



ISA TECHNICAL STUDY NO. 23



Towards the Development of a Regional Environmental Management Plan for Cobalt-Rich Ferromanganese Crusts in the Northwest Pacific Ocean



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Towards the Development of a Regional Environmental Management Plan for Cobalt-Rich Ferromanganese Crusts in the Northwest Pacific Ocean

Report of an International Workshop Convened
by the International Seabed Authority and China
Ocean Mineral Resources Research and Development
Association in Qingdao



China, 26-29 May, 2018



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CONTENTS

Background Note	4
Introduction	5
Acronyms and Abbreviations	6
Executive Summary	7
Opening Remarks	13
1. Opening Remarks by Mr. Shanqing Lin, Member of the Leadership of the Ministry of Natural Resources, People's Republic of China	13
2. Opening Remarks by Mr. Michael Lodge, Secretary-General of the International Seabed Authority	14
Sessions, Presentations and Discussions	17
Part I Legal and Scientific framework of REMPs	17
I. Presentations	17
II. Working Group Discussion	23
Part 2 Seamount Ecosystem and scientific knowledge	29
I. Introduction	29
II. Presentations	33
III. World Café Discussions	40
Part 3 Proposed approach for developing a REMP for CRC in the Northwest Pacific Ocean	44
I. Background Information	44
II. Presentations	46
III. World Café Discussions	48
Annex I. Workshop Programme	52
Annex II. List of Participants	55
Annex III. Co-Chairman and Steering Committee Members	57



BACKGROUND NOTE

An international workshop entitled “Towards the Development of a Regional Environmental Management Plan for the Cobalt-rich Ferromanganese Crusts in the Northwest Pacific Ocean” was held in Qingdao, China, between 26 and 29 May 2018. The workshop was jointly convened by China Ocean Mineral Resources Research and Development Association (COMRA) and the International Seabed Authority (ISA), in collaboration with the Second Institute of Oceanography, State Oceanic Administration (SOA) and National Deep Sea Center of SOA.

Over 100 officials and experts from government agencies, contractors, international organizations, non-governmental organizations, and academia as well as several members of the Legal and Technical Commission (LTC) attended the workshop.

With the overall objectives to provide a framework and strategic approaches for the development of a regional environmental management plan (REMP) for the cobalt-rich ferromanganese crusts in the Northwest Pacific Ocean, the workshop covered various issues relating to REMP, including policy and legal matters, characteristics of a seamount ecosystem and current knowledge gaps, science

based approaches for marine ecosystem protection, principles for designing areas of particular environmental interest (APEI), and mechanisms for future cooperation and coordination.

The workshop deliberations were conducted in both plenary meetings and working group discussions in the form of the World Café approach in which participants rotated among different working group tables, periodically, and contributed to various topics in an efficient manner. Each group was led by an expert in his or her respective field, drawing on background presentations provided at the beginning of each session. Before the discussion at each table began, the previous discussion was introduced to the participants by the moderator (table host) and then supplemented by new and additional inputs. However, given the limited time available for the workshop, further discussion and elaboration would be required for different topics, in particular the design and development of APEI networks.

This workshop report contains the summaries of the presentations and the plenary and working group discussions contributed by workshop participants.

INTRODUCTION

The regional environmental management plan (REMP) is one of the appropriate and necessary measures required to ensure the effective protection of the marine environment of the Area from harmful effects that might arise from activities in the Area, in accordance with Article 145 of the Convention. This workshop, “Towards the Development of a Regional Environmental Management Plan for the Cobalt-rich Ferromanganese Crusts in the Northwest Pacific Ocean”, is the first substantive step towards the development of REMPs, since the adoption of the first REMF for the Clarion-Clipperton Zone (CCZ) by the Council in 2012. It responds to repeated calls by the Council for the development of REMPs.

I am pleased that the Qingdao workshop was organized in a collaborative and transparent manner, with the participation of renowned experts and relevant stakeholders from the international scientific community, contractors and relevant international organizations. All ideas and views of the experts will provide an important foundation for ISA in developing the REMPs.

I wish to express my appreciation for the willingness demonstrated by the contractors who have done substantial exploration work in their contract area in the Northwest Pacific Ocean to enhance collaboration and cooperation among themselves, under initiatives of ISA, in the process of developing a REMF in this area, including the collection and analysis of



environmental data. I recognize the critical role of the contractors in the development of the REMPs and welcome any further collaborations for this purpose.

I extend my gratitude to the Chinese Government and China Ocean Mineral Resources Research and Development Association (COMRA) for successfully hosting the workshop. Every participant was very impressed by the beauty of Qingdao and the hospitality of the Chinese people.

A good beginning is half of the task. Meanwhile, the development of the REMF is not a short journey. More workshops are expected to be held, under the auspices of ISA, to ensure that the REMPs will be developed on the basis of the best available scientific information and evidence and in a transparent and collaborative manner.

Michael W. Lodge
Secretary-General
International Seabed Authority

1 See Annex I for the workshop programme and Annex II for the list of participants

ACRONYMS AND ABBREVIATIONS

ABMT	Area Based Management Tools
ADCP	Acoustic Doppler Current Profiler
APEI	Areas of Particular Environmental Interest
CBD	Convention on Biological Diversity
CCZ	Clarion-Clipperton Zone
COMRA	China Ocean Mineral Resources Research and Development Association
CRC	Cobalt-Rich Crusts
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ERA	Environmental Risk Assessment
FAO	Food and Agriculture Organization
JCOPE2	Japan Coastal Ocean Predictability Experiment
JOGMEC	Japan Oil, Gas and Metals National Corporation
KIOST	Korea Institute of Ocean Science and Technology
IRZ	Impact Reference Zone
ISA	International Seabed Authority
LTC	Legal and Technical Commission
MMAJ	Metal Mining Agency of Japan
PRZ	Preservation Reference Zone
PMN	Polymetallic Manganese Nodules
PMS	Polymetallic Massive Sulphides
REA	Russian Exploration Area
REMP	Regional Environmental Management Plan
SOA	State Oceanic Administration
SOPAC	South Pacific Applied Geoscience Commission
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea

EXECUTIVE SUMMARY

The workshop organizers, in cooperation with the Steering Committee (see Annex III), summarized the main conclusions and recommendations from three working groups convened during the workshop as well as comments or suggestions received from the participants after the workshop.

The objectives of the workshop were:



To enhance understanding of relevant ocean policies and laws at the national, regional and global levels.



To find a consensus on the design of the regional environmental management plan (REMP) for the cobalt-rich ferromanganese crusts, in particular its preliminary framework.



To explore mechanisms for communication and coordination; and formulate a work plan of collaboration and cooperation to collect data necessary for the design of the REMP.

Objectives and Principles of the REMP for CRC

In broad terms, the objective of the REMP is to provide proactive area-based

management tools for relevant organs of ISA, as well as the contractors and their sponsoring States, to support informed decision-making that balances resource development with conservation.² The EMP for the CCZ was the first and the only REMP developed to date by ISA.

Based on the lessons learned from the development and implementation of the REMP for the CCZ and the discussion of the workshop, the following guiding principles were proposed for the development of REMP for CRC in the northwest Pacific:

1) *Common Heritage of Mankind*

The Area and its resources are the common heritage of mankind.³ All rights in the resources of the Area are vested in mankind as a whole on whose behalf ISA shall act.⁴ Article 1.1 of UNCLOS defines the Area as “the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction”.

2) *Precautionary Approach*

Principle 15 of the Rio Declaration on Environment and Development⁵ specifies that where there are threats of serious or

² Preliminary strategy for the development of regional environmental management plans for the Area (ISBA/24/C/3). International Seabed Authority, Kingston, Jamaica, 2018,

³ UNCLOS, art. 136.

⁴ UNCLOS, art. 137, para. 2.

⁵ Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992 (United Nations publication, Sales No. E.91.I.8 and corrigenda), vol. I: Resolutions adopted by the Conference, resolution 1, annex I.

irreversible damage to the environment, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

3) *Protection and Preservation of the Marine Environment*

All States have an obligation to protect and preserve the marine environment.⁶ States must take the necessary measures to ensure the effective protection of the marine environment from harmful effects and for, inter alia, the protection and conservation of the natural resources of the Area and for the prevention of damage to its flora and fauna of the marine environment from the harmful effects that may arise from activities in the Area. States must take measures to protect and preserve rare or fragile ecosystems, as well as the habitats of depleted, threatened or endangered species and other forms of marine life.

4) *Environmental Impact Assessment*

When States have reasonable grounds for believing that planned activities under their jurisdiction or control may cause substantial pollution of, or significant and harmful changes to, the marine environment, they shall, as far as is practicable, assess the potential effects of such activities on the marine environment and shall communicate reports of the results of such assessments at appropriate intervals to the competent international organizations, which should make them available to all States.⁷

It was recommended to:

- a) Develop standardized evaluation systems for seamount ecosystems to

assess the health of the ecosystems and define the strategies for ecosystem protection; and

- b) Investigate specialized environmental parameters for CRC according to the environmental guidelines of ISA and establish a long-term observation inside and outside of the contract areas in the "Triangle Area".

5) *Conservation and Sustainable Use of Biodiversity*

It is the responsibility of all States to conserve the marine environment while exercising their right to sustainably use marine resources. The development of the REMP should pay due consideration to the work of the *Intergovernmental Conference on an international, legally binding instrument under UNCLOS on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction*.

6) *Transparency*

ISA shall enable public participation in environmental decision-making procedures in accordance with its own rules and procedures.

7) *Use of Best Available Scientific Information, Best Available Techniques and Best Environmental Practice*

In acknowledgement of the principles highlighted above, that should guide the scientific design of the REMP, a robust set of conclusions were arrived at and recommendations put forward, as follows.

- a) Science with the application of the precautionary approach is the key to developing a robust REMP that can fit into regional policy.
- b) Seamounts, which are potential stepping stones for species dispersal, may host

⁶ UNCLOS, art. 192.

⁷ UNCLOS, art. 206.

high faunal abundance and biomass and can be hotspots of biodiversity at a global scale.

- c) Species composition and spatial distribution of benthic assemblages are influenced by the interplay of environmental factors, and are closely related to water depth. The role of cobalt-rich crusts in determining the composition of benthic assemblages is unclear.
- d) Corals and sponges are often the predominant benthic groups and can be considered as key taxa of concern since they can be: habitat-forming organisms in many seamount assemblages; extremely long-lived, slow-growing and fragile; and highly vulnerable to anthropogenic impacts. Therefore, the recovery of a seamount ecosystem after any disturbance can be prolonged and is likely to take decades or centuries.
- f) Methods of nondestructive surveying and monitoring suitable for seamount habitats should be developed, standardized, and implemented.
- g) Main investigations on environmental parameters required outside contract areas include those related to physical oceanography, chemical oceanography, characteristics of biological communities and biodiversity, as well as geology.
- h) ISA might consider developing an "atlas" for the Triangle Area.
- i) The experience and most current scientific information and measures adopted by States and/or other inter-governmental competent organizations/bodies should be taken into account when developing a REMP for cobalt-rich crusts in the northwest Pacific Ocean; this should also be taken into account when making invitations for follow-up workshops.

8) Area Based Management Tools - APEI

In the process of the development of the REMP, it is necessary to design a network of APEIs. The workshop discussed

conservation goals, basis for delineation and scientific design of the APEIs for the CRC in the northwest Pacific Ocean. The conclusions and recommendations were as follows.

- a) APEI objectives should be to protect the biodiversity, integrity and functions of ecosystems in the "Triangle Area" and to understand the resilience of ecosystems, impact of human and natural disturbance, and restoration capacity.
- b) General guidelines set by ISA for the CCZ should be closely followed, with a particular attention to specific seamount ecosystem complexity, in designing APEIs in the "Triangle Area".
- c) Seamount ecosystems vary at multiple spatial scales, and this variability for each seamount should be considered when designing APEIs.
- d) The identification of a network of APEIs should avoid any overlapping with the reserved areas and contract areas in the "Triangle Area"; unless strong evidence that an APEI network that meets the APEI objectives cannot be put in place without overlapping with a reserved or contract area is reviewed and accepted by ISA.
- e) APEI design should consider the size and range of seamounts, and the full character of each seamount shall be included to protect the integrity of the ecosystem.
- f) 30-50% of the region should be included in a network of APEIs. While the 30-50% of protected areas established in the EMP for the CCZ is also important to meet APEI objectives for cobalt crust mining, it cannot be immediately applied in the same way in the "Triangle Area". The CCZ and the "Triangle Area" differ in nature, as the location of resources in the former is on the abyssal seafloor, whereas in the latter it is on seamounts, which have different topography and bathymetry. Providing scientific inputs and advice for

APEI network design(s) that meets this goal within the west Pacific Seamount Province and Prime Cobalt Crust Zone, inclusive of the “Triangle Area” and based on natural biogeographic units, should be a priority for stakeholders.

