IPCC, 1996). Expected are, among others, a weakening of the global thermohaline circulation (GTC) and changes in the strengths of coastal and open ocean upwelling systems (Joos et al., 1997). These changes will affect the nutrient distribution and availability in the oceans with consequences for marine biological production. The oceans' capacity to biologically sequester atmospheric CO₂ and their ability to sustain economically important fisheries will be seriously impaired.

Our current knowledge on the ocean's response, for example, to climate change comes from model predictions and from records preserved in ice-cores, corals and sediments. In most cases, they provide information on changes in the physical characteristics of the ocean. Although it is widely accepted that these changes will have an impact on oceans' chemistry and biology, information on the exact nature and magnitude of the potential impacts and their effect on the use of the oceans as a provider of goods and services to society is still lacking.

Data sets on material fluxes to the ocean's interior collected using time-series instruments attached to moorings in many marine regions indicate their usefulness in detecting and identifying changes in ocean biogeochemistry that are related to environmental and climatic changes (Ittekkot et al., 1996). They clearly show that the fluxes in the deep sea vary in pulse with upper ocean biological and biogeochemical processes. These processes are sensitive to changes in the nutrient distribution and availability, both of which are expected to be affected by the projected global changes. Flux studies thus have the potential to detect and identify the impact of global changes on ocean processes.

This proposal aims to document marine biogeochemical fluxes in Indonesian Seas by deploying moorings with time-series devices to record in situ physico-chemical and biological situation, to collect water samples as well as to measure settling particle fluxes at selected sites in marine regions around Indonesia. The moorings will help to record the response of the ocean biogeochemical system to ENSO type-events and to trace the propagation of the signals of these events from the Indonesian Seas to areas in the Bay of Bengal and the Arabian Sea. It is proposed that these investigations be begun by deploying moorings in the upwelling areas off South Java, which is currently being investigated by the Indonesian partner.

Partners:

Center for Tropical Marine Ecology,
Institute for Biogeochemistry and Marine Chemistry (University of Hamburg),
BPPT

VII.1.5.4

Impact of Land-Based Activities on Coastal Sea – Brantas – 01: Brantas River – Madura Strait Biogeochemistry

Dr. Tim Jennerjahn and Dr. Seno Adi
Center for Tropical Marine Ecology (ZMT)

The overall objective of the project is to characterize the response of coastal marine waters of Indonesia to regional and global environmental changes. Specifically, it will examine the changing pattern of river inputs and its impact on the straits and coastal seas. It is proposed that in the first phase the project activities be carried out in the system covered by the Brantas River and the Madura Strait in east Java.

The Madura Strait represents a coastal marine system influenced by the seasonally varying inputs from the Brantas River. The River has been severely affected by human activities in the drainage basin such as deforestation, river damming, agriculture and industry. The effects of these activities are compounded in recent years by the frequent occurrence of the ENSO events causing additional environmental problems.

The objectives of the first phase of the project are: (1) to synthesize the available information on the biogeochemistry of the river inputs, (2) to collect new data on the distribution biogeochemical parameters in the Madura Strait as well as (3) to establish their fluxes and variability at least within a hydrological year. In the second phase, attempt will be made to trace the history of response of the marine biogeochemical processes to the recorded environmental changes over the last few decades. The specific objectives of this phase will be developed as results from the first phase become available.

The project execution will draw on the available infrastructure and facilities in partner country institutions and will be accompanied by training and education of students from both countries. The proposed studies will contribute to the ongoing national and international efforts to better understand the impact of both climatic and non-climatic changes on coastal marine systems. The results from the two phases will together help to develop scientifically sound strategies for the sustainable use and management of the coastal zone. It is expected that, this will facilitate the continuing development and deployment of platforms and technologies for the long-term observations of tropical coastal marine regions.

The project will be carried out within the framework of the bilateral cooperation between Germany and Indonesia in the field of marine sciences and has been selected for implementation at the joint German-Indonesian Workshops in Hamburg (1998) and in Puspitek (1999).

The continuing degradation of the environmental quality of coastal water bodies from nutrient discharges threatens the quality of life of millions of people also in Indonesia. Assessment of the impact of nutrient discharges is part of national environmental policy. The present project will build on the ongoing activities. It will help to better understand the functioning of coastal systems, to better appreciate the influence of their sectoral activities on water bodies, and to implement a more comprehensive approach to managing waters as a means to collectively achieve global environmental benefits.

