



# ENDOWMENT FUND

## Collaborative Marine Scientific Research



The International Seabed Authority is responsible for organizing and controlling all mineral-related activities that take place in the international seabed area. This is an enormous task: the ocean floor in this area covers more than 50 per cent of the world's surface! Mineral-related activities are also highly diverse: prospecting may target polymetallic nodule deposits and sulphides on the ocean floor or minerals embedded in cobalt-rich crusts; and mining may take place in depths of up to 6,000 metres and along biologically rich ocean floor areas, such as seamounts and hydrothermal vents.

The mandate of the International Seabed Authority is sufficiently broad to address these and other issues. While the Authority aims to encourage the development of seabed resources, for example, it also works to ensure that biodiversity within the marine environment is sustained. To maintain this balance, the Authority encourages and promotes marine scientific research. Scientific knowledge gained is also shared amongst the international science community so scientists around the world can benefit from the findings.

This concept of 'common heritage' is an important overriding principle of the International Seabed Authority. The international seabed area and its resources are designated as the common heritage of all mankind. The Authority ensures that any economic benefits gained from extracting mineral resources in the Area are shared between miners and the international community. It makes sense that any scientific understanding gained through research in this area be equally shared within the international scientific community.

"If the concept of the common heritage of mankind is to mean anything, it is essential not only that the benefits of the resources of the deep seabed be shared amongst all States, but also scientific knowledge."

10 December 2007, Secretary-General Satya N. Nandan

Over the past decade, much of the Authority's efforts have focused on encouraging study of the deep-sea environment and working with scientists to analyze and disseminate the results of such research. In addition, mining entities and collaborations that have entered into contracts with the Authority have led research cruises in the international area to learn more about mineral deposits and to test exploration techniques and new technologies in keeping with the Authority's environmental guidelines for exploration and mining.

Scientists, researchers and technical personnel from developing countries have, in some cases, taken part in these research cruises and scientific studies. They have also been active participants in the technical workshops held annually by the International Seabed Authority to disseminate the results of such research and to identify initiatives for future collaboration.

In many cases, however, financial costs to conduct marine scientific research in the deep seabed have prohibited the involvement of developing nations' scientists and other personnel. Lack of technology and expertise in a field that remains on the cutting edge of science may have also contributed to fewer researchers from developing countries being involved in deep-sea research initiatives.

As a global resource, scientific study in the international seabed area should include, wherever possible, scientists and researchers from both developing and developed countries. To achieve this objective, the member States of the International Seabed Authority established an endowment fund in 2006.

## The Fund

The International Seabed Authority Endowment Fund promotes and encourages the conduct of collaborative marine scientific research in the international seabed area through two main activities:

1. By supporting the participation of qualified scientists and technical personnel from developing countries in marine scientific research programmes and activities.
2. By providing opportunities to these scientists to participate in relevant initiatives.

The Secretariat of the International Seabed Authority is facilitating these activities by creating and maintaining an ongoing list of opportunities for scientific collaboration, including research cruises, deep-sea sample analysis, and training and internship programmes. This entails building a network of co-operating groups interested in (or presently undertaking) these types of activities and programmes, such as universities, institutions, contractors with the Authority and other entities.

The Secretariat is also actively seeking applications from scientists and other technical personnel from developing nations to be considered for assistance under the Fund. Application guidelines have been prepared for potential recipients to participate in marine scientific research programmes or other scientific co-operation activity, to enroll in training programmes, and to qualify for technical assistance. An advisory panel will evaluate all incoming applications and make recommendations to the Secretary-General of the International Seabed Authority so successful applicants may be awarded with Fund assistance.

To maximize opportunities for and participation in the Fund, the Secretariat is also seeking donations and in-kind contributions to build on the initial investment of US\$3 million. This entails raising awareness of the Fund, reporting on its successes and encouraging new activities and participants.

Terms of Reference for the International Seabed Authority Endowment Fund, as well as the guidelines for applications, marine scientific research and training opportunities list, and other information on the Fund may be found at [www.isa.org/jm/en/efund](http://www.isa.org/jm/en/efund).

## Benefits of the Fund

### *Scientific, Social, Developmental, and Environmental*

The International Seabed Authority Endowment Fund is guided by the common heritage principle that requires activities taking place within the international seabed area to benefit all mankind. Activities and programmes encouraged and promoted through the Fund in fact achieve social, scientific, developmental and environmental criteria that are intended to benefit the world as a whole.

Socially, the Fund facilitates the transfer of multi-disciplinary skills to scientists and technicians from developing countries by providing opportunities for practical application of knowledge and scientific research techniques that may not be readily available. It also fosters collaboration within the science community; linking scientists from developed and developing countries together to share and build on their skills, knowledge and expertise in marine scientific research fields.