- g) There should be further research concerning the dispersal kernel, particularly to determine whether the 100-km (in one direction) buffer zone used for the CCZ is suitable for the REMP in the “Triangle Area”.
- h) More data will be available in the future. Therefore, future adaptation of the APEI should be allowed for, including possible changes of location and dimensions of APEI elements in the network, so long as conservation objectives are maintained.

9) Data Resource and Sharing

Data collection and sharing are the priority for the current development of the REMP. ISA’s database can be operational when it is populated with a comprehensive set of data. Several suggestions were put forward.

- a) Environmental data sharing should be realized as soon as possible to promote the development of the REMP. Data should include environmental baseline data, biological data, images, and so on.
- b) A list of possible data sources should be compiled. An initial list was suggested to include contractors, States, international organizations, universities, institutions, and so on.
- c) When contacting the data-holding States, organizations and institutions, their mandate and any reason stated for a potential withholding of the data should be taken into account. Explanations should be provided regarding the purpose of the request and the potential use of the data. This is especially important when the data requested are of a confidential nature. This approach will minimize instances of refusal to share data.

- d) The sourcing of historic data should be pursued, where available, for benchmarking purposes.
- e) ISA should share historical environmental data of the CRC in the northwest Pacific with the relevant contractors as soon as possible. This action should be included in the strategy for implementing an efficient digital database within ISA, where all environmental data should be available to the general public. However, it is necessary to specify what environmental data/measurements are confidential and non-confidential.
- f) The contractors should conduct “gap” analyses of baseline information and collect necessary data on: topography, physical characteristics, biodiversity, community structure, migration and dispersal, connectivity, ecosystem function and service, resilience, and restoration/recovery capacity, and human impacts. Scope and time limits of confidential data outside the contract area should be defined.
- g) The contractors and the scientists, who are the main producers of the data on the contract areas, should be given priority access to the data for publication purposes before it is made available to the public.

10) Cooperation and Coordination

The working groups emphasized that another key element to be considered in the development of the REMP was the promotion of close cooperation and collaboration among scientists, managers, policy agencies, commercial entities and NGOs, etc. Their suggestions are listed below.

- a) The development of the REMP should be based on the principle of cooperation and coordination, primarily among the States directly involved in the REMP, and, more generally, among all stakeholders.
- b) Increased collaboration and cooperation among the contractors, ISA, and

- international institutions are required, particularly in terms of information and specimen sharing, methodology standardization and capacity building.
- c) Close cooperation between contractors and research institutions was encouraged to develop efficient approaches for multi-disciplinary research, monitoring, EIA and ERA, as well as to share data and specimens. Development of new technology could be appropriate in some situations.
 - d) Contractors and countries in/around the "Triangle Area" should be encouraged to work together to collect data from areas beyond contract areas. Cooperation through international programmes, such as the Argo, which has the participation and support of all countries sponsoring ISA's contractors in the "Triangle Area", should be able to provide valuable data for the development of the REMP.
- a) Contractors should strengthen training in data, technology and management, and make efforts to provide training programmes or technical assistance to developing countries, especially the adjacent developing island countries.
 - b) Active communication with developing countries is necessary. Scientific and technical assistance should be provided to developing countries, such as organizing joint voyages, developing training programmes for environmental survey technology and helping with deep-sea curriculum development in universities.
 - c) Lessons need to be learned from international cooperation experience, and sufficient financial support would be necessary to facilitate international cooperation.

11) Training and Funding

Contractors are required to develop practical programmes to train personnel of ISA and developing States, including the participation of such personnel in activities in the Area covered by the contract⁸ as well as the promotion of the transfer of technology and scientific knowledge relating to activities in developing States.⁹ In this process, States shall also ensure that competent international organizations consider the interests and needs of developing States when coordinating their activities, including any regional or global programmes.¹⁰ The developing States which may need and request technical assistance should be encouraged to acquire necessary equipment, processes, and make appropriate financial arrangements, etc.¹¹

Next Steps

The workshop proposed that the following points needed to be considered in the process of developing the REMP for the CRC in the northwest Pacific Ocean:


- a) The establishment of a steering committee, liaison office and working group to coordinate the development of the REMP programme.
- b) The adoption of an international partnership for two to three years to promote the development of the REMP; the funding and support of the scientific community (such as universities, research institutes, etc.), with the role of the contractor given full play through a stable level of funding support from ISA.
- c) Due consideration should be given to socio-economic aspects for the development of the REMP, taking into account the following factors: 1) the contract areas; 2) the exclusive

⁸ UNCLOS, Annex III, art. 15.

⁹ UNCLOS, art. 144.

¹⁰ UNCLOS, art. 272.

¹¹ UNCLOS, art. 274.



economic zones (EEZs) and continental shelves of the coastal States surrounding the “Triangle Area”; 3) other marine activities, including fishing, submarine cables and pipelines and shipping; 4) migratory animal pathways; and 5) maintenance of the populations of endemic species.

d) ISA, contractors, and other organizations should cooperate and communicate in promoting data sharing through joint voyages, joint projects, and international workshops on important scientific issues such as data standardization.

OPENING REMARKS

1. Opening Remarks by Mr. Shanqing Lin, Member of the Leadership of the Ministry of Natural Resources, People's Republic of China

His Excellency Mr. Michael W. Lodge,
Secretary-General of ISA,
Ladies and gentlemen,

Let me begin by welcoming you to this beautiful city of Qingdao to discuss the strategic plan for the regional environment protection in the Triangle Area in the northwest Pacific Ocean. First, on behalf of the Government of the People's Republic of China, I would like to extend my appreciation for your participation and to offer congratulations on the opening of the workshop.

Contractors from China, Japan, the Republic of Korea and the Russian Federation have carried out intensive studies and research in the Triangle Area in the northwest Pacific region. Under the UNCLOS and ISA's Regulations, ISA and the contractors have the obligation to protect the deep-sea environment. Accordingly, during the 23rd session of ISA, COMRA presented the idea for the development of a REMP for the cobalt resources in the northwest Pacific region. I am pleased to see that this initiative has received positive feedback and support from ISA and the Secretary-General himself.

China appreciates this opportunity to jointly organize this workshop with ISA. It is also an opportunity for China to



demonstrate readiness to be actively involved in global ocean governance and marine environment protection.

China, as the largest developing country, is still working hard to develop our ocean related capacities. At the same time, China actively performs its international obligations, along with our global partners, to achieve common prosperity and progress.

On 1 May 2016, the Law of the People's Republic of China on Exploration for and Exploitation of Resources in the Deep Seabed Area took effect. It will be followed by implementation regulations and rules, including rules for deep-sea resource

exploration and the interim measures for specimen and material management.

Over the years, COMRA has carried out oceanic and environment surveys and submitted the data and information collected to ISA in a timely manner. I believe the data and information, particularly environmental data, will be useful in the development of REMPs. The Chinese contractors will continue their active involvement in contributing to this process.

I wish that the Triangle Project as proposed by COMRA, with the guidance and support of ISA, with valuable inputs from experts present from around the world, and with the support of contractors and other stakeholders, will be a good start for the development of the REMP for the cobalt-rich crusts in the northwest Pacific.

China is ready to work with other members of ISA, not only in developing the exploitation revolution, but also in protecting the deep-sea environment, and will continue to play an active and constructive role in rational exploration and exploitation of the common heritage of mankind.

Chinese President Mr Xi Jinping's concept of "a community of a shared future for mankind" has been affirmed by a UN resolution, as it serves the shared interest of the international community and shared aspirations of all the countries for prosperity and development. I sincerely hope that this workshop will present new opportunities to explore international deep-sea cooperation for shared development. Such mutually-beneficial international cooperation will make our future better and brighter.

I wish the workshop great success, and that you will enjoy your stay in Qingdao. Thank you.



2. Opening Remarks by Mr. Michael W. Lodge, Secretary-General of the International Seabed Authority

Dear Mr. Shanqing Lin,
Distinguished colleagues, ladies and gentlemen,

Let me begin by thanking COMRA for its generous support for this international workshop. I also appreciate the hard work put into the preparation for this workshop by many colleagues from COMRA, National Deep-Sea Center in Qingdao and the Second Institute of Oceanography in Hangzhou. I also extend my gratitude to each member of the Steering Committee which made a tremendous contribution to the organization of this workshop.

As all of you are aware, ISA is the only international organization mandated by the United Nations Convention on the Law of the Sea (UNCLOS) to administer and manage, on behalf of the States Parties

to the Convention, the mineral resources in the Area. There are two aspects to this mandate; one is the exploration and exploitation of the mineral resources in the Area for the benefits of humankind as a whole, while the other is the effective protection for the marine environment from harmful effects which may arise from such exploration and exploitation activities.

The environmental management objectives of ISA may be derived from Article 145 of UNCLOS, which includes: (a) the prevention, reduction and control of pollution and other hazards to the marine environment; and (b) the protection and conservation of the natural resources of the Area and the prevention of damage to the flora and fauna of the marine environment.

These environmental management objectives will be achieved through several different vehicles, including regulation during the exploration and exploitation phases, and the contractor's own environmental management and monitoring plans during exploitation. At the regional level, however, the primary vehicle for delivery of ISA's environmental management objectives will be the REMP. As you know, the first REMP for the Area was adopted for the CCZ in 2012. This included the designation of a network of nine areas of particular environmental interest (APEIs) through a collaborative process involving relevant stakeholders.

Since 2012, the Council has, repeatedly, called upon the Secretariat of ISA and the Commission to progress the development of similar REMPs in other parts of the Area, in particular where contracts for exploration currently exist. These calls have also been reflected in the resolutions of the General Assembly.

As a consequence, in March 2018, the Council considered a preliminary strategy, proposed by me, for the development of

REMPs under the auspices of ISA for key provinces where exploration activities are taking place. The Council also agreed that the priority areas to be considered include the mid-Atlantic Ridge, the Indian Ocean triple junction ridge and nodule-bearing province, as well as the northwest Pacific and south Atlantic for seamounts.

It is anticipated that having REMPs in place in all mineral provinces where exploration occurs will create the enabling conditions to inform better decision-making processes as well as contribute to the effective management of activities undertaken in the Area. The importance of this project is recognized in the draft strategic plan for ISA for the five-year period 2019-2023 and we will also be proposing a specific work programme on REMPs in the budget for the financial period 2019-2020.

The first phase of this project will consider an appropriate methodology for the development of REMPs in areas where there are contracts for polymetallic sulphides and cobalt-rich crusts exploration through the organization of scientific workshops. This workshop, being held in partnership with COMRA in Qingdao, China (in May 2018) and the second workshop in Szczecin, Poland, in June 2018. The Szczecin workshop is aimed at setting the priorities and geographical areas for the development of REMPs for polymetallic sulphides deposits on mid-ocean ridges. During the second half of 2018, a workshop will be held to review the status of implementation of the REMP adopted for CCZ on the basis of newly-available data.

The second phase of work will focus on the organization of follow-up workshops to finalize the recommendations that will be presented to the LTC for its consideration. The Commission will then be in a position to decide on any recommendations or proposals to be submitted to the Council.

Ladies and Gentlemen,

The present Qingdao workshop is intended to initiate discussions on the development of a REMP for the CRC zone in the Pacific Ocean (the so-called 'Triangle Area'). The goals of the workshop are to:

- a) understand the national, regional and international policies and laws;
- b) find a consensus on the design of the REMPs as well as the preliminary ideas for its framework; and
- c) produce a work plan for two to three years of scientific collaboration to collect and share the data needed for the design of the REMP.

I would like to highlight three points.

Firstly, in designing a REMP for the "Triangle area", many lessons might be drawn from the existing CCZ-REMP including the guiding principles, implementation methodology, design principles for APEIs, etc. In each case, we must keep in mind the different nature of the distribution of resources and consider how environmental management objectives will be progressed and what will go into a REMP for each mineral resource.

Secondly, ISA must provide guidelines on the assessment and archiving of data and information on baseline studies. Well-structured and organized information for the area where ISA has issued contracts

is of utmost priority for the design of any REMP. ISA's new database will be a critical asset in ensuring sound and efficient data management. It will contain information collected by contractors and by independent scientific institutions worldwide. It will also host all the environmental information collected on APEIs as well as other baseline management tools defined in REMPs.

Thirdly, the design of REMPs relies on the cooperation of stakeholders. While the prime responsibility is with ISA, ISA should cooperate with other competent international organizations, contractors and independent researchers, as appropriate.

Actually, the REMP is largely dependent on the exploration activities by contractors. However, at present, much of these data are not available. Therefore, consideration will have to be given to identifying gaps in science and to target research at the appropriate scale, which will require different stakeholders to cooperate, in particular with and among the contractors.

Ladies and gentlemen,

I am looking forward to a successful and fruitful workshop with your contributions. I reiterate my thanks to all of you for your participation in the workshop and continued support of the work of ISA.