It will contribute towards efforts in assessing the response of marine systems to both climate and nonclimate-related environmental changes. Furthermore, by incorporating information on land-based human activities and its effects on marine systems, the project attempts to link geospheric processes with processes that drive and sustain the marine biosphere and its regulatory and socio-economic functions.

VII.1.6 Paleooceanography and Paleoclimatology

VII.1.6.1

The Indonesian Gateway and the Western Pacific "Warm Pool"

The closure of low latitude gateways during the late Cenozoic led to the genesis of "warm water pools". They occupy western tropical regions of the Pacific, Atlantic and Indian Oceans where they receive the most incoming solar radiation and, therefore, largely affect the oceanic and atmospheric heat transfer. These regions also supply the largest water vapor flux to the atmosphere and may augment greenhouse warming during interglacial periods and provide moisture to build large ice sheets during glacial periods. The development of the western Pacific "warm pool", the largest of these warm surface water masses, began with the constriction of the Indonesian Gateway over the last 10 million years. The emergence of the Indonesian archipelago restricted the water and heat transport from the Pacific to the Indian Ocean and led to profound changes in oceanic circulation patterns in both Oceans. On the other hand, this should have resulted in an enhanced poleward heat transfer due to an intensified Kuroshio Current. The formation of the W-Pacific "warm pool" is also essential for the ENSO-phenomenon, because easterly migrations of warm pool water associated with a shoaling of the thermocline toward the west are closely linked to El Nino. Furthermore, the equator-to-pole surface temperature gradient exerts a strong control on atmospheric circulation, which affects the location of the convergence zones and, subsequently the relative strength of the southeast trade winds and equatorial upwelling. One feedback is that the warm pool expands and contracts in response to the strength of both the Hadley (meridional) and Walker (zonal) convective cells.

Hence, the constriction of the Indonesian passage and the evolution of the W-Pacific "warm pool", play a major role in understanding global climate change. Moreover, for the development of predictive climate models it is critical to identify how sensitive the tropics are to changes in climate forcing typical of glacial-interglacial cycles (temperature, evaporation precipitation, heat transfer, oceanic pCO₂ etc). The region of the W-Pacific "warm pool" and the adjacent E-Indian Ocean are paleoceanographic key regions in order to understand climate forcing mechanisms and the ocean's role in long term climate change.

1. Eustatically Controlled Changes in the Indonesian-Australian Gateway during the last Glacial Cycle and Fluctuations in Terrigenous Sediment Flux

Prof. Dr. Karl Stattegger
GEOMAR - Kiel

Main objective is the reconstruction of (1) the sea-level fall at the beginning of the last glacial maximum and (2) the late glacial and post-glacial sea-level rise in the Indonesian-Australian gateway. The focus of the study will be the Arafura Shelf and a transect from the continental margin SE of Yamdena Island to the inner shelf of the Gulf of Carpentaria. Large areas of the over 500 km wide shelf formed a coastal lowland with incised valleys during the sea-level lowstand. These valleys became filled with marine sediments during the ensuing transgression. The paleo-coastline in the areas of infilled river systems will be mapped with Parasound profiles. Sediment cores will be taken in marginal areas of the river mouth system, where *in situ* mangrove remains can be found. High resolution AMS-¹⁴C dating of these mangroves will provide a precise temporal and spatial reconstruction of sea-level changes along the Arafura shelf. Comparison with the evolution of the Sunda shelf (Hanebuth et al., Science, 288, 1033-1035 (2000)) will allow the eustatic changes within the Indonesian-Australian passage to be understood with much higher precision.

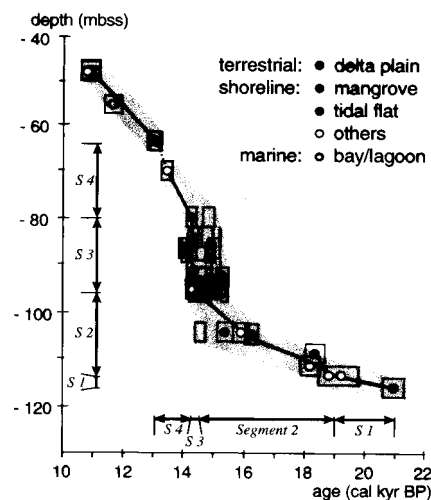


Fig. 1: High resolution reconstruction of the postglacial sea-level change on the Sunda Shelf (from Hanebuth et al., 2000) which will serve as a basis for comparison with the planned research on the Arafura shelf.