Scientifically, the Fund leverages scarce scientific research funds by encouraging collaboration and partnerships in research projects that can be very costly. It also connects scientists from around the world into a network of deep-sea researchers and scientists; one that encourages collaborative research and the sharing of information and study across the international scientific community. Finally, the Fund expands the knowledge base of the deep-sea environment, which is both vast in size and under-researched.

Developmentally, the Fund encourages information gathering on deep-seabed mineral resources, biodiversity and the effects of human activities in the deep ocean. With this information, the International Seabed Authority can continue to improve its regulations for deep-sea mining. Deep-sea exploration entities may also use this information to better prepare for their future mining activities.

Environmentally, the Fund promotes increased scientific research in the deep-sea where biodiversity, ecosystem and marine resources dynamics are not always well understood. By expanding knowledge in this area, the International Seabed Authority and exploration entities under contract with the Authority can continue to ensure that the effects of future mining and prospecting activities do not cause undue harm to the deep-sea environment.

## Model for the Fund – Based on Past Success

Encouraging marine scientific research in the international seabed area has been a key pillar of the International Seabed Authority's mandate since it was established in 1994. This includes encouraging the participation of scientists from developing countries in research programmes. All exploration contracts issued by the Authority, for example, require prospectors to organize and provide training programmes for personnel from developing countries.

The terms of reference for the International Seabed Authority Endowment Fund are based on this past experience. In particular, they consider how partnerships amongst scientists in the international community, as well as collaborations amongst the Authority's contractors, have successfully increased scientific knowledge of the deep-sea environment and involved scientists from both developed and developing nations.

The following are three examples of collaborative marine scientific research activities that were undertaken by the International Seabed Authority and its partners to predict and manage the impacts of deep-seabed mining – and increase international knowledge of the deep-seabed environment. The fourth story is a personal profile of a marine geologist from Brazil who benefited from the training programme offered by one of the Authority's contractors.

### KAPLAN Project: Analyzing Biodiversity, Species Ranges and Gene Flow in Nodule Areas of the Seabed

*Project dates: March 2002 – June 2007*

*Funded by: J.M. Kaplan Fund and the International Seabed Authority*

*The Kaplan Project is the first and most successful attempt to analyze species composition and rates of gene flow of living organisms across the abyssal plains of the Clarion-Clipperton Zone in the Central Pacific Ocean. It is also an excellent example of how collaborative marine scientific research is being used by the International Seabed Authority to minimize the risks of mining activities to deep-sea biodiversity in this Zone.*



*photo from IFREMER - [www.ifremer.fr](http://www.ifremer.fr)*

Abyssal sediments in the Clarion-Clipperton Zone are home to abundant nickel- and copper-rich nodules of increasing commercial interest. Sediments in the deep sea may also be major reservoirs of biodiversity; but before the Kaplan Project, there was very limited knowledge of the number of species residing within the nodule-rich areas and the typical geographic ranges of these species. This made it extremely

difficult to predict the threat of nodule mining to biodiversity and, in particular, the likelihood of species extinctions within areas that would potentially be perturbed by single mining operations.

During the Kaplan Project, scientists set out to evaluate the biodiversity of three key faunal groups by determining levels of species overlap in sample areas and estimating numbers of species at 'stations' spaced out over areas across the Clarion-Clipperton Zone. The sample groups represented a broad range of ecological and life-history faunal types and, combined, they constituted a high percentage of species abundance and richness in abyssal sediments.

Samples were collected by scientists using special "DNA-friendly techniques" during three major research cruises in the nodule province of the deep sea in the Clarion-Clipperton Zone. Collected samples were then transported to laboratories in the United States, United Kingdom, Japan and France for sorting, and detailed morphological and molecular analyses.

Overall results indicated high, unanticipated and still poorly sampled levels of species diversity for all three sample faunal groups. For example, of the more than 250 morphospecies of foraminifera recognised from one of the sampling sites, only 17 were shared by the other two sites.

Based on data collection and analysis, the researchers recommended that the International Seabed Authority establish marine protected areas at multiple locations across the zone to safeguard biodiversity that could be affected by mining activities.

### Next Steps

Based on the results of the Kaplan project, the International Seabed Authority is in discussion with the Global Census of Marine Life on Seamounts (CenSeam) to conduct a similar study of the genetic make-up of plant and animal life found on seamounts.