SESSIONS, PRESENTATIONS AND DISCUSSIONS

Part 1 Legal and Scientific framework of REMPs

I. PRESENTATIONS

1. China's Deep-Sea Environment Policy and Practice

Mr. Feng Liu

Mr. Feng Liu affirmed China's commitment to the policy of respecting, adapting to and protecting nature, and the adoption and implementation of the strictest possible environmental protection policy. The concept of "Ecological Civilization" was widely accepted across the country and even globally. The principle of extensive consultations and joint contributions for the shared benefits was adopted by the Resolution of the United Nations (UN) on 21 September 2017. He said that China's main position on deep seabed regimes included: (1) sticking to the principle of the Common Heritage of Mankind; (2) use of the Area exclusively for peaceful purposes; (3) maintaining a balance between utilization of the resources and protection of the environment.

The Law of the People's Republic of China on Exploration and Exploitation of Resources in the Deep Seabed Area was adopted on 26 February, 2016. The law provided for "Exploration and Exploitation" and "Environment Protection" in Chapters II and III, respectively.



As one of the pioneers in deep-sea mineral resources exploration, COMRA had consistently insisted on balancing the utilization of the resources with the protection of the environment. During the 23rd session of ISA in August 2017, COMRA held a side event entitled "Balance between Resources Exploitation and Environmental Protection". He emphasized that COMRA had always fulfilled its obligations under the UNCLOS and ISA's regulations.

Mr. Liu highlighted the work of COMRA in relation to the design and development of the REMPs. Firstly, COMRA proposed the NaVaBa (Natural Variability Baseline Study) programme as the environmental practice in the CCZ. COMRA's environmental data from both the contract area and the APEIs was provided to ISA. Secondly, a U-Shaped Project was proposed for the PMS area in the mid-ridge in the Indian Ocean and the

South Atlantic Ocean recently. Last, but not least, COMRA proposed an initiative to co-develop a REMP for CRC in the “Triangle Area” in the northwest Pacific Ocean. It was on this basis that ISA and COMRA jointly organized the international workshop to advance the development of the REMP for CRC.

Mr. Liu emphasized that the deep sea is vast with many mysteries and exploitation activities came at a high cost. A single scientist or institution would not be able to take on the challenge or bear the burden of these activities on its own. Consequently, he recommended that ISA, the contractors, international organizations and other stakeholders cooperate to develop REMPs, with a view to building a community with a shared future for mankind and creating a bright tomorrow for all.

2. Towards the Development and Implementation of an Environmental Management Plan Strategy for the Area

Dr. Sandor Mulsow

Dr. Mulsow introduced his presentation with a discussion on ocean governance, including the direct and indirect links among the different international organizations, highlighting ISA's functions under the Convention and the 1994 Agreement relating to the implementation of Part XI of the Convention (Fig. 6-1). He noted that ISA was the only international organization mandated by the Convention to organize and control activities in the Area, on behalf of the States Parties, particularly with a view of administering the resources of the Area.

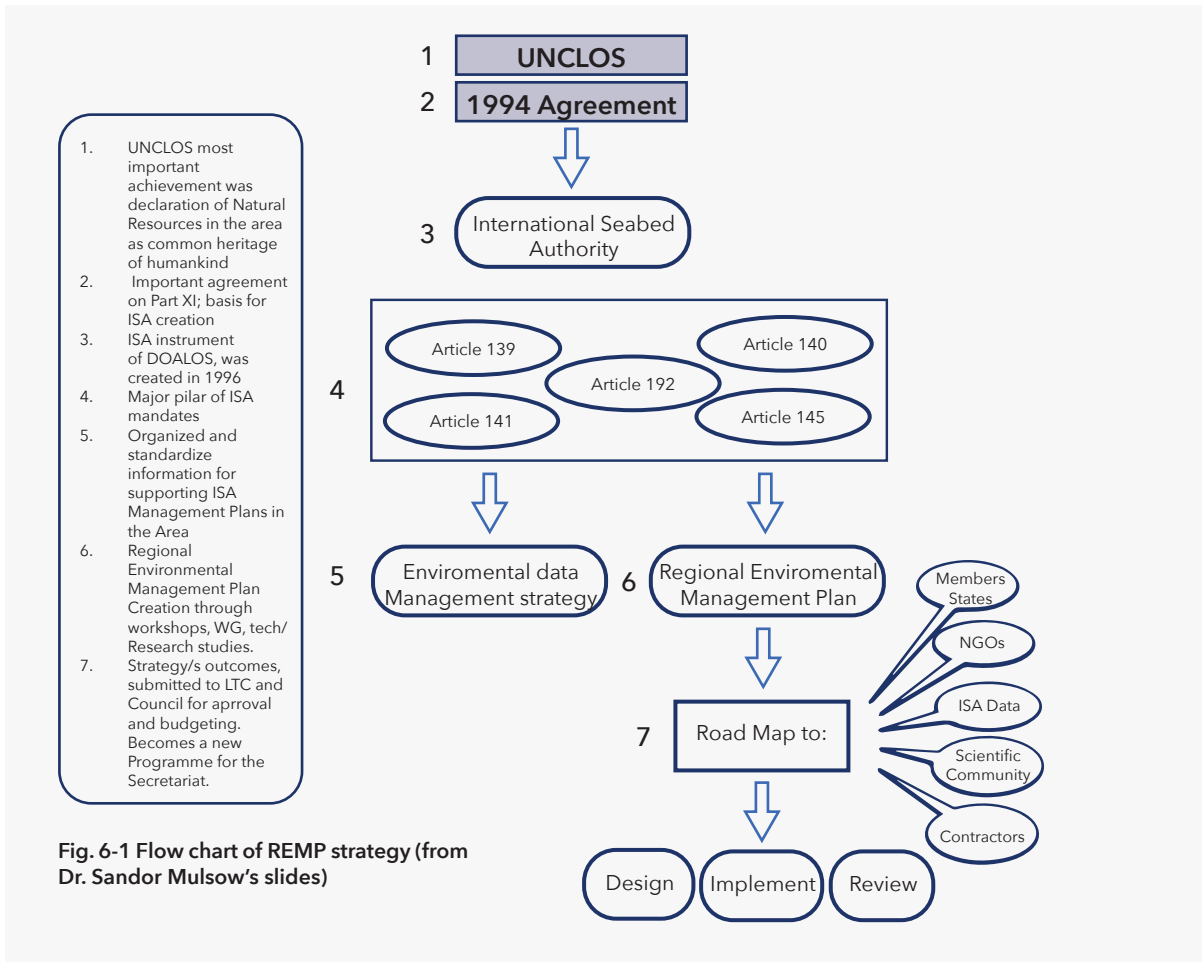
He summarized the approved plans of work under ISA's contract regimes and locations of contract areas on the map and briefs on the Regulations on Prospecting and Exploration for CRC in the Area.



He highlighted the mining criteria and challenges for the CRC. Questions relating to the methodologies/samplers/techniques to be utilized were raised, particularly in situations such as: where mining operations were taking place around the summit of guyots on flat or shallowly-inclined surfaces and seamount summits which are generally not deeper than 2,200m; where there was little or no sediment on the summit platform and strong and persistent bottom currents were present; and where the summit region above 2,500m was more than 400km².

He noted that the following factors should be considered when determining geographical areas for mining. Submarine flanks of islands and atolls were identified as inappropriate. Clusters of large seamount, old seamounts (Cretaceous age, 140-65 My old) with thick crust, high grades (Co, Ni, Cu, etc.), and stable slope and guyots with large summit areas were preferred. The Central Pacific seamounts fulfill the criteria.

Dr. Mulsow emphasized the objectives of the REMP in the CCZ:



- a) to ensure that relevant organs of ISA as well as contractors and their sponsoring States were provided with proactive area-based and non-area based management tools to support informed decision-making that balances resource development with conservation;
- b) to contribute to the effective conservation and management of biodiversity in the marine area beyond national jurisdiction and to help build the resilience of deep-sea benthic ecosystems to the impacts of climate change on the ocean; and
- c) to ensure that a clear and consistent mechanism was established in order to identify particular areas thought to be representative of the full range of habitats, biodiversity and ecosystem structure and function, and provide those areas with appropriate levels of protection.

Dr. Mulsow concluded that ISA clearly has the mandate and legal framework to undertake the design of a REMP in the Area. Considering that the cobalt ferromanganese crusts were well defined and seamount-guyots presented geographical constraints (block size-shape), the ABMT should be carefully chosen. He noted that the REMP strategy was a dynamic one which had to be reviewed and updated periodically. The strategy would be built on the outcome of the workshops (Qingdao and Szczecin), in particular on designing methodologies, cost-effective data gathering (gap analysis) initiatives, etc. Another workshop would be convened in due course to review the REMP for CCZ. The same strategy would be used for Indian Ocean nodules fields.

3. Legal & Regulatory Framework on the protection of marine environment

Mr. Yongsheng Cai

Mr. Yongsheng Cai, Legal Officer of ISA, briefed participants on the mandates of ISA in respect of protection and preservation of the marine environment, different roles of the organs of ISA, responsibilities of the States Parties and the sponsoring States, and responsibilities of the contractors in relation to the process of the development and implementation of REMPs. He highlighted, in particular, the roles of the State Parties, Sponsoring States and contractors.

States Parties to the Convention were obliged to protect and preserve the marine environment. They were required to take, individually or jointly as appropriate, all measures necessary to prevent, reduce and control pollution of the marine environment from any source, and to ensure that pollution arising from incidents or activities under their jurisdiction or control does not spread beyond the areas of their national jurisdiction. The measures taken should include those necessary to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life. Furthermore, he said, the States Parties were required to take all measures necessary to prevent, reduce and control pollution of the marine environment resulting from the use of technologies under their jurisdiction or control, or the intentional or accidental introduction of species, aliens or new, to a particular part of the marine environment, which may cause significant and harmful changes thereto. They should cooperate on a global or regional basis, directly or through competent international organizations, in formulating and elaborating international rules, standards and recommended practices and procedures for the



protection and preservation of the marine environment. They should also monitor the risks or effects of pollution and assess the potential effects of activities which could cause substantial pollution of or significant and harmful changes to the marine environment.

In terms of pollution from activities in the Area, Mr. Cai said that States Parties should adopt complementary laws and regulations to prevent, reduce and control pollution from any activities in the Area undertaken by vessels, installations, structures and other devices flying their flag or of their registry or operating under their authority. Those laws and regulations should be no less effective than the rules, regulations and procedures of ISA.

He observed that only the States Parties to the Convention could sponsor an exploration or exploitation contract and then become the sponsoring State. Therefore, the sponsoring States must fulfil their obligation in regard to protection and preservation of the marine environment, in their capacities as States Parties. Further, they had particular responsibilities relating to the activities in the Area. According to the Advisory Opinion issued on 1 February

2011 by the Seabed Disputes Chamber of the International Tribunal for the Law of the Sea, the sponsoring States had two kinds of obligations under the convention and related instruments. The primary obligation was to ensure compliance by sponsored contractors with the terms of the contract and the obligations set out in the Convention and related instrument. This was an obligation of “due diligence”. The sponsoring State was bound to make best possible efforts to secure compliance by the sponsored contractors. The sponsoring States shall also fulfil the following direct obligations:

- a) to assist ISA, as set out in article 153, paragraph 4, of the Convention;
- b) to apply a precautionary approach;
- c) to apply the “best environmental practice”;
- d) to adopt measures to ensure the provision of guarantees in the event of an emergency order by ISA for protection of the marine environment;
- e) to provide recourse for compensation; and
- f) to ensure compliance by the sponsored contractor with its obligation to conduct an EIA.

He outlined the responsibilities of the contractors in respect of the protection and preservation of the marine environment, which included:

- a) prior environmental impact assessment for specified activities that may have significant adverse impacts on the environment;
- b) an environmental monitoring programme to be carried out before, during and after the specific activity;
- c) cooperative research which may provide additional data for the protection of the marine environment and may be cost-effective for contractors;
- d) making the best use of large-scale research facilities such as vessels, autonomous underwater vehicles

and remotely operated vehicles and expertise in geology, ecology, chemistry and physical oceanography of academic institutions; and

- e) exploring opportunities to unite their efforts in international cooperative oceanographic studies.

4. Frameworks for REMPs: the CCZ Nodule Example

Dr. Cindy Lee Van Dover

Dr. Van Dover shared that the EMP for the CCZ had been approved by ISA in 2012 and included at least a dozen key management elements or tools, not the least of which is the scientific design of a replicated network of APEIs. She provided a brief review of the management tools included in the plan, highlighted the area-based management tool and the science-based principles that underlie the design of a network of APEIs, and illustrated how well these principles were aligned with those developed for other area-based management contexts.