2. Paleoceanography and Throughflow Through the Indonesian-Australian Gateway over the last 150 000 Years, Biodiversity and Evolution of the Marine Fauna

Prof. Dr. Wolfgang Kuhnt
GEOMAR - Kiel

Productivity fluctuations in the eastern Indian Ocean (in the region of the Indonesian Throughflow at the western end of the Timor Sea) will be investigated in high stratigraphical resolution. Different carbon flux- and paleo-productivity proxies will be used and their significance will be tested. Main proxies are: accumulation rates, diversity and species composition of benthic foraminifers, dinoflagellate assemblages, carbon isotopes of planktic and epi- and endobenthic foraminifers, TOC- and chlorin-accumulation rates as well as biogenic barium. For calibration of the micropaleontological proxies we will use sediment surface samples along a depth transect from the Australian shelf to the western end of the Timor sea as well as data from a sediment trap deployed by the Hamburg working group. The proposed research will unravel the temporal variability of the "Indonesian Throughflow" and assess the influence of the Indonesian Passage on the temporal and spatial variability of the West Pacific Warm Pool and the intensity of the East Asian Monsoon. The main time windows for this reconstruction are periods of (1) high eustatic sea-level (Holocene and Isotope Stage 5e) and (2) low eustatic sea-level during the LGM, and Isotope Stages 4 and 6).

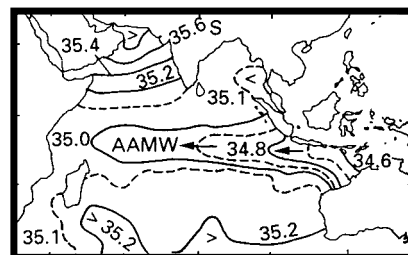
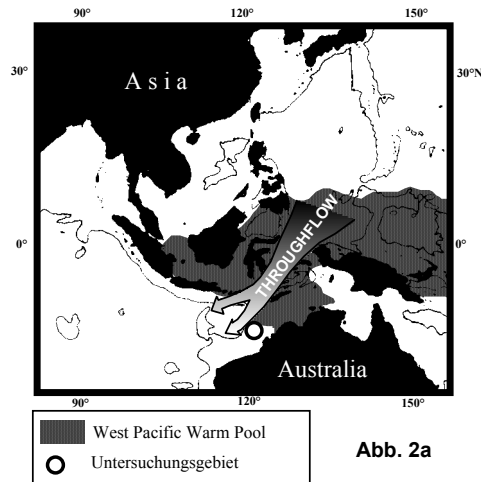


Fig. 2: Simplified circulation pattern in the Indonesian Passage (Indonesian Throughflow and extension of the West Pacific Warm Pool) modified after Yan et al. (1992) and Müller & Opdyke (2000). 2b. Influence of the Indonesian Throughflow on the water mass signature of the eastern Indian Ocean (from You & Tomcak, 1993). (AAMW = Australasian Mediterranean Water = Indonesian Throughflow)

3. Reef Geometries and Carbonate Production in the Makassar Strait (Indonesia)

Prof. Dr. Christian Dullo and Dr. John. Reijmer
GEOMAR - Kiel

The study of carbonate platforms in the Makassar Strait will offer the opportunity to determine in great detail the influence of oceanographic processes on the geometry and carbonate production of carbonate platforms in an active ocean passage.

The steep slopes that mainly resulted from tectonic processes form a controlling factor of the enhanced velocities and flow rates of water masses between the Pacific and the Indian Ocean. Because of these special circumstances, a large number of benthic sessile organisms do not have the possibility to settle down. Species that are not highly specialised like fast growing *Acropora* species or articulate green algae, mostly *Halimeda*, however, do possess the ability to settle down on the outer side of the reef. Thus, the carbonate platforms of this region are very special in comparison with other carbonate platform regions while only a restricted number of carbonate producing organisms possess the ability to steer carbonate production.

