

## Proceedings of the German-Malagasy Research Cooperation in Life and Earth Sciences

The present volume comprises the proceedings of a German-Malagasy research symposium in life and earth sciences titled "Madagascar: Un jardin d'évolution en danger", held at the University of Antananarivo in October 2004. The book includes 19 chapters presented by scientists from five Malagasy and ten German institutions. The spectrum of topics ranges from fundamental research to conceptual approaches and applied conservation biology, to the training of young Malagasy scientists and to the description of joint Malagasy-German conservation programmes. The majority of articles in this volume emphasises the faunal biodiversity of Madagascar and provides different approaches as to its conservation. Some contributions also target the strong relations between economics and conservation as well as the need for further research into possible ways of linking these two reputedly contrasting fields, probably one of the most important challenges for the future of Madagascar.

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## Geleitwort

Das deutsch-madagassische Wissenschaftssymposium vom 5. und 6. Oktober 2004 im Rahmen der zweiwöchigen Deutsch-Madagassischen Kulturwochen an der Universität Antananarivo war ein großer Erfolg. Dank der hervorragenden Organisation der DAAD-Lektorin Frau Dr. Sylvia Brandt und der Unterstützung durch den DAAD ist es gelungen, unter dem Arbeitstitel "Madagascar - Un jardin d'évolution en danger" 16 deutsche Wissenschaftler aus 10 deutschen Forschungseinrichtungen zu einem bilateralen wissenschaftlichen Kolloquium auf den Gebieten der Biologie, Geologie und der Agrar- und Forstwissenschaften nach Madagaskar zu bringen. Sie haben hier mit ihren madagassischen Kollegen von drei Universitäten wissenschaftliche Informationen austauschen und gegenseitig neueste Forschungsergebnisse vorstellen können. Alle Teilnehmerinnen und Teilnehmer haben bei diesem Kolloquium wichtige Impulse erhalten.

Der hiermit vorgelegte Sammelband "Proceedings of the German-Malagasy Research Cooperation in Life and Earth Sciences" versammelt 19 Beiträge aus den vorgenannten Gebieten und dokumentiert die Arbeiten des seinerzeitigen Symposiums. In ihrer Vielfalt spiegeln die Vorträge und Seminarpapiere das gemeinsame Thema von Natur und Lebensraumschutz, das sich als Roter Faden durch die Arbeiten zieht. Dabei wird auch an vielen Stellen die enge Verbindung von ökonomischen Aspekten und Naturschutzfragen bzw. Forschung deutlich aufgegriffen.

Ich freue mich, dass es den Herausgebern gelungen ist, die Veröffentlichung zu ermöglichen und damit die geleistete Arbeit einer größeren wissenschaftlichen Community als das gemeinsame Projekt deutscher und madagassischer Forscher zugänglich zu machen.

Damit wird ein weiterer wichtiger Baustein für die deutsch-madagassische Zusammenarbeit erstellt und das Motto der Deutsch-Madagassischen Kulturwochen "Deutschland und Madagaskar - Eine moderne Partnerschaft" nachhaltig belebt.

Ich wünsche dem Symposiumsband die größtmögliche Verbreitung und Anerkennung.

Dr. Dieter Zeisler  
Botschafter der Bundesrepublik Deutschland in Madagaskar

## Préface

Le symposium scientifique germano-malgache ayant eu lieu les 5 et 6 octobre 2004 à l'Université d'Antananarivo dans le cadre des deux semaines culturelles germano-malgaches, fut un grand succès. Grâce à l'organisation extraordinaire de Madame le Dr. Sylvia Brand, lectrice d'Allemand, et avec l'appui du DAAD, Office Allemand d'Echanges Universitaires, 16 scientifiques allemands venant de 10 instituts de recherche en Allemagne ont pu se rendre à Madagascar pour participer à un colloque bilatéral ayant pour titre "Madagascar - Un jardin d'évolution en danger" et portant sur les domaines de la biologie, de la géologie, des sciences agronomiques et de la sylviculture. Avec leurs collègues malgaches de trois universités de la Grande Ile, ils ont pu échanger des informations scientifiques et présenter mutuellement des résultats de recherches les plus récentes. Toutes les parties prenantes à ce colloque y ont trouvé d'importantes impulsions pour la poursuite de leurs travaux.