She introduced some key management elements in the development of the CCZ REMP such as environmental risk evaluation, environmental impact



Clarion Clipperton Zone Environmental Management Plan Key Management Elements

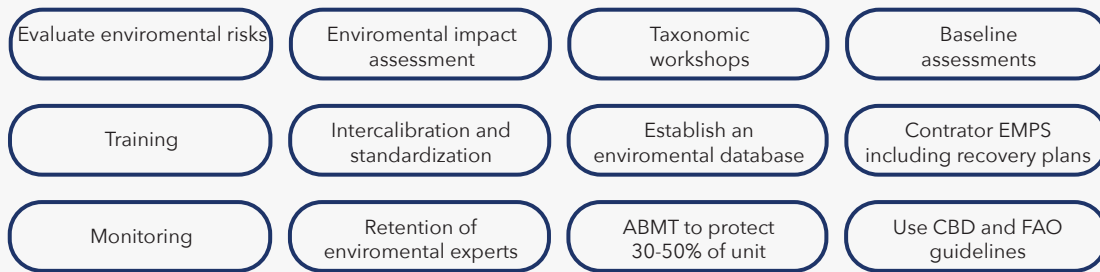


Fig. 7-1 Key management elements in the development of the CCZ REMP (from Dr. Cindy Lee Van Dover's slides)

ABMT: Area-Based Management Tools
 CBD: Convention on Biological Diversity
 FAO: Food and Agriculture Organization

assessment, taxonomic workshops, etc (Fig. 7-1).

Dr. Van Dover also highlighted design principles for CCZ REMP codified by the LTC of ISA and were applicable to REMPs in the ABNJ as follows.

- Protect 30-50% of the management area
- Fit the design into existing legal frameworks
- Minimize socioeconomic impacts
- Maintain sustainable, intact and healthy marine populations
- Take into account biophysical gradients that affect the biogeography of marine biodiversity
- Protect the full range of habitat types found within each subregion
- Ensure maintenance of minimum viable population sizes for species potentially restricted to a sub-region (2 x dispersal distance)
- Use a buffer zone to ensure that biota and habitats in the protected area are not affected by anthropogenic threats occurring outside the MPA
- Establish straight-line boundaries.

Based on Annex III to the Convention on Biological Diversity (CBD) Decision IX/20,

Dr. Van Dover proposed four initial steps in the development of representative networks of marine protected areas. She shared criteria developed to define important areas of vulnerable marine ecosystems and ecologically or biologically significant marine areas by the FAO and CBD, respectively. According to network criteria based on Annex II to the CBD Decision IX/20, scientific guidance for selecting areas to establish a representative network of marine protected areas included representativity, connectivity, replication and adequacy & viability including under ocean climate change.

Finally, she highlighted the following key points in the design of APEIs.

- Final design and placement of APEIs was the purview of Member States of ISA
- Design principles should allow for a robust framework based on inter-governmentally agreed criteria
- Quantitative metrics allowed for network design options to be evaluated against conservation goals
- Design principles may be applied to other mid-ocean ridges
- APEIs were only one aspect of a REMP

- Regional conservation targets may be met by multiple management measures (e.g., protection of active vents, temporal planning).

II. WORKING GROUP DISCUSSION

1. Introduction to the legal framework related to the protection and preservation of the marine environment

Dr. Luigi Santosuoso, co-moderated by Dr. Russell Howorth, Dr. Cindy Lee Van Dover and Mr. Linlin Li

General obligations

It was observed that under the 1982 UNCLOS, States had a general obligation to protect and preserve the marine environment.¹² This overarching obligation encompassed responsibilities to prevent, reduce and control pollution of the marine environment from any source, to monitor the risks or effects of pollution and to assess

the potential effects of planned activities under a State's jurisdiction or control that may cause substantial pollution of or significant and harmful changes to the marine environment.¹³

In particular, States should take measures to protect and preserve rare or fragile ecosystems, as well as the habitats of depleted, threatened or endangered species and other forms of marine life. They should also prevent, reduce and control pollution resulting from the use of technologies under their jurisdiction or control and the intentional or accidental introduction of alien or new species to a particular part of the marine environment.¹⁴

Obligations in the Area

In the deep seabed beyond national jurisdiction, that is the "Area", those responsibilities were shared among all States Parties to the Convention as the Area and its resources are the common heritage of mankind.¹⁵



¹² UNCLOS, art. 192.

¹³ UNCLOS, arts. 194, 204 and 206. Of particular relevance to deep seabed mining is art. 194 (3) (d), which provides that States shall take measures to minimize to the fullest possible extent pollution from installations and devices in exploration or exploitation of the natural resources of the seabed and subsoil, in particular measures for preventing accidents and dealing with emergencies, ensuring the safety of operations at sea and regulating the design, construction, equipment, operation and manning of such installations or devices.

¹⁴ UNCLOS, arts. 194 (5) and 196 (1).

¹⁵ UNCLOS, art. 136.

Legal framework related to the mandates of ISA on the protection of the marine environment

ISA, on behalf of the States Parties to the Convention, had responsibility for administering the mineral resources of the Area, including prospecting, exploration and exploitation activities for those resources.¹⁶

It was shared that as part of its responsibility, ISA was charged with taking the measures necessary to ensure effective protection of the marine environment from the harmful effects that may arise from such activities. For that purpose, ISA must adopt appropriate rules, regulations and procedures for, *inter alia*:

- The prevention, reduction and control of pollution and other hazards to the marine environment, including the coastline, and of interference with the ecological balance of the marine environment. In doing this, its mandate called for particular attention to be paid to the need for protection from the harmful effects of activities such as drilling, dredging, excavating, disposing of waste, and constructing and operating or maintaining installations, pipelines and other devices related to such activities.
- The protection and conservation of the natural resources of the Area, and the prevention of damage to the flora and fauna of the marine environment.¹⁷

The 1994 Agreement relating to the Implementation of Part XI of the UNCLOS of 10 December 1982 reaffirmed those responsibilities by establishing “the importance of the Convention for the protection and preservation of the marine

environment and of the growing concern for the global environment” and goes on to state that between the entry into force of the Convention and the approval of the first work plan for exploitation, ISA shall concentrate on, *inter alia*, the “Adoption of rules, regulations and procedures incorporating applicable standards for the protection and preservation of the marine environment”.¹⁸

It was explained that under Annex III to UNCLOS, rules, regulations and procedures had to be drawn up by ISA to secure effective protection of the marine environment from both harmful effects directly resulting from activities in the Area or from shipboard processing immediately above a mine site of minerals derived from that mine site. The procedures should take into account the extent to which such harmful effects may directly result from drilling, dredging, coring and excavation, as well as from disposal, dumping and discharge into the marine environment of sediment, wastes or other effluents.¹⁹

The General Assembly of the United Nations (UN), in its resolutions on oceans and the law of the sea, had reiterated the importance of the ongoing elaboration and standardization by ISA, pursuant to article 145 of UNCLOS, of rules, regulations and procedures to ensure the effective protection of the marine environment for, *inter alia*, the protection and conservation of the natural resources of the Area and for the prevention of damage to the flora and fauna of the marine environment from the harmful effects that may arise from activities in the Area. In those resolutions, the Assembly recognized the importance of the responsibilities entrusted to ISA by articles 143 and 145, which referred to marine scientific research and protection

¹⁶ UNCLOS, art. 157 (1).

¹⁷ UNCLOS, art. 145, Annex III, art. 17 (1) (b) (xii).

¹⁸ Implementing Agreement, Annex, section 1, para. 5 (f).

¹⁹ UNCLOS, Annex III, art. 17 (2) (f).

of the marine environment in the Area, respectively.²⁰

The Regulations on Prospecting and Exploration for CRC in the Area ("CRC Regulations") that were approved by ISA in 2012 imposed comprehensive environmental protection obligations on the States and State-sponsored entities involved in the prospecting and exploration phases of deep seabed mining.

States and State-sponsored entities submitting plans of work for exploration in the Area were required to submit a description of their proposed programmes for oceanographic and environmental baseline studies. Those studies enabled the scientific assessment of the potential environmental impact of the proposed exploration activities on the marine environment, and provided a description of proposed measures for the prevention, reduction and control of pollution and other hazards, as well as describing possible impacts on the marine environment.²¹ Once exploration contracts were signed with ISA, exploration contractors were required to gather environmental baseline data against which to assess the likely effects of their activities on the marine environment; they should also devise programmes to monitor and report on such effects.²² The contractors were expected to report, annually, to the Secretary-General of ISA on the implementation and results of their monitoring programmes and submit environmental baseline data.²³

The REMP for the northwest Pacific Ocean should be consistent with the obligations, responsibilities, rules, regulations and procedures described above. Terms used

in the Convention and CRC Regulations should have the same meaning in the present document.

The REMP should contribute to the implementation of Sustainable Development Goal 14, namely to "conserve and sustainably use the oceans, seas and marine resources for sustainable development", which includes, for example, the target of conserving at least 10% of coastal and marine biodiversity (target 14.5).

Scope of application

Pursuant to article 1, paragraph 1, of the Convention, "Area" means the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction. The delineation of the outer limits of the continental shelf by coastal states, pursuant to article 76, of the Convention, is therefore necessary to determine that the area included in the northwest Pacific Ocean is entirely beyond the limits of national jurisdiction.

Other international organizations and processes related to the protection of the marine environment

ISA should work in consultation with many other international organizations and processes related to the protection of the marine environment.

Preliminary strategy for the development of REMPs for the Area

A preliminary strategy for the development of REMPs for the Area was presented by the Secretary-General of ISA, at its 24th session. Its purpose was to provide the Council with the outline of a coordinated strategy for developing REMPs under the auspices

20 For the latest resolution see A/RES/72/73, paras. 61 and 67. Similar provisions have been adopted annually in previous resolutions.

21 Cobalt-rich Ferromanganese Regulations, Reg. 20 (b)-(d).

22 Cobalt-rich Ferromanganese Regulations, Reg. 34 (1); see also Part XI Implementing Agreement, Annex, section 1, para. 7.

23 Cobalt-rich Ferromanganese Regulations, Reg. 34 (2).

of ISA, in line with relevant decisions of the Council. The strategy identified, on a preliminary basis, the following priority areas for development of REMP in the Area: The mid-Atlantic Ridge, the Indian Ocean triple junction ridge and nodule-bearing province, as well as the northwest Pacific and south Atlantic for seamounts.²⁴

The following guiding principles were proposed for the REMP.

- a) **Common heritage of mankind:** The Area and its resources are the common heritage of mankind.²⁵ All rights in the resources of the Area are vested in mankind as a whole on whose behalf ISA shall act.²⁶
- b) **Precautionary approach:** Principle 15 of the Rio Declaration on Environment and Development²⁷ specifies that where there are threats of serious or irreversible damage to the environment, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.
- c) **Protection and preservation of the marine environment:** All States have the obligation to protect and preserve the marine environment.²⁸
- d) **Prior environmental impact assessment:** When States have reasonable grounds for believing that planned activities under their jurisdiction or control may cause substantial pollution of or significant and harmful changes to the marine environment, they shall, as far as practicable, assess the potential effects of such activities on the marine environment and shall communicate reports of the results

of such assessments in the manner provided in article 205 of UNCLOS.²⁹

- e) **Conservation and sustainable use of biodiversity:** All States have a duty to conserve marine environment and have a right to sustainably use marine resource.
- f) **Transparency:** ISA shall enable public participation in environmental decision-making procedures in accordance with its own rules and procedures.
- g) **Use of best available scientific information, best available techniques and best environmental practice:** These are the principles that should guide the scientific design of the REMP.
- h) **Area based management tools:** ABMTs for REMP should be developed taking into account the EMP for the CCZ (ISBA/17/LTC/7), which provides guidance with regard to the design principles for APEI.

2. Summary of discussions (conclusions and recommendations)

The following questions were addressed to the Working Group 1:

- i) Besides the CRC Regulations, does the development of a REMP for CRC in the northwest Pacific Ocean need to refer to other rules, regulations and processes formulated by States and/or other international governmental organizations or institutions?
- (ii) During the process of developing a REMP for CRC in the northwest Pacific Ocean, what lessons can be learnt from the EMP for the CCZ?

24 Preliminary strategy for the development of regional environmental management plans for the Area (ISBA/24/C/3). International Seabed Authority, 2018, Kingston, Jamaica. para. 2.

25 UNCLOS, art. 136.

26 UNCLOS, art. 137, para. 2.

27 Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992 (United Nations publication, Sales No. E.91.I.8 and corrigenda), vol. I: Resolutions adopted by the Conference, resolution 1, Annex I.

28 UNCLOS, art. 192.

29 UNCLOS, art. 206.

Working Group 1, which met on 28 May 2018, was subdivided in two sub-groups moderated by Dr. Russell Howorth (rapporteur: Dr. Luigi Santosuosso) and Dr. Cindy Lee Van Dover (rapporteur: Mr. Linlin Li).

In view of the time constraints, it was decided that the subgroup moderated by Dr. Howorth would focus primarily on question (i) and the subgroup moderated by Dr. Van Dover would focus primarily on question (ii). Below is a summary of the conclusions and recommendations by the two subgroups which were reported to the plenary of the workshop on 28 May 2018.

Conclusions and recommendations relating to Question (i)

The conclusions and recommendations of the working group are:

- (a) The experience, current scientific information gained and measures adopted by States, and/or by other international governmental organizations or institutions should be taken into account when developing a REMP for CRC in the northwest Pacific Ocean. This should also be taken into account when organizing the follow-up CRC workshops (e.g. an invitation should be extended to the Marshall Islands in view of their legislation concerning exploration for CRC).
- (b) A list of appropriate international and national resources from which data can be obtained should be compiled. An initial list might include the following.-
States: Federated States of Micronesia, Marshall Islands, New Zealand, United States of America (Capstone project); States that have sponsored contracts signed with ISA and might have data concerning the area to be included in the REMP. **International Organizations:** FAO, including data on bottom trawling (see A/RES/61/105),

in particular through its regional offices in Fiji and Samoa, IHO, North Pacific and South Pacific RFMOs, Secretariat of the Pacific Community (for data collected by SOPAC).