The carbonate platforms present in this Indonesian Passage, which are dominated by calcareous algae, form an actualistic counterpart of fossil platforms that occurred throughout the entire western part of the Tethys during the Late Jurassic. Comparable scenarios for water mass exchange processes, as occur today between two ocean basins of the Indian Ocean and the Pacific in the areas of the Indonesian Passage, most likely must have prevailed during the Jurassic. The clear dominance in the Upper Jurassic sediments of calcareous algae and small calcareous sponges might indicate that enhanced currents or water mass exchange rates between the Tethyan realm and the slowly opening Atlantic formed the steering factor for the development of these type of carbonate platforms. So, the analysis of the data that will be generated by the study of the modern reefs and their sediment export products in the Makassar Strait, will enable us to understand the processes that determine the development of fossil carbonate platforms.

In co-operation with the University of Hamburg sediment traps will be installed to determine the correlation between the present-day processes of a variety of paleo-oceanographic and paleo-climatic proxies. To register the steering processes of the present-day sedimentation processes, high-resolution particle flux measurements will be integrated with the analysis of the thermohaline structure of the water masses and their specific nutrient contents. The analysis of these parameters will be combined with the analysis of satellite data (wind, precipitation, SST, SSTA, chlorophyll).

4. Corals and Sclerosponges as Recorders of Climatic and Oceanographic Variability

Prof. Dr. Christian Dullo and Dr. John. Reijmer
GEOMAR - Kiel

Corals and Sclerosponges are excellent recorders for climatic and oceanographic variability. Our present understanding is based on data sets coming from the central western and eastern Indian Ocean and several sites from the Pacific region. With respect to the global water-mass exchanges between the major world oceans the Indonesian passage is one of the major key sites in understanding oceanographic variability. To study the dynamics of the Indonesian throughflow on high high-resolution time scales corals provide the proper archive.

Well established proxies for reconstructing seasurface temperature changes are the $\delta^{18}\text{O}$ method and with growing impact Strontium/Calcium ratios. Seasurface temperature is one of the key indicators being strongly influenced by El Niño and monsoonal variabilities. The major driving force for the seasurface temperature in the Pacific Ocean is the El Niño frequency while for the Indian Ocean the monsoon has a strong impact. Both regimes are coupled and exhibit a complex interplay especially in the eastern Indian Ocean.

The Indonesian throughflow around the Street of Makassa and around Timor Island as well as around Bali and Lombok are ideal sites to study the El Niño influence on the monsoonal regime.

Apart of SST proxies we also propose to study other proxies which may indicate the dynamics and variability of different water masses reaching the surface layer and therefore, carrying important messages to the corals which they may record. Such proxies are Barium, Calcium ratios or Cadmium-Calcium ratios. This innovative proxy may provide a new insight into the dynamics of the water-mass exchanges through the Indonesian passage.

The combination of seasurface temperature and upwelling events, different wind patterns in combination with oceanographic and topographic regimes create the regional weather and climate conditions. However, these conditions have also an important impact on regions far away, which are known as teleconnections. Although the present day meteorology and the physics of the atmosphere may describe these teleconnections and even have empirical numerical models for their better understanding, true and long records of past variabilities are lacking. These paleorecords provide the data for testing climate models. We know already that the intensity of these climatic effects with the teleconnection are not constant, however, it shows decadal and centennial variabilities. For example the El Niño events of the years 1891, 1925 and 26 and 1982 and 83 have been of an extreme intensity, as well as those of the last decade. In contrast El Niño events which occurred during other years of the last century had only minor and in many cases even no influence.

We strongly propose that these envisaged studies should be performed according to the UNESCO: Training through research. The high quality of geochemical-analytical methods and instruments established at GEOMAR may provide the ideal partnerside for Indonesian Ph.D. and postgraduate students. We are very much in favour in creating strong links on the basis of this research and educational level. Reef research these days can only be performed if a strong partnership is being created between the scientists of the host country and the scientists having the analytical facilities.

Proposed areas for research are located in the Street of Makassa, around Timor Island and Flores Island as well as Bali and Lombok.