Le présent recueil "Proceedings of the German-Malagasy Research Cooperation in Life and Earth Sciences" dans lequel sont réunis 19 articles des domaines susmentionnés, est un document sur les travaux de ce symposium en 2004. La diversité des rapports et des documents sur le séminaire reflète le thème commun qu'est la nature et la protection de l'espace vital et qui constitue le fil conducteur des travaux. La relation étroite entre les aspects économiques et les questions portant sur la protection de la nature voir sur la recherche est clairement abordée à plusieurs reprises.

Je suis heureux que les éditeurs soient parvenus à la publication de ce recueil pour permettre l'accès des travaux réalisés à une plus large communauté de scientifiques que celle du projet commun de chercheurs allemands et malgaches.

Ainsi, une importante étape de la coopération germano-malgache est franchie tout en ranimant perpétuellement la devise des semaines culturelles germano-malgaches, „L'Allemagne et Madagascar, un partenariat moderne“.

Je souhaite à l'équipe du symposium toute la reconnaissance et la diffusion la plus large possible de ses travaux.

Dr. Dieter Zeisler  
Ambassadeur de la République fédérale d'Allemagne à Madagascar

## Research, ecosystem conservation and economic development: An integrated approach

CHRISTOPH SCHWITZER, SYLVIA BRANDT, OLGA RAMILIJAONA, MARLÈNE RAKOTOMALALA RAZANAHOERA, DIETRICH ACKERMAND, THÉODORE RAZAKAMANANA & JÖRG U. GANZHORN

Madagascar, "La Grande Ile" off the coast of southeast Africa, is the fourth largest island on earth. Its 587 000 km<sup>2</sup> are only surpassed by the islands of Greenland, New Guinea and Borneo. Madagascar broke off from Africa some 150 - 160 million and from India some 88 - 95 million years ago. Plants and animals of different origins colonized the island and produced one of the most impressive biotic radiations with most plant and animal species found nowhere else on earth but in Madagascar. Since the arrival of Man some 2400 years ago more than 80% of the island's natural forests have disappeared. The high degree of endemism and the pending threat of extinction due to ongoing habitat destruction make Madagascar one of the most prominent biodiversity hotspots of the world, ranging on top of the list of international conservation priorities (Myers *et al.*, 2000; Goodman & Benstead, 2003; Burney *et al.*, 2004). Protection of the unique plant and animal species has to go hand in hand with the conservation of ecosystem functions and ecosystem services. This can only be achieved by integrating the needs of the local human population that relies on the utilization of natural resources.

In order to be able to formulate possible solutions for the various environmental problems that Madagascar is facing we need to learn more about

- the abiotic environment and its role in the evolutionary history of Madagascar,
- floral and faunal components,
- the structure, functions and services of ecosystems, and
- the socio-economic situation and needs of the people living in, around and from these ecosystems.

Over the last few years Malagasy and German institutions have developed and maintained very fruitful collaborations that are well integrated into the international research community. In October 2004, a German-Malagasy research symposium in life and earth sciences titled "Madagascar: Un jardin d'évolution en danger" was held at the University of Antananarivo. More than 60 contributions within the fields of geology, biology and agroforestry were presented there.

The present volume comprises the proceedings of this symposium, altogether including 19 chapters presented by scientists from five Malagasy and ten German institutions. The spectrum of topics ranges from fundamental research (e.g., Emmel *et al.*, Jöns *et al.*, Razakamanana *et al.*) to conceptual approaches (Sorg) and applied conservation biology (e.g., Andrianasolo *et al.*, Olivieri *et al.*, Schwitzer *et al.*), to the training of young Malagasy scientists (Goodman *et al.*) and to the description of joint Malagasy-German conservation programmes (Fichtel & Kappeler, Zimmermann *et al.*). The majority of articles in this volume emphasises the faunal biodiversity of Madagascar and provides different

approaches as to its conservation (e.g., Ralison & Razanahoera, Day & Randria, Rabesandratana, Marquart & Harisoa, Woog *et al.*, Schütte *et al.*). Some contributions also target the strong relations between economics and conservation as well as the need for further research into possible ways of linking these two reputedly contrasting fields, probably one of the most important challenges for the future of Madagascar (e.g., Ackermund *et al.*, Nambena, Vincelette *et al.*).