- (c) **Institutions:** International Cable Protection Committee, Woods Hole Institute of Oceanography; **Other sources:** such as Argo, Census of Marine Life, World Ocean Database, Seadatanet, and WOCE. When contacting the data-holding States, organizations and institutions, their mandate and any reasons stated for a potential withholding of the data should be taken into account. Explanations should be provided with regard to the purpose of the request. This is especially important when the data requested is of a confidential nature. This approach will minimize instances of refusal to share data.
- (d) Any available historic data should be consulted, to the fullest possible degree, for bench-marking purposes.
- (e) The development of the REMP should pay due consideration to the work of the Intergovernmental Conference on an international, legally-binding instrument under the UNCLOS on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction.
- (f) Follow-up workshops should be organized to facilitate the completion of the designing of the REMP.
- (g) The coastal States should fulfil their obligation under the UNCLOS to deposit a copy of charts or lists of geographical coordinates in specifying the outer limits of their continental shelf with both the Secretary-General of the UN and the Secretary-General of ISA. This obligation applied, generally, to all data collected on outer limits of the continental shelf, and not just to the outer limits beyond 200 nautical miles.

Conclusions and recommendations in regard to Question (ii)

The working group recognized the need for consistency in the management plans for the various regions and mineral resources in the Area and, therefore, the development of the REMP should take into account the EMP for CCZ (ISBA/17/LTC/7). In discussing CRC in the "Triangle Area" in the northwest Pacific, including the application of the principles contained in the CCZ EMP to the "Triangle Area", the working group recommended the following.

- (a) The total size of APEIs covering 30-50% of the total area established in the EMP for the CCZ was important to meet APEI objectives for cobalt-rich crust mining. Development of recommendations for APEI network design(s) that meet this goal within the western Pacific Seamount Province and Prime Cobalt Crust Zone, inclusive of the "Triangle Area", based on natural biogeographic units, should be a priority.³⁰ The CCZ and the "Triangle Area" differed in nature as the location of resources in the former is on the seafloor whereas in the latter it is on seamounts, which are three-dimensional.
- (b) The socio-economic aspects for the development of the REMP should consider the following factors: contract areas, EEZs and continental shelves of the coastal states surrounding the "Triangle Area"; other marine activities, including fishing, the laying of cables and pipelines, shipping, migratory pathways, and maintenance of populations of endemic species.
- (c) The identification of an APEI should avoid any overlapping with the reserved areas in the "Triangle Area".
- (d) There should be further research on the dispersal kernel in order to determine whether the 200-km buffer zone size used for the CCZ would be suitable for a REMP in the "Triangle Area"³¹.
- (e) Due consideration should be given to whether:
 - the REMP should extend beyond the "Triangle Area";
 - it should be defined biogeographically if it were to extend beyond the "Triangle Area";
 - there should be a linkage between the EIAs to be carried out by the contractors and the REMP; and
 - there should be a relationship between the PRZs and IRZs to be established by the contractors and the REMP.
- (f) The REMP should be designed with the recognition that additional data will be available in the future. Consequently, room should be left for the future adaptation of the APEIs, including the possible changing of location and dimensions of APEI elements in the network, as long as the conservation objectives are maintained.

³⁰ Some suggested that the protected area in the triangle may be limited to the seamounts. Others highlighted the importance to protect also seafloor between seamounts. Another view was that protection measures should cover 30%-50% of each seamount, given the differences existing among the seamounts. The question of replication should also be considered in identifying the protected area.

³¹ Some mentioned the diverse geography and topography of the seamounts. For example, the top of the seamount may be hard, while the hillside may be soft following the slope of the mountain. In addition, other factors including the oceanography, fluid dynamics, Taylor columns, tide movements, should be considered in deciding the size of the APEI. Some participants drew attention to the fact that the contract area of the cobalt rich crust is only 3,000 square km and, therefore, if the Triangle were to take the same size as the APEI of the CCZ, that may be disproportionate. Others referred to the indirect influence on the environment by the mining activities in considering the size of the APEI.

Part 2 Seamount Ecosystem and Scientific Knowledge

I. INTRODUCTION

Seamount Ecosystem

Seamounts are defined as independent features that rise to at least 1000m above the ocean seafloor³² (although ecological definitions of “seamounts” include hills and knolls³³), and most are extinct volcanoes. Based on differences in the distance from the ocean surface to the top of seamounts and associated physical and ecological characteristics, seamounts are classified as:³⁴

- shallow-water seamounts (the summit reaches to the euphotic zone);
- middle-depth seamounts (the summit is below the euphotic zone but above 400m); and
- deep-ocean seamounts (the summit is deeper than 400m).

The number of seamounts, globally, is not known. However, many studies have estimated the number and density of seamounts and knolls based on satellite altimetry, and extrapolated to poorly known areas, indicating that there are likely to be more than 200,000 seamounts and knolls in the world’s oceans, with the density of seamounts being higher in the northwest Pacific Ocean than in other regions.³⁵

The seamounts formed by off-axis magmatism at the mid-ocean ridge occupy the vast majority of the seafloor, but they

tend to be smaller in size and height. By comparison, seamounts formed in island arcs occur in smaller numbers, but with very strong magmatism, and many of which form the eruptive volcanoes that often rise above the sea level. As for the intra-plate seamounts, they are often medium to large in size and distribute as a seamount chain. The number is estimated to be about 12,000. They are formed by continuous magmatism in a fixed hot spot, growing from small seamounts to large ones. At the same time, the magmatic activities gradually weaken as the tectonic plate moves away from the hot spot. Long-term wave erosion can shave off the top of seamounts eventually forming guyots with flat surfaces. The subsiding seamount usually experiences drainage lake deposition and develops the formation of a biological atoll. When a seamount reaches the trench as the plate moves it breaks and collapses, and even disintegrates due to the bending of the subducting plate, and finally subducts into the trench that finishes its evolution story.³⁶

The topography of seamounts can influence local and global oceanic hydrological patterns. Changes strongly affect the ocean circulation that can transport ocean energy from large-scale to meso-scale and fine-scale, and ultimately provide energy for the local turbulent mixing. These hydrodynamic processes enhance productivity in the upper column and play important roles in benthic-pelagic coupling. Turbulence, upwelling/downwelling, tidal flow, Taylor columns, internal waves and trapped waves are the

32 IHO. Standardization of Undersea Feature Names: Guidelines Proposal form Terminology, 4th ed. International Hydrographic Organization and Intergovernmental Oceanographic Commission, Monaco, 2008

33 Pitcher T. J., Morato T., Hart P. J. B., Clark M. R., Haggan N., Santos R. S. (eds). Seamounts: ecology, fisheries, and conservation. Blackwell Fisheries and Aquatic Resources Series 12. Blackwell Publishing, Oxford, 2007.

34 Genin A. Bio-physical coupling in the formation of zooplankton and fish aggregations over abrupt topographies. *Journal of Marine systems*, 2004, 50(1): 3-20.

35 Wessel P., Sandwell D. T., Kim S. S. The global seamount census. *Oceanography*, 2010, 23(1): 24-33.

36 Staudigel H., Clague D.A. The Geological History of Deep-Sea Volcanoes: Biosphere, Hydrosphere, and Lithosphere Interactions. *Oceanography*, 2010, 23(1): 58-71.

physical phenomenon commonly existing in seamount regions. This complex and dynamic environment is bound to have an important impact on the ecological environment of seamounts.³⁷

High primary productivity caused by nutrient transport through upwelling and Taylor columns may occur at some shallow-water seamounts. Inflow and trapping of plankton from surrounding waters due to the effects of currents and topography of the seamounts result in high biomass and primary productivity in regions with middle-depth and deep-ocean seamounts.³⁸ Diurnal migration can lead to the trapping of zooplankton at the summit thus enhancing food availability for fish and benthos.³⁹

The benthic communities of seamounts are dominated by large suspension feeders, such as corals, sponges and crinoids.⁴⁰ They can form structural habitats and act as food resources for a variety of small and mobile species such as crustaceans and echinoderms with strong mobility.⁴¹ Growth of seamount benthos can be extraordinarily slow and they often have long life spans. Thus, the seamount benthos is highly vulnerable to human and natural disturbance. With variable geomorphologic features and

large numbers of habitat-forming species, seamount habitats show high diversity and heterogeneity.⁴² Seamount population may not be genetically isolated because the larvae or adults are capable of long-distance dispersal or migration driven by hydrodynamic properties or food availability.

Recently, more and more studies have been focusing on community structure and spatial distribution of biodiversity from a single seamount. Within a single seamount, due to high diversity and patchy distribution of seamount habitats, benthic assemblages are highly variable.⁴³ McClain et al. investigated the seamount in the northeast Pacific and found that there was a considerable species turnover across the whole seamount slope with a rate of up to 70%. A change of 50% in composition was observed for approximately every 1500m, and the species similarity between the summit and bottom was only 20-30%.⁴⁴ It was also suggested that at a single seamount, benthic assemblages have high taxa turnover rate with depth and distance.⁴⁵ Alvarez Perez *et al.* suggested that the benthic structure of assemblages and beta-diversity were closely related to habitat diversity since seamounts comprised numerous distinctive habitats associated with depth, topography and

37 Lavelle J. W., Mohn C. Motion, commotion, and biophysical connections at deep ocean seamounts. *Oceanography*, 2010, 23(1): 90-103.v

38 Dower J. F., Mackas D. L. "Seamount effects" in the zooplankton community near Cobb Seamount. Deep Sea Research Part I Oceanographic Research Papers, 1996, 43(6): 837-858.

39 Genin A. Bio-physical coupling in the formation of zooplankton and fish aggregations over abrupt topographies. *Journal of Marine Systems*, 2004, 50(1): 3-20.

40 Clark M. R., Rowden A. A., Schlacher T., et al. The ecology of seamounts: structure, function, and human impacts. *Annual Review of Marine Science*, 2010, 2: 253-278.

41 Roberts J. M., Wheeler A. J., Freiwald A. Reefs of the deep: the biology and geology of cold-water coral ecosystems. *Science*, 2006, 312: 543-547.

42 Torriente A. D. L., Serrano A., Fernandez-Salas L. M., Garcia M., Aguilar R. Identifying epibenthic habitats on the Seco de los Olivos Seamount: species assemblages and environmental characteristics. Deep Sea Research Part I Oceanographic Research Papers, 2018, 135: 9-22.

43 Clark M. R., Bowden D. A. Seamount biodiversity: high variability both within and between seamounts in the Ross Sea region of Antarctica. *Hydrobiologia*, 2015, 761:161-180.

44 McClain C.R., Lundsten L., Barry J., et al. Assemblage structure, but not diversity or density, change with depth on a northeast Pacific seamount. *Marine Ecology*, 2010, 31: 14-25.

45 Schlacher T., Baco A., Rowden A. A., O'Hara T., Clark M. R., Kelley C., Dower J. Seamount benthos in a cobalt-rich crust region of the Central Pacific: implications for conservation challenges posed by future seabed mining. *Diversity and Distributions*, 2014, 20(5): 491-502.

water mass dynamics.⁴⁶ The fauna of seamounts are still poorly documented and a limited number of seamounts, worldwide, have been investigated for the structure of the whole assemblage. The knowledge in taxonomy, the technology of molecular biology and sampling should be improved for the development of global, integrated structural and functional frameworks concerning seamount benthos.⁴⁷

Major Factors Influencing Seamount Ecosystem

Species composition and spatial distribution of benthic assemblages are influenced by environmental factors including primary production in the upper water, particulate organic carbon flux, hydrodynamic conditions, marine chemical profile characters, topography, geomorphology, geological history and ages, distance from continent and habitat heterogeneity. Among them, multiple factors are closely related to the water depth; therefore, the depth is usually considered as the key index to explain the differences between benthic communities in seamounts.⁴⁸

Though the depth gradient is distinctive, distributions of benthic assemblages seem to be more complicated.⁴⁹ Spatial distribution patterns may be different for different taxa. For example, the dominance of octocorals versus scleractinians may be driven by depth due to their particular chemical requirements⁵⁰ and many of the asteroids observed as corallivores also showed a pattern of depth zonation,⁵¹ whereas hexacorallia, decapods, actinopterygii and holothurians showed no apparent depth related pattern in terms of specie composition and abundance.

Different types of substrates host different benthic species. Sediment substrate is usually inhabited by mobile fish and crustaceans,⁵² while filter-feeders are normally found on steep slopes, where hard substrata⁵³ are washed by strong current, leaving bare rocks without sediment covering hard substrata. In addition, sessile animals like corals and sponges, could provide reef structure for mutualisms, thus increasing the species diversity at a small scale.⁵⁴ Besides, roughness and slope are also important factors influencing benthic assemblage structure.⁵⁵

46 Perez J. A. A., Kitazato H., Sumida P. Y. G., Sant'Ana R., Mastella A. M. Benthopelagic megafauna assemblages of the Rio Grande Rise (SW Atlantic). *Deep Sea Research Part I Oceanographic Research Papers*, 2018, 134: 1-11.