Principal German Investigators:

Dr. J.J.G. Reijmer (GEOMAR, Kiel)
Prof. Dr. W.-Chr. Dullo (GEOMAR, Kiel)
Prof. Dr. Chr. Betzler (Hamburg University and Cambridge University, U.K.)
P.D. Dr. A. Vecsei (University of Freiburg)
Prof. Dr. W. Kuhnt (IfG, Kiel)
Prof. Dr. K. Statteger (IfG, Kiel)
Prof. Dr. A. Eisenhauer (GEOMAR, Kiel)

Indonesian Partners (through our Dutch co-operation partners in Leiden):

Prof. Dr. Alfian Noor, MSc (Radiation Chemistry Laboratory, Hasanuddin University, Makassar)
Dr. Ir. H. Ono Kurnaen Sumadhiharga, MSc (Research and Development Centre for Oceanology,
Dr. Hantoro (University of Jakarta)

Dutch co-operation partners:

Prof. Dr. D. Kroon (present Edinburgh, as of 01.04.01 Vrije Universiteit, Amsterdam)
Dr. S. Troelstra (Vrije Universiteit, Amsterdam)
Dr. W. Renema (Nationaal Natuurhistorisch Museum Naturalis, Leiden)
Dr. F. Wesselingh (Nationaal Natuurhistorisch Museum Naturalis, Leiden)

VII.2 INNOVATION AND APPLICATION OF TECHNOLOGY

VII.2.1

The Use of Automatic Instrumentation on board of Ferries to Study the Environmental Conditions and Transport of Compounds through the Sunda Strait

Prof. Dr. Franciscus Colijn
Research and Technology Center Westcoast (FTZ)

Dr. Ono Sumardhiharga, LIPI, Oceanology Section, Jakarta, Indonesia

Introduction

During the last decade several attempts have been made by different European institutes to install automatic instrumentation on board of ships-of-opportunity, like ferries or container ships. These ships can easily be used as measuring platforms because both the intake of water and availability of energy sources is guaranteed. In the early days mainly oceanographic parameters like salinity and temperature were measured. At present our possibilities for other parameters has strongly increased: to the available equipment belong fluorimeters to estimate the phytoplankton biomass, sensors for the measurement of chemical compounds like oxygen and pH, sensors for nutrients like phosphate, nitrogen compounds and silicate, the estimation of algal group composition by wavelength dependant fluorimetry or even flowcytometry to reveal algal species/groups. The possibilities to measure primary production by active fluorimetry (pump-and-probe, or PAM) are shortly within reach. ADCP (acoustic doppler current profiler) also belong to the category of equipment available for on-line measurements.

The use of these data, especially if they can be combined with other observation techniques like remote sensing, is promising: both for fundamental research questions where temporal and spatial scales play an important role, as well as for applied research like monitoring the environmental quality of estuarine and coastal waters. The strength of the application lies in the high temporal resolution of the parameters which then can be used in model exercises to predict spatial effects or calculation of transport processes in straits or inlets.

Combination of Measurements in the Sunda Strait

The Sunda Strait connecting the Java Sea with the Indian Ocean transports water in either direction. The coastal areas are influenced by antropogenic discharges on both sides. An existing ferry line connects Java with Sumatra several times a day. The harbour is not too far away from Jakarta (LIPI, Oceanology headquarters) to be able to control and service the equipment on board of the ferry. Discussions with the BPPT have revealed that an interest in ground truth data for remote sensing would be very useful. Also current projects in the Lampung Bay (Ph.D. Study of eutrophication in Indonesian waters, Damar, IPB, Bogor) would profit from better understanding of water transports through the Sunda Strait.

Other scientific questions to be solved with this project are: (Indonesian counterpart to fill in suggestions)

Tasks and Co-operation

The project runs under the guidance of the German partner Prof. Dr. Franciscus Colijn, University of Kiel, Büsum, and Dr. Friedhelm Schröder of the GKSS/Geesthacht, and the Indonesian counterpart at LIPI, Jakarta, Dr. Ir. Ono Kurnaen Sumadhiharga with co-workers.

The installation of the ferry-Box equipment will take place under the supervision of the LIPI as well as the servicing of the installations. Data retrieval will take place weekly as well as service of the installation. A copy of the entire data set will be made available for the FTZ in Büsum, the GKSS in Geesthacht and other German colleagues interested in Ferry-Box data.