In his speech at the 2003 World Parks Congress in Durban, South Africa, termed “the Durban vision”, the President of Madagascar, Marc Ravalomanana, announced his commitment to biodiversity conservation and his willingness to triple the size of Madagascar's protected area network within five years. In his preface to Rübél *et al.*'s book “Masoala - The eye of the forest”, the president also points to the strong link between a harmonic economic development of Madagascar and the conservation of the country's biodiversity.

Today, many of Madagascar's environmental problems are known, and in many cases researchers and conservationists alike have suggested possible solutions. Without any doubt a considerable amount of research is still necessary in all fields referred to in this volume, and both Malagasy and German researchers will jointly continue to carry out respective studies. One further goal, which the German-Malagasy partnership should continue to strive for in the years to come, is to build up alliances of investors, researchers and conservationists in order to be able to implement sustainable conservation of Madagascar's ecosystems with direct links to the economic development of the country. We hope that this volume with its broad array of approaches and examples will make a contribution to further strengthen the successful cooperation between Malagasy and German research and conservation institutions.

### Acknowledgements

The editors would like to thank the embassy of the Federal Republic of Germany in Madagascar, and in particular the German ambassador, Dr. Dieter Zeisler, for the continuous support of the German-Malagasy research cooperation. We also thank the University of Antananarivo for hosting the German-Malagasy research symposium “Madagascar: Un jardin d'évolution en danger”, and the DAAD, the DFG, the University of Hamburg and the Cologne Zoological Garden for their contributions to the organisation of the latter. Lucienne Wilmé (WWF Madagascar) is thanked for translating the English abstracts into French. Thanks to Irina Massmann for designing the beautiful cover, and to Irène Horavaka and Mario Perschke for helping with the production of the book. C.S. thanks Danièle Ademmer for corrections of the French manuscripts, Friedhelm Peters for help with software problems, and Nora Schwitzer for critical remarks and suggestions. The production of this volume has been made possible with support from the embassy of the Federal Republic of Germany in Madagascar and the DFG.

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Part I:

# Geology



## Introduction to the geoscience chapters

DIETRICH ACKERMAND

Madagascar is part of the East African Orogen (EAO) which is the largest orogenic belt found on Earth. This belt stretches from the Middle East, through Arabia, East Africa, Madagascar and southern India to East Antarctica. The rocks of the belt were highly deformed and metamorphosed in Neoproterozoic times, resulting from the collision between East and West Gondwana. For fundamental research of the EAO, Madagascar is an important area for the understanding of the geologic evolution. Most of the presentations of this seminar present investigations using modern laboratory equipment in order to understand the ages of igneous intrusions, the tectonic structures developed during the main crust-forming events, the pressure temperature time paths of metamorphism, the pressure temperature evolution of tectonic units and the chemistry of minerals in relation to bulk rock compositions, and including main, minor and rare earth elements.

Madagascar is rich in natural resources, which are always associated with a specific rock-type. Therefore, previous and today fundamental research work provides important information for finding new mineral resource areas which may be economically important. Economic aspects can also be aided by studies of coastal evolution. Analysis of satellite images provides a classification of coastal zones, and seasonal changes of dry and wet periods related to major variations in river discharge and longshore current patterns. For example, the locally high sedimentation rate in Toliara harbour is restricting the waterway access.

Today, research with new techniques has been made possible, because scientists like Grandidier, Lacroix, Besairie, Razafiniparany, etc. have undertaken fundamental field work and geological-petrographical descriptions over the last century.