47 Samadi S., Schlacher T., Richer de Forges B. Seamount benthos[M] //Pitcher T J, Morato T, Hart P J B, et al, eds. *Seamounts: Ecology, Fisheries and Conservation*. Oxford, UK: Blackwell, 2007, 119-140.

48 O'Hara T.D. Seamounts: Centres of endemism or species richness for ophiuroids? *Global Ecology & Biogeography*, 2007, 16: 720-732.

49 Williams A., Althaus F., Schlacher T.A., Towed camera imagery and benthic sled catches provide different views of seamount benthic diversity. *Limnology and Oceanography: Methods*, 2015, 13: 62-73.

50 Tittensor D.P., Baco-Taylor A.R., Brewin P., et al. Predicting habitat suitability for stony corals on seamounts. *Journal of Biogeography*, 2009, 36: 1111-1128.

51 Mah C., Nizinski M., Lundsten L. Phylogenetic Revision of the Hippasterinae (Goniasteridae; Asteroidea): systematics of Deep Sea Corallivores, including one new genus and three new species. *Zoological Journal of the Linnean Society*, 2010, 160: 266-301.

52 Narayanaswamy B. E., Hughes D. J., Howell K. L., et al. First observations of megafaunal communities inhabiting George Bligh Bank, Northeast Atlantic. *Deep Sea Research Part II*, 2013, 92: 79-86.

53 Genin A., Dayton P. K., Lonsdale P. F., et al. Corals on seamount peaks provide evidence of current acceleration over deep-sea topography. *Nature*, 1986, 322: 59-61.

54 Henry L. A., Roberts J. M. Biodiversity and ecological composition of macrobenthos on cold-water coral mounds and adjacent off-mound habitat in the bathyal Porcupine Seabight, NE Atlantic. *Deep Sea Research Part I Oceanographic Research Papers*, 2007, 54: 654-672.

55 Preez C. D., Curtis J. M. R., Clarke M. E. The structure and distribution of benthic communities on a shallow seamount (Cobb seamount, northeast Pacific Ocean). *PLoS ONE*, 2016, 11: e0165513.

The role of CRC in determining the composition and abundance of benthic communities is uncertain. Schlacher et al. built on data from ISA Technical Study: No.8 to examine patterns of community structure along seamounts of the Hawaiian-Emperor seamount chain inside and outside the Pacific CRC zone.⁵⁶ It is indicated that benthic assemblages of invertebrates are structurally different between seamounts inside and outside the CRCs zone. This spatial contrast is caused by variations in species composition and relative abundance of species, rather than differences in species richness. This challenges historical notions of an impoverished CRC fauna in the region. A similar study by Morgan et al. on the Necker Ridge showed a discontinuous and patchy nature of benthic communities adding to growing evidence that cobalt-rich seamounts are highly heterogeneous habitats.⁵⁷ These recent studies suggest that ecological and evolutionary processes may vary considerably on a single seamount, and emphasize that regional variation must be evaluated.

Scientific approaches to conservation

REMPs will provide a useful framework for the preservation of representative and unique marine habitats, and to preserve and conserve marine biodiversity and ecosystem structure and function. It is necessary to understand the ecosystems in the target regions in order to develop REMP. As the presentations pointed out, seamount ecosystems are different from other deep-sea ecosystems. Each seamount can be considered as an individual ecosystem. It is recommended that the development of REMP should be based on a comprehensive understanding

of seamount ecosystems. Currently, we lack knowledge on seamount ecosystems, especially for deep-ocean seamounts.

It is widely believed that the seamount ecosystem is fragile and vulnerable to human activities. The area of a single seamount is relatively small compared to the continental shelf or other types of seafloors in the deep-sea. The resilience of seamount ecosystems should also be a major factor in considering human-induced disturbances of seamount habitats and fauna. The life cycles of some seamount benthos are relatively long with slow growth. They may not be able to recover in a short period. Thus, the impacts of human activities at a seamount location have to be considered.

Science-based conservation is based on the understanding of target ecosystem structure and function from scientific research, which could be used to assist the design of conservation measures. The knowledge of seamount ecosystem structure and function is insufficient; thus, strengthening scientific research will improve the efficiency of environmental management and conservation.

Current Knowledge and Gaps in Seamount Ecosystems in the Northwest Pacific

Currently, Japan Oil, Gas and Metals National Corporation (JOGMEC) sponsored by Japan, COMRA sponsored by China, the Government of Russian Federation and the Government of the Republic of Korea have signed exploration contracts with ISA in the CRC in the northwest Pacific. Nearly all contractors have begun environmental surveys of this

⁵⁶ Schlacher T. A., Baco A.R., Rowden A.A., et al. Seamount benthos in a cobalt-rich crust region of the central Pacific: conservation challenges for future seabed mining. *Diversity and Distribution*, 2014, 20: 491-502.

⁵⁷ Morgan N. B., Cairns S., Reiswig H., Baco A. R. Benthic megafaunal community structure of cobalt-rich manganese crusts on Necker Ridge. *Deep Sea Research Part I Oceanographic Research Papers*, 2015, 104: 92-105.

region and have provided briefs on their research outcomes during the workshop. However, the environmental data are still considered insufficient for precisely developing the REMP.

APEI Design Principles in the Northwest Pacific

The designation of APEIs is an effective way to protect and preserve the marine environment. A total of nine APEIs were designated in the CCZ with the purposes of:⁵⁸

- protecting biodiversity and ecosystem structure and function by a system of representative seafloor areas closed to mining activities. The system must be in place before additional mining claims further compromise the ability to develop a scientifically robust design;
- including a wide range of the habitat types present in the CCZ within the APEIs (for example seamounts and fracture zone structures);
- establishing an APEI system to avoid overlap with the current distribution of claimant and reserve areas (as was the basis for the current scientific design); and
- providing a degree of certainty to existing and prospective contractors by laying out the location of areas closed to mining activities.

In the process of the development of the REMP, it is necessary to designate APEIs. However, are the conservation goals, basis of delineation and scientific designation of the APEIs for the CRC in the northwest Pacific Ocean consistent with those for the CCZ? If not, what are the differences between the two regions in relation to APEI design?

The habitat, biodiversity, ecosystem structure and function in the CRC in the northwest Pacific Ocean are different from other deep-sea environments, such as the

PMS and PMN regions. The components of environmental survey and monitoring may need to be adjusted in order to fulfil the scientific requirements for developing the REMP. Thus, within the range of environmental surveys required by ISA, we need to ensure observance of the key index of evaluating the marine environments in the CRC regions in the northwest Pacific in order to fully understand the characteristics of seamount ecosystems and determine the principles of APEIs in the northwest Pacific.

II. PRESENTATIONS

1. Structure and Functional Characteristics of Seamount Ecosystems

Dr. Tina N. Molodtsova

Dr. Molodtsova stated that seamounts were generally considered to be undersea features with elevations of more than 1,000m above the surrounding seafloor of limited area at the summit and do not break the sea surface. She said that this iconic marine habitat was mostly volcanic in origin and dominated by hard substrates with steep topographic gradients and complex topography. Seamounts were prominent structures on the ocean floor



⁵⁸ Environmental Management Plan for the Clarion-Clipperton Zone (ISBA/17/LTC/7)

and could significantly influence local and global oceanic hydrological patterns by becoming a source of higher productivity and thus affecting pelagic and mid-water communities as well as attracting highly migratory species by serving as important stepping stones. She added that seamounts were well known for their diverse and abundant communities including commercial fish and benthic invertebrates. In the literature, seamounts are often regarded as potential stepping stones for dispersal, oases of high faunal abundance and biomass, and hotspots of species richness.

The last decades showed an increase in seamount studies, however, seamount sampling at a global scale was still limited and the complete picture of the structure of seamount assemblages is known only from the exploration of a limited number of seamounts worldwide.

Dr. Molodtsova noted that numerous factors drove the diversity of seamount communities. A range of environmental variables including depth, salinity, oxygen, substratum composition, hydrological regime, and latitude/longitude were reported to be important ecological drivers. Substantial taxa turnover was reported across depth gradients. Seamount ecosystems vary at multiple spatial scales. She noted that patchy community distribution may occur within an individual seamount, between individual seamounts of the same seamount group, and between groups of seamounts or oceanic basins. Complex hydrologic regimes at some seamounts could lead to significant isolation and high percentage of endemic species. The invertebrate fauna of seamounts is dominated by suspension feeders, mostly corals and sponges that serve as refuges, feeding grounds and nurseries for fish and invertebrates. Corals and sponges were considered to be the core taxa and habitat-forming organisms for many seamount assemblages. They are,

predominantly, extremely long-lived, slow-growing, fragile, and highly vulnerable to any anthropogenic impact, thus recovery of the seamount fauna after disturbances may be exceedingly prolonged, with the likelihood of taking decades or centuries.

2. Major Factors Influencing Seamount Niches

Dr. Tomohiko Fukushima

Dr. Fukushima informed the workshop participants that in the deep sea, distribution and abundance of benthic organisms were studied on the basis of quantity/quality of feed supply. However, the paths of organic material reaching the habitat of benthic organisms were diverse, and the organisms had selective feeding strategies according to their paths, i.e. suspension feeding, deposit feeding etc. So, in order to specify “major factors influencing seamount niches”, it was necessary to understand material flow around seamounts and ecology of benthic organisms in these. With this in mind, the author examined the distribution of megafauna in areas of the Pacific Ocean.

Between 1985 and 2004, the Metal Mining Agency of Japan (MMAJ), under a technical cooperative agreement with the South Pacific Applied Geoscience Commission (SOPAC), had surveyed the seafloor mineral



resources around the area. In this survey, they obtained a lot of photographs of the seafloor including benthic organisms. The author, by using those images, calculated the abundance of megabenthic organisms in each PMN, PMS and CRC area. On this basis, the CRC seabed type was shown to be more diverse than that of the PMN. In other words, the seabed around seamounts includes clays, ooze, nodule crusts and cobble. And, megabenthos distributions were abundant in the PMS, the CRC and the PMN areas. The larger heterogeneity of abundance was observed in both the PMS and the CRC areas; and the larger number of faunae were recognized in the CRC and PMS areas. The research shows that there are many faunae to be considered in the CRC.

The findings showed that there were various paths of organic materials flow, and various ecological niches in the CRC. Therefore, various studies and diverse evaluations were required for an EIA. On the other hand, since deep sea mineral resource development is an economic act, the question of how to balance development with protection of the environment must be considered. Dr. Tomohiko Fukushima, the delegate of Japan, reported that the seafloor feature was most variable in the CRC regions, harbouring high faunal diversity, and suggested that a variety of environmental evaluation targets are needed. They also found the existence of a complex water flow pattern that influenced the distribution of suspension feeders in the CRC regions.

3. Exploration Plan for CRC in the Korean Contract Area - Environmental Research and Management Plan

Dr. Se-Jong Ju

Dr. Se-Jong Ju reported that in the last few decades, there had been growing interest in the commercial mining of seabed mineral resources such as PMN, CRC and



PMS due to the depletion of land-based resources and rapidly increasing industrial demands for metals. To meet the scientific and economic demand, the Republic of Korea had been conducting geological, geophysical, and environmental surveys in the western Pacific since 1997. On 27 March 2018, the Korean Government signed the contract for the exploration of CRC in the western Pacific with ISA. In the first part of the presentation, Dr. Se-Jong Ju presented a brief history of the previous surveys conducted by the Korea Institute of Ocean Science and Technology (KIOST) for CRC, and described the objectives and scientific approaches of the exploration programme during the contract period. A REMP is required in the western Pacific to protect the marine environment and ecosystems as the four exploration contracts had been issued for CRC in the relatively small geographical region.

In the second part of the presentation, he shared a brief on the role of the contractor in relation to the REMP that was essential to minimizing the mining impact and to protecting marine environment and ecosystems. He provided some suggestions for establishing a scientifically sound EMP. Lastly, he presented possible contributions of the Government of Republic of Korea to the REMP. He

believed that continuous collaborative and coordinated efforts among contractors and between the contractors and ISA would be necessary for the development of appropriate measures to protect the marine environments in the region.

4. Environmental Studies of the CRC in the Russian Exploration Area

Dr. Melnik Viacheslav

Dr. Viacheslav noted that the Russian Exploration Area (REA) represented separate clusters spread over an area of four seamounts - Govorov, Vulkanolog, Kotcebu and Alba seamounts (Fig. 8-1). The clusters took up a small part of the Govorov and Alba seamounts areas or covered almost all of the Vulkanolog and Kotcebu seamounts areas. The distance across the seamount chain of REA is about 500km from west to east.