Due to the difficult financial situation in Indonesia the investment of the equipment will be covered by the German counterpart. Installation and servicing is taken care of by the LIPI Institute in Jakarta. The delivery of the equipment will take place directly to the LIPI which also takes care about the (financial) part of the import of the equipment. Travel expenses for a scientist or technician to get informed in the operation of the Ferry-Box system / and parts are part of the project budget as well as travel expenses for the German counterpart for a short meeting on the results after about one year. All other communication can be dealt with per Email.

Budget Indo-Ferry (3 years)

Investments	Ferry-Box (complete*)	75.000,- DM
Travel	3 visits to Indonesia	9.000,- DM
Spare parts	(unforeseen)	10.000,- DM
PC for data storage	(to complete system)	5.000,- DM
Calibration-runs	Two combined surveys (LIPI)	20.000,- DM (**)

(*): system consists of tubing with sensor sites, and includes sensors for salinity, temperature, chlorophyll, 2 nutrients, pH and oxygen

(**): costs are taken care of by LIPI, research vessel for 2 x 2 days including sample analyses

The costs of travel to Germany in case of visit of Indonesian technician or scientist to inspect the Ferry-Box before installation and calibration exercises are taken care of by the Indonesian counterpart.

Time Schedule

The Ferry-Box should be installed within half a year after proposal approval. Before delivery of the equipment the Indonesian counterpart organises the local conditions on the ferry, so that installation can take place within a few days. Tubing etc. is prepared on the ferry before installation. Also the hardware connections for the PC are in place or prepared.

Within two months after installation a calibration test is run together with one of the Indonesian research vessels. This survey is repeated after one year, if possible during other climatological conditions (wet-dry monsoon). Results of the calibration runs are made available for the German partner. They will be discussed during one of the visits of the German partners to Indonesia.

VII.3. MARINE SCIENCE EDUCATION AND CAPACITY BUILDING

VII.3.1

Indonesian-German R&D in Tropical Mariculture

Dr. Claudio Richter
Center for Tropical Marine Ecology (ZMT)

This project should aim at the sustainable production of high-valued commodities for export of (1) food and (2) ornamental organisms for the aquaria trade. The goal is to implement small demo plots for the mariculture of high-priced fish species, including their food (phyto- and zooplankton, hatchery unit, small grow-out unit for limited tonnage annual production. Plant should be built in a modular fashion for future scaling up. This should provide the seed for commercial investment into mariculture of reef organisms using a participatory approach, in order to provide alternative incomes for the coastal population and alleviate current problems of over-exploitation and deleterious extraction practices.

The project should be set up on a 2+2 basis and have a strong training component for transfer of know-how in crucial parts of the system (e.g. rotifer culture, artificial feeds). It should involve state-of-the-art technology (recirculation systems, ozonators, etc.). Indonesian technicians and students/young scientists should receive on-the-job training in laboratory methods, handling, maintenance, repair etc. for water quality control and disease treatment in established laboratories and commercial companies.

The following Project Ideas were identified

1) Pilot plant for production of grouper, snapper and Napoleon wrasse for consumption

3-6 mo. Training Programme for 2-4 Indonesian technicians at German SME, 1-3 mo. on site visits of German University and SME experts in Indonesia

German and Indonesian M.Sc. studies

Possible Partners:

Overall co-ordination: DKP

LIPI-P3O, CRIFI, UNSRAT

SME's of Germany (Fa. Butt, Fa. Ecomares, Sanders Ltd., PUSKUD, N.N.), Fish Diseases and Parasites expert (H. Palm, DAAD/IPB Bogor), Feed experts (IfMK)

Possible areas: Manado, Gondol

2) Pilot plant for production of marine ornamentals (corals, other reef invertebrates and fish)

3-6 mo. Training Programme for 2-4 Indonesian technicians at German SME, 1-3 mo. on site visits of German University and SME experts in Indonesia

German and Indonesian M.Sc. studies

Possible Partners:

Overall co-ordination: DKP

LIPI-P3O, CRIFI, UNHAS

SME's of Germany and Indonesia (Fa. D. Knop, Sanders Ltd., CV. DINAR, PT Lestari, N.N.), Diseases and Parasites expert (H. Palm, DAAD/IPB Bogor), Reef ecologists (ZMT)

Possible areas: Makassar, Tembok, Padang

IIX. Addresses

IIX.1 INDONESIAN DELEGATION, NOVEMBER 2000

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