The Authority is also engaging with scientists, contractors and its Legal and Technical Commission in the development of a comprehensive proposal to establish preservation reference zones (marine protected areas) in the Clarion-Clipperton Zone. To that end, in October 2007 a group of scientists, funded with the support of Pew Foundation, developed a set of recommendations for determining the size and location of a network of representative preservation zones. The draft recommendations will be presented to members of the Authority at their 2008 annual meeting.

### The Kaplan Project Marine Scientific Research Team

#### **Project leader:**

*Dr. Craig R. Smith, University of Hawaii at Manoa*

#### **Co-Principal investigators:**

*Drs. Gordon Paterson, John Lamshead and Adrian Glover, Natural History Museum of London*

*Dr. Alex Rogers, Zoological Society of London*

*Dr. Andrew Gooday, National Oceanography Center, Southampton*

*Dr. Hiroshi Katazato, Japan Agency for Marine-Earth Science and Technology*

*Drs. Myriam Sibuet, Joelle Galeron, and Lenaick Menot, French Research Institute for Exploitation of the Sea*



*photo from Nina Ohkawara, JAMSTEC*



*photo from IFREMER - [www.ifremer.fr](http://www.ifremer.fr)*

## CenSeam Project: Assessing Biodiversity Patterns on Seamounts to Identify Knowledge Gaps

Project dates: To begin in 2008

Funded by: International Seabed Authority

*CenSeam is a programme within the Census of Marine Life which aims to determine the role of seamounts in the biogeography, biodiversity, productivity and evolution of marine organisms, and to evaluate the effects of human exploitation on seamounts. The International Seabed Authority is partnering with CenSeam to assess the patterns of biodiversity on seamounts and the factors that determine these patterns in order to identify the gaps in current knowledge, and encourage collaborative research initiatives that will address them. The results of this project will also be used by the Authority to minimize the risks of mining activities on deep-sea seamounts.*



photo from CenSeam - [www.censeam.niwa.co.nz](http://www.censeam.niwa.co.nz)

Seamounts are undersea mountains, often of volcanic origin, that feature prominently in the world's underwater topography. Seamounts may be hotspots of biodiversity and play an important role in patterns of marine biogeography. Often highly productive ecosystems for fish, marine mammals, and seabirds, seamounts are also of potential interest for deep-seabed

mining. The long-term effects of prospecting and potential impacts of mining, however, are vastly understudied.

The lack of marine scientific research in seamount areas can be blamed in part on the sheer enormity of the task. The number of seamounts over 1 km high has been estimated at more than 100,000 and there are many more with smaller elevation. Relatively few seamounts have been studied; about 350 have been sampled, and less than 200 in any detail. As a result, the biodiversity of most seamounts on a global scale is poorly known.

In March 2006 the International Seabed Authority held a workshop to determine how exploration and mining activities on cobalt-rich crusts may impact seamount biodiversity and the biogeography of seamount species.

This knowledge, combined with the results of other workshops, is being used by the Authority to develop environmental baselines for exploration and future mining of cobalt-rich crusts.

Through presentations and discussions over the three-day workshop, participants examined gaps in the current knowledge of seamount fauna patterns of diversity and the degree to which species are restricted or isolated to the seamount or the immediate seamount area. Workshop participants also discussed opportunities for future collaboration through marine scientific research to close the knowledge gaps.

CenSeam was one participant in this workshop. CenSeam aims to strategically guide future sampling in seamount areas to fill critical knowledge gaps and target understudied regions and types of seamounts. CenSeam is undertaking these tasks to make progress towards achieving global understanding of how seamount ecosystems are structured and function to form a global census of marine life on seamounts.

As a result of their participation in the workshop, CenSeam and the International Seabed Authority began to outline a collaborative research initiative that has three main activities:

- 1) assessing patterns of community composition and diversity of fauna on seamounts (with and without cobalt-rich crusts) and the factors that determine these patterns;
- 2) examining gaps in current knowledge of these patterns to support future collaborative research to address them; and
- 3) providing the Authority with recommendations to input into the development of environmental guidelines for future mining contractors.

Participants in this collaboration include scientists who have contributed to the Authority's workshops, as well as their colleagues in the wider international scientific community. Data collected from this research will be extremely valuable for both seamount science and the future management of seamount resources.