He shared that exploration works was carried out on research vessel *Gelendzhik*, owned by the joint-stock company "Yuzhmorgeologiya" which is 110m in length and 5,600 tons in weight. Data from 17,200 bottom photos, placed on 44 photo transects, were used to determine background characteristics of megafauna



inhabiting exploration clusters of the Govorov Seamount. In total, 2,900 animals belonging to 24 different taxa were recognized in these photos. The glass sponges and soft coral were the most abundant taxa. The megafauna community on the seamount includes animals with all feeding types - seston feeders, deposit feeders and carnivorous. According to the photo transect data investigation, the main factors influencing megafauna composition, density and distribution were depth, bottom deposit structure

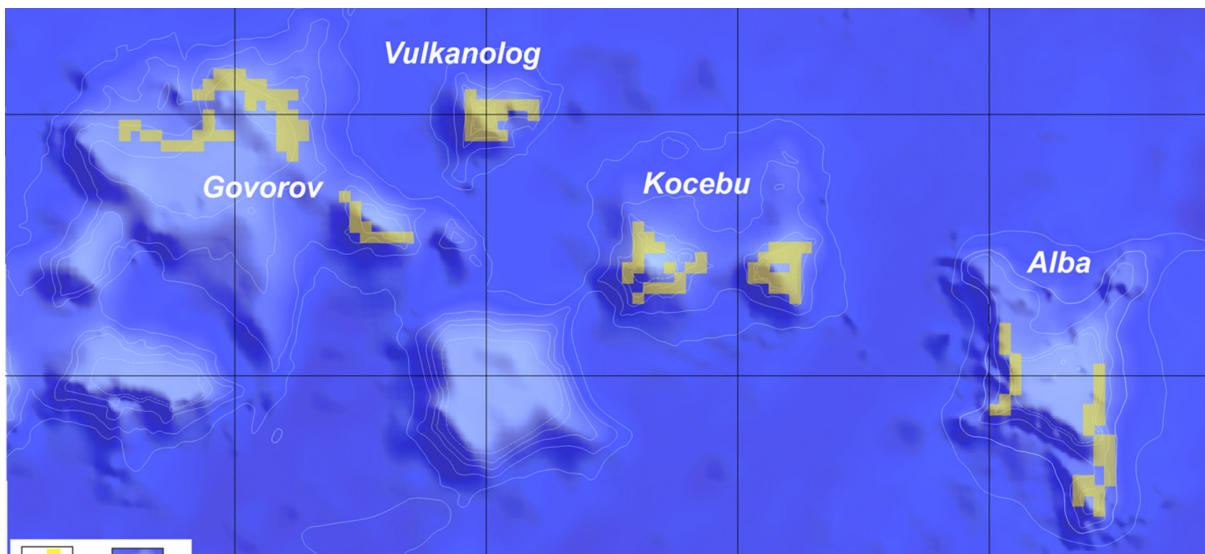


Fig. 8-1 Govorov Seamount, Vulkanolog Seamount, Kotcebu Seamount and Alba Seamount in the Russian Exploration Area (REA).

(sediment or hard substrate) and location on the seamount (a slope side).

The author observed that distribution of megafauna animals by depth depended on their feeding type. Megafauna investigation on three seamounts made it possible to determine a significant difference in numbers between taxa. It was particularly the case for the two most abundant fauna groups - glass sponges and soft corals. Sediment samples were collected on the exploration seamount clusters to identify macrofauna and meiofauna characteristics. Sediment on the seamount top and on flat parts of the slopes consisted mostly of calcareous foraminifera tests and its fragments.

Ecological investigations, carried out in exploration clusters of three seamounts, led to the following conclusions.

- Seamounts on the ocean floor are inhabited by diverse and unique benthic communities.
- Photo transecting represents the main source of information on the background characteristics of megafauna.
- It is very difficult to get undisturbed sediment samples for study of macrofauna and meiofauna background characteristics.
- It is necessary to modify the document ISBA/19/LTC/8 in view of the new ecological data derived on seamounts.
- REMP for the CRC is a good proposal and deserves further detailed examinations.

5. Community Structure, Distribution and Impact Factors of Megafauna on the Northwest Pacific Seamounts

Mr. Chunsheng Wang

Mr Wang reported that in the northwest Pacific, 13 dives by the Jiaolong submersible had been carried out on the

Caiwei Guyot during two of COMRA's cruises (Fig. 8-2). Specimens, video and photographic data collected by Jiaolong had been used to analyze megafaunal community structure and their potential relationship with environmental factors.

The results showed that 64 species from 6 phyla and 38 families had been identified. The megafaunal community was dominated by poriferan (22 species), cnidarian (17 species) and echinoderm (15 species). To date, six new species have been described including three sponge species: *Platylistrum subviridum* n. sp., *Poliopogon canaliculatus* n. sp., *Semperella retrospinella* n. sp.⁵⁹ and three crustaceans: *Paralebbeus Jiaolongi* n. sp.⁶⁰, *Spongicoloides weijiaensis* n. sp.⁶¹ and *Uroptychus inaequipipes* n. sp. (Fig. 8-3). It was noted that megabenthic assemblages between summit and slope were similar, both were dominated by sessile taxa such as sponges and corals, while at the base benthic assemblages were different from those on the summit and slope, which are dominated by sea cucumber, star fish, brittle star and small sponges. Mr. Wang reported that bottom current and sedimentary environment appeared



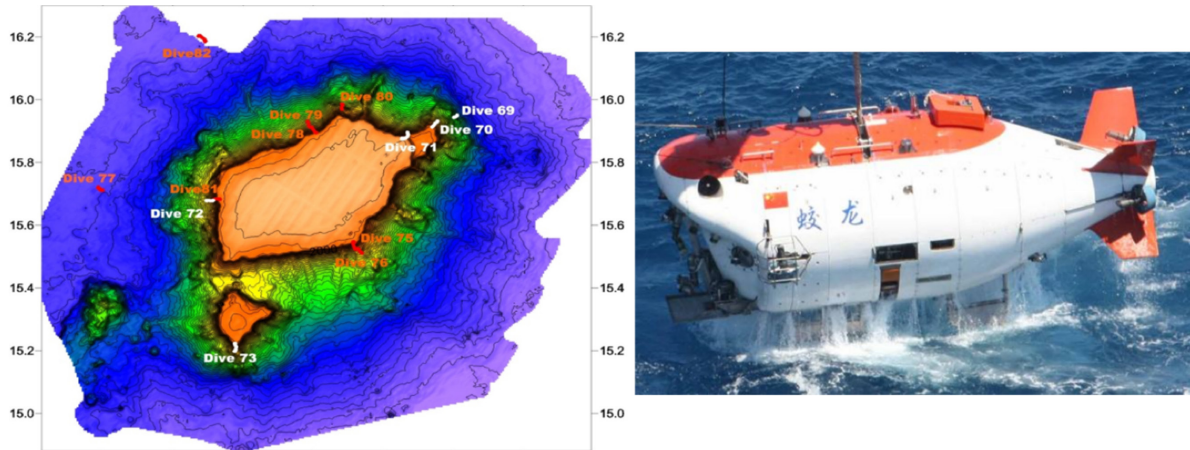


Fig. 8-2 During two of COMRA's cruises, 13 dives by *Jiaolong* submersible (right) were carried out on the Caiwei guyot (left) in the northwest Pacific Ocean.

to play important roles in controlling megafauna distribution. Abundance and distribution of megafauna were seen to be closely related to topography. High abundance of corals and sponges were generally observed on steep cliffs due to more suspended particles brought by strengthened currents. The particles were the major food sources of these filter feeders, in favour of their growth. The intensity of bottom currents was distinctively different between the east

and west sides of the seamount, which might be the main reason for the different patterns of megafauna. On the west slope, due to relatively flat terrain and weak bottom currents, most parts exhibited high sediment coverage, therefore habitats were more diversified and demonstrated higher biodiversity. On the contrary, on the east slope, above 2,500m, with strong bottom currents washing the seabed, the substratum was mostly composed of crust and rock, and sediment coverage was

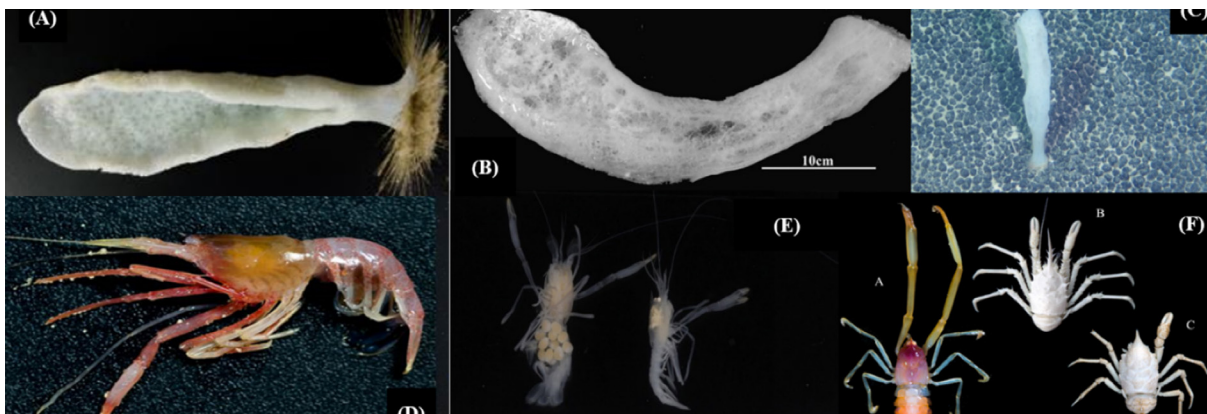


Fig. 8-3 six new species were described including three sponge species: (A) *Platylistrum subviridum* n. sp., (B) *Poliopogon canaliculatus* n. sp., (C) *Semperella retrospinella* n. sp.⁵⁹ and three crustaceans: (D) *Paralebbeus Jiaolongi* n. sp.⁶⁰, (E) *Spongicoloides weijiaensis* n. sp.⁶¹ and (F) *Uroptychus inaequipes* n. sp.

59 Wang D. X., Wang C. S., Zhang Y. et al. Three new species of glass sponges Phoronematidae (Porifera: Hexactinellida) from the deep-sea of the northwestern Pacific Ocean. *Zootaxa*, 2016, 4171(3): 562-574.

60 Xu P., Liu F., Wang C. S. et al. A new species of the thoridae genus *Paralebbeus* Bruce & Chace, 1986 (Crustacea: Decapoda: Caridea) from the deep sea of the northwestern Pacific Ocean. *Zootaxa*, 2016, 4085(1): 119-126.

61 Xu P., Zhou Y., Wang C. S. A new species of deep-sea sponge-associated shrimp from the North-West Pacific (Decapoda, Stenopodidea, Spongicolidae). *Zookeys*. 2017, 685:1-14.

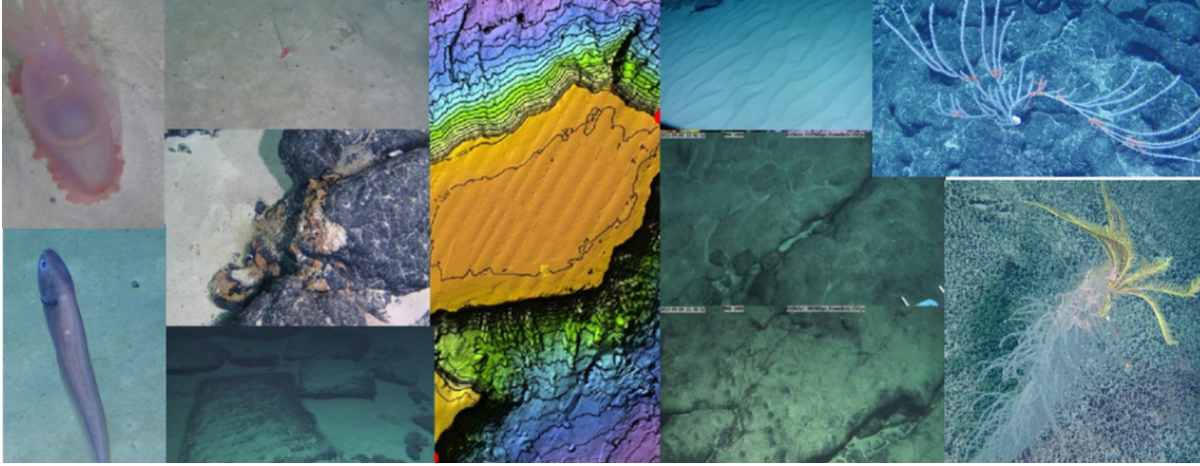


Fig. 8-4 The substratum type and benthic communities on the west and east slopes of the Caiwei Guyot.

low. Such hard substratum is the favoured habitat for sessile animals, such as corals and sponges. Biodiversity was lower but abundance was higher on the east slope than on west slope (Fig. 8-4).