## Geological Model Project:

### Metals of Commercial Interest in Polymetallic Nodule Deposits of the Clarion-Clipperton Zone

Project dates: May 2003 – December 2008

Funded by: International Seabed Authority

*The Geological Model is a comprehensive representation of the quantity, distribution and metal content of polymetallic nodule deposits in the Clarion-Clipperton Zone. It provides exploration entities under contract with the International Seabed Authority and future mining prospectors with a detailed mineral resource assessment in the Zone. It also contributes to scientific knowledge of how these deposits form and the marine variables that may contribute to nodule formation and abundance. The project includes a prospectors' guide that lists the proxy indicators for nodule distribution along the seabed for use by prospectors and explorers in future seabed mining exploration.*

Polymetallic nodules are rounded rock formations about the size of potatoes that have a core primarily made up of a rock piece or a shark tooth. Around this core are concentric layers of minerals that contain metals such as nickel, copper, cobalt and manganese. While no one is entirely certain how these nodules are formed, it is agreed that nodule growth is one of the slowest of all geological phenomena: about one centimetre over several million years!

While nodules have been found in all the world's oceans, and even in some lakes, their abundance and distribution in certain areas of the ocean are more economically interesting to mining prospectors. The Clarion-Clipperton Zone in the Pacific Ocean, for example, has the largest known deposits of deep-seabed polymetallic nodules. Here, nodule distribution can be compared to a carpet along the seabed; covering more than 70 per cent of the Zone, with some nodules touching one another.

Seven seabed entities are presently under 15-year contracts with the International Seabed Authority to conduct exploratory work, environmental

studies and develop mining technology in an exclusive area of the Clarion-Clipperton Zone of up to 75,000 km<sup>2</sup>. In March 2001 the Authority and representatives of these contractors met to discuss ways to better assess the mineral resources of the Clarion-Clipperton Zone. As a result, they decided to develop a geological model of the polymetallic nodule deposits in the Zone. This collaborative project was led by a group of technical experts, in partnership with the Secretariat of the International Seabed Authority, and scientists and other representatives from each of the Authority's contractors.

The resulting model predicts the geographical distributions of nodule metal content (of manganese, cobalt, nickel and copper) as well as abundance (kilograms of nodules per square metre of the seafloor), using data of other known variables on the seabed and in the water column of the Clarion-Clipperton Zone. Tested 'proxy data' included: chlorophyll concentration depth; distance from the East Pacific Rise and islands in the West; and carbonate compensation depth; seafloor topography; tectonic and volcanic framework; sediment character; among others. For example, nodule abundance did not appear to have any relation to carbonate compensation depth, while nodule grade towards the West of the Zone was affected by this variable. Statistical analysis showed that the highest grade nodules occur between -250m and +250m of the carbonate compensation depth.

The geological model was developed using information from the central data repository and additional samples and information acquired by the Authority's contractors. The contractors also provided expertise to complete various implementation aspects.

For example:

- China Ocean Mineral Resources Research and Development Association provided two scientists to assist with the resource assessment component, and large amount of data on nodule grade, abundance, sediments, and bathymetry.
- Korea Ocean Research and Development Institute contributed several consultants to help process and interpret data sets for nodule grade and abundance, type and sedimentation.
- *Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER)*, France provided data on different sediments for the preparation of sediment distribution maps.
- Data from Yuhzorgeologiya was used to analyze the interrelationships between nodule grade and abundance with tectonic and volcanic frameworks.
- Interoceanmetal Joint Organization provided a substantial amount of data on bathymetry, abundance and metal content, sedimentation, nodule types, water column, tectonic and volcanic activity observed in the Zone, as well as underwater photographs.
- Deep Ocean Resources Development Company Ltd. of Japan also provided some data on nodule abundance and grade.

The development of the geological model and prospectors' guide is a valuable example of implementation of the Authority's mandate; particularly its



### My Story:

#### Kaiser de Souza, Marine Geologist

*Chief, Division of Marine Geology, Geological Survey of Brazil, Ministry of Mines and Energy*

In 1993, I was busy completing post-doctoral work at the Federal Institute of Geosciences and Natural Resources in Germany, when I learned that the French prospector IFREMER/AFERNOD (*Institut Français de Recherche pour l'Exploitation de la Mer and Association Française pour l'Étude et la Recherche des Nodules Océaniques*) was seeking applications to take part in a 12-month training programme related to international seabed mineral prospecting.

I was immediately interested. Not only would the training present an opportunity for me to learn more about mining and exploration of mineral deposits in the deep sea; I would also gain insight into how and where these deposits were formed, and the techniques being used to evaluate them for metal content.

I was very pleased when my application was accepted. On 1 October 1993, I began the first phase of the programme at the *Centre d'Enseignement Supérieur en Exploration et Valorisation des ressources minérales* in Nancy, France. Over the next six months, I completed courses about mineral deposits and various mining operations, and the treatment methods and data processing that are used to study these deposits. I also learned how to analyze all the issues linked to mineral deposits, such as economics, tax law, and mining business jurisdiction. In this part of the programme, I had access to the most advanced knowledge and techniques being used in mining research and by mining geologists. This provided me with a solid basis of knowledge for the remainder of the training programme.

The second phase was led by IFREMER from 1 April to 30 September 1994. During this time, I completed a synthesis of the exploration work on polymetallic nodules that had been carried out by IFREMER/AFERNOD over 25 years. The synthesis was presented on 19 posters with detailed explanations. I also participated in a month-long oceanographic research cruise onboard the *L'Atalante* to study the morphobathymetric and geophysical coverage of New Caledonia's exclusive economic zone in order to identify the areas of greatest economic interest. During the cruise, I gained experience using different ocean exploration methods, oceanophysical measuring instruments, and the on-board data-processing systems. I also learned how to plan and implement a research cruise.

In the final phase of the training programme, I put into practice all of the lessons I had learned and experience I had gained by drafting a project paper to explore and evaluate the polymetallic nodules of the International Seabed Authority's reserved mining areas. This project considered the time involved, and approximate cost of at-sea operations, before and after mining operations would begin.

Upon completion of the programme, I was recruited by the Brazilian Government to serve as a scientific expert on ocean resources' affairs at their Ministry of Science and Technology. This was a great opportunity to apply my former professional experience, my education, and the new knowledge I had acquired during the IFREMER training.

responsibility to encourage collaborative scientific research in the international seabed area for the benefit of all mankind. The model provides the international scientific community with a better understanding of how and where economically interesting polymetallic nodule deposits have formed. For deep-sea mining entities, the model also provides a detailed resource assessment of the metals of economic value in nodules found in the Clarion-Clipperton Zone. Finally, the model facilitates future mineral prospecting in other international seabed areas through its prospectors' guide.

### Group of Technical Experts

#### **Project Co-ordinator:**

*Dr. Charles Morgan, Planning Solutions Inc., Hawaii*

#### **Bathymetry and Topography:**

*Dr. Lindsay Parson, Southampton Oceanography Centre*

#### **Tectonic and Volcanic Framework:**

*Mr. Yuri Kazmin and Dr. Valeri Yubko, Yuhzorgeologiya Enterprise, Gelendzhik*

#### **Sediment and Water Column Factors:**

*Professor David Cronan, Imperial College, London*

*Professor Michel Hoffert, Université Louis Pasteur, Strasbourg*

#### **Biological Factor:**

*Dr. Craig Smith, University of Hawaii*

So, in 1995, I returned home to assume this post for the next two years. In this position, I worked with technical staff from other ministries of the Brazilian government to expand the *National Programme for the Evaluation of the Mineral Resources Potential of the Brazilian Continental Shelf*. I also participated in the development of other national programmes and served as the scientific expert member of the Brazilian Delegation to the International Seabed Authority.

In November 1997, I was recruited as a marine geologist for the International Seabed Authority Secretariat. My duties included assessing and evaluating polymetallic nodule resources of the Authority's reserved areas, and analyzing data from contractors related to prospecting and exploring the international seabed. I also helped to organize meetings and workshops for scientists and other participants – and even lectured at one training programme to pass on my experiences to researchers entering deep-sea scientific fields.

My day-to-day activities exposed me to different techniques of seabed mineral resource prospecting, exploration and exploitation. I expanded my knowledge and expertise of marine data acquisition, processing, management, and interpretation. I also learned more about the regime governing the sea and oceans.

By December 2004, I was ready once again to return to my home in Brazil. I was offered, and I accepted, my current position as the Chief of the Division of Marine Geology at the Geological Survey of Brazil, which is part of the Brazilian Ministry of Mines and Energy.

Today, my responsibilities are focused on the implementation of the *National Programme for the Evaluation of the Mineral Resources Potential of the Brazilian Continental Shelf*. This includes systematic projects designed for the geological mapping of the Brazilian continental shelf as well as specific projects for the research of marine mineral resources, such as offshore diamonds, gold, heavy minerals, phosphorites, sand and gravels. At the same time, I have worked on proposals for scientific research in the international seabed area of the South Atlantic Ocean, and have participated on various national boards, commissions and working groups as the technical and scientific expert in marine mineral resources affairs.

I keep in contact with my former colleagues at the Authority, as well as contractors, scientists and other researchers in international seabed issues each year when I attend the Authority's annual sessions and participate in their workshops.

My education and the initial training programme in 1993 have brought me far in my career as a marine geologist. Providing opportunities to participate in training, courses, and hands-on research and analysis is an important initiative for the International Seabed Authority Endowment Fund to continue to generate for future scientists around the world.