6. Confirming the Validity of ADCP Velocity Measurements for Physical Environmental Assessments in Marcus-Wake Seamount Group for CRC

Dr. Akira Iguchi

CRC, which is composed of manganese, cobalt, nickel, platinum, and rare earth elements, had been found on the tops and slopes of seamounts. According to Dr. Iguchi, their thickness varied from a few centimeters to ten centimeters in the deep areas from 1,000-5,000m. It is thought that the formation of crusts is strongly related to physical environmental factors such as current flows around the seamounts, the details were still unknown. In the twenty-first century, CRC have attracted much attention as an important resource for metals because the terrestrial sources have become depleted. He reiterated that ISA regulates mining areas in the high seas in accordance with the "Mining Code" under the 1982 UNCLOS. To avoid and/or reduce the environmental impacts during the exploration for marine minerals as much as possible from the point of

view of biodiversity conservation, ISA recommends that contractors conduct EIAs and environmental monitoring surveys. After the exploration, the recovery of communities would depend on the larval dispersal which is strongly influenced by water current. Thus, current velocity in deep-sea areas must be measured during physical environmental assessments of exploration areas for CRC.

Dr. Iguchi noted that the use of an Acoustic Doppler Current Profiler (ADCP) for velocity measurement in the abyssal zone had technical disadvantages: 1) insufficient acoustic backscatter due to the low density of suspended matter; and 2) difficulty in detecting low abyssal velocity. Therefore,



an appropriate method for confirming the validity of velocity measurement results was needed. He said that they examined physical aspects of the reliability of ADCP velocity measurements made during one year, by verifying the Coriolis Effect, validating the velocity power spectrum, and comparing the ADCP results with the second version of the Japan Coastal Ocean Predictability Experiment (JCOPE2) reanalysis velocity data. The presentation, compared techniques to assess the detail of water current around CRCs.

III. WORLD CAFÉ DISCUSSIONS

Dr. Pei-Yuan Qian, co-moderated by Dr. Tina Molodtsova, Dr. Tomohiko Fukushima, Prof. Chunsheng Wang, Dr. Se-Jong Ju and Dr. Alison Swaddling

1. Introduction

General principles for the conduct of marine scientific research

Under the Convention, States shall conduct marine scientific research observing the following principles:⁶²

- It is to be conducted exclusively for peaceful purposes.
- It is to be conducted with appropriate scientific methods and means compatible with this Convention.
- It should not unjustifiably interfere with other legitimate uses of the sea compatible with this Convention and shall be duly respected in the course of such uses.
- It is to be conducted in compliance with all relevant regulations adopted in conformity with this Convention including those for the protection and preservation of the marine environment.

⁶² UNCLOS, art. 240.

⁶³ UNCLOS, art. 263.

⁶⁴ Clark M.R., et al. Science priorities for seamount: Research links to Conservation and Management. PLoS ONE. 2012, 7 (1): E29232.

Responsibility and liability of States in marine scientific research

States and competent international organizations shall be responsible or liable for:⁶³

- ensuring that marine scientific research, whether undertaken by them or on their behalf, is conducted in accordance with this Convention;
- measures they take in contravention of this Convention in respect of marine scientific research conducted by other States, their natural or juridical persons or by competent international organizations, and shall provide compensation for damage resulting from such measures; and
- damage caused by pollution of the marine environment arising out of marine scientific research undertaken by them or on their behalf.

Important role of scientific research in the protection and preservation of the marine environment

Science is critical in transferring the information into robust advice that eventually informs the precepts for the management of marine environments. Current scientific knowledge is not sufficient to support the management plan for seamount regions. As a result, future research comprising a combination of broad scale as well as detailed studies is necessary.⁶⁴ The scientific committee has also emphasized that with science as the base of the REMP, the role of the scientific research should be increased in the development of the REMP for CRC. The key element in this process is to promote cooperation and collaboration between scientists, managers, policy agencies, commercial entities and NGOs.

Role of international cooperation and collaboration in the protection and preservation of the marine environment

International cooperation for the development and transfer of marine technology shall be carried out, where feasible and appropriate, through existing bilateral, regional or multilateral programmes, and also through expanded and new programmes in order to facilitate marine scientific research, the transfer of marine technology, particularly in new fields, and appropriate international funding for ocean research and development.⁶⁵

2. Summary of discussion (conclusions and recommendations)

Working Group 2 discussions, using the World Café approach, and were divided into two rooms (Caiwei Hall and Weijia Hall).

Discussions in Caiwei Hall focused mainly on questions related to seamount structure and function, impacts of human activities and approaches to scientific conservation. These discussions were moderated by Dr. Tina Molodtsova, Dr. Tomohiko Fukushima and Prof. Chunsheng Wang. The following questions were discussed:

- Current scientific knowledge is not sufficient to support the management plan for seamount regions. What are the major characteristics of seamount ecosystems? How do these characteristics affect biodiversity, biological community structure and ecosystem functions in benthic environments?
- What is the longest distance of benthic species (or dispersal distance of larvae)? Which factors may influence the migration distance?

- What are the criteria for determining the typical species (or key species) at seamount regions?
- What kind of human activities could distinctively affect seamount ecosystems nowadays or in the future?
- Compared to human activities, which natural disturbance may distinctively affect seamount ecosystems? Do these affect seamount ecosystems in the northwest Pacific Ocean?
- What does the evaluation index system include for seamount ecosystems (e.g. connectivity, similarity and biodiversity of species)?
- Which key environmental parameters should be collected for determining the change levels if the seamount ecosystem has been disturbed?
- Which approaches can be used to monitor and restore the seamount habitats? Have these techniques been applied?
- Which approaches and techniques should be applied for conserving and managing seamounts?

In Weijia Hall, the discussion considered current knowledge and gaps in the northwest Pacific, APEI principle and future research approaches and orientations. The moderators were Dr. Alison Swaddling, Dr. Pei-Yuan Qian and Dr. Se-Jong Ju. The following questions were discussed:

- Which approaches can be used to access data collected from seamount regions, especially from the CRC in the northwest Pacific Ocean?
- Which key scientific questions should be addressed first in the study of seamount ecosystems in the CRC in the northwest Pacific Ocean?
- Which research methods can be applied in order to understand seamount ecosystems in the northwest Pacific Ocean?

⁶⁵ UNCLOS, art. 270.



- What should the minimum conservation objectives of the APEI include in the CRC in the northwest Pacific Ocean?
 - Is the policy and science basis of APEI delineation in the CRC in the northwest Pacific Ocean different from other regions (e.g. nodule regions)?
 - How should APEIs in seamount regions be scientifically designed in order to protect the integrity of the seamount ecosystem? Which key species should be selected as indicators for designating APEIs on a scientific basis?
 - What is the process for designating APEIs? How much effort will be needed? What are the challenges?
 - Should the designation and delineation of an APEI at a seamount region consider differences among the ecosystems on the top, on the flank and on the bottom of a seamount?
 - Could an APEI be established on a seamount with a cobalt-rich crust contract? What is the basis?
 - What is the area of a typical APEI? Should it cover the whole seamount or part of the seamount? What are the sizes of the core area and buffer zone of an APEI? If the borders are straight lines, should they be parallel to the latitude and longitude?
 - What are the key points for future environmental survey and monitoring for the CRC in the northwest Pacific Ocean? What are the unique features in the region in terms of environmental survey and monitoring?
 - What are the main directions of future scientific research?
 - Which technical methods are efficient and have been used in the environmental survey and monitoring at seamount regions currently? Which factors should be considered, if we are planning the development of new techniques and methods?
- Dr. Pei-Yuan Qian, on behalf of all moderators, reported the final conclusions from the discussion by all participants in the two rooms and made recommendations for future reference for the development of the REMP and APEI design principles. The working group reached the following conclusions:
- (a) Seamounts are potential stepping stones for species dispersal, have high faunal abundance and biomass and are the hotspots of biodiversity at a global scale.
 - (b) Species composition and spatial distribution of benthic assemblages are influenced by

- interplaying environmental factors, and are influenced by water depth. The role of CRC in determining those of benthic assemblages remained unclear.
- (c) Corals and sponges are often the predominant groups and could be considered to be the core and significant taxa since they are habitat-forming organisms for many seamount assemblages, extremely long-lived, slow-growing, fragile, and highly vulnerable to anthropogenic impact. Therefore, the recovery of a seamount ecosystem after disturbances might be exceedingly prolonged and likely to take decades or centuries.
- (d) Seamount ecosystems vary at multiple spatial scales within individual seamounts, between individual seamounts, and between groups of seamounts or oceanic basins. Complexity of ecosystems in each seamount should be considered when designing APEIs.
- (e) APEI objectives in the "Triangle Area" should be to maintain biodiversity, integrity and function of seamount ecosystems and to understand resilience of the ecosystem, impacts of human activities and natural disturbance, and restoration capacity.
- (f) Development of a REMP is indispensable. Science is key to the development of a robust REMP that could fit into the regional policy or meet administrative requirements.
- (g) New methods of non-destructive survey and monitoring suitable for seamount habitats should be developed, standardized, and implemented.
- (h) Improved collaboration and cooperation among the contractors, ISA, and international institutions are required, particularly in terms of information and specimen sharing, standardization of methodology, capacity building, among others.
- The working group made the following recommendations:
- (a) The contractors should conduct "gap" analysis of baseline information and collect necessary data on: topography, physical characteristics, chemical characteristics, biodiversity (megafauna, macrofauna, meiofauna, microfauna), community structure, migration and dispersal, connectivity, ecosystem function and service, resilience, restoration/recovery capacity, and human impacts.
- (b) ISA should consider developing an "atlas" for the "Triangle Area".
- (c) ISA should encourage close collaboration between contractors and research institutions to develop new technology for multi-disciplinary research, monitoring, and EIA and ERA. It should also encourage the sharing of data and even specimens.
- (d) ISA should develop an evaluation system for seamount ecosystems in order to assess the health of ecosystems and define the strategies for ecosystem recovery and remediation.
- (e) In designing an APEI in the "Triangle Area" (management unit to be defined), the general guidelines set by ISA for the CCZ should be closely followed, with due consideration for the complexity of the seamount ecosystem.
- (f) The entire seamount should be included to protect ecosystem integrity in designing the APEI.
- (g) The APEI should not overlap with the contract area, unless the seamount is big enough and has sufficient data support to show that the plume has no effect on APEI; APEI design should consider size and range of the seamount.
- (h) APEIs should be established before more applications are granted or received. Participants did not reach a consensus on this issue.
- (i) ISBA/19/LTC/8 should be modified

based on new scientific findings, Microfaunal techniques may need to be modified, due to extremely low abundance and difficulties in sampling.

It was felt that since the current knowledge of the seamount ecosystem in the northwest Pacific Ocean was insufficient, there was an urgent need to develop the REMP to protect and preserve the ecosystem at the outset. As more scientific research, including environmental baseline survey, long-term monitoring and gene flow is conducted in the Area, biodiversity, ecosystem structure and function would be better understood. Then, designation of the areas for protection and preservation as well as those for mining activities would be proposed and implemented.

Part 3 Proposed approach for developing a REMP for CRC in the Northwest Pacific Ocean

I. BACKGROUND INFORMATION

The EMP of the CCZ was the first and the only REMP developed to date by ISA.⁶⁶ The Council approved the plan at its 18th session in July 2012 and decided to implement it for the first three years,⁶⁷ and the LTC reviewed the plan at its 22nd session⁶⁸ and is continuing to update this review in 2018.

Resolutions of the General Assembly of the United Nations⁶⁹ invited ISA to consider the development and approval of REMPs in other regions, especially in the current exploration contract areas.

During the 23rd session of ISA in August 2017, COMRA held a side event on the “Balance between Resources Exploitation and Environmental Protection”, Dr. Feng Liu, the Secretary-General of COMRA, introduced recent activities in the cobalt-rich crusts contract area by COMRA, and proposed an initiative of co-developing a REMP for the region of CRC in the “Triangle Area” in the northwest Pacific Ocean. The Secretary-General of ISA and the Secretary-General of COMRA held preliminary discussions for the REMP and agreed to conduct further discussions in due course.⁷⁰

In March 2018, the Council considered the Preliminary Strategy for the Development of REMPs for the Area presented by the Secretary-General of ISA and welcomed the cooperation between COMRA and other contractors and stakeholders to formulate a REMP for the CRC zone in the Pacific Ocean. ISA and COMRA have agreed to jointly organize an international workshop to progress development of a REMP for the CRCs in the northwest Pacific Ocean, 26-29 May 2018 in Qingdao, China.⁷¹

66 Environmental Management Plan for the Clarion-Clipperton Zone (ISBA/17/LTC/7), International Seabed Authority, Kingston, Jamaica, 2011.

67 Decision of the Council relating to an environmental management plan for the Clarion-Clipperton Zone (ISBA/18/C/22), International Seabed Authority, Kingston, Jamaica, 2012.

68 Review of the implementation of the environmental management plan for the Clarion-Clipperton Fracture Zone (ISBA/22/LTC/12), International Seabed Authority, Kingston, Jamaica, 2016.

69 General Assembly of the United Nations. Resolution 68/70 (2013), 69/245 (2014) and 70/235 (2015).

70 Implementation of the decision of the Council in 2016 relating to the summary report of the Chair of the Legal and Technical Commission (ISBA/23/C/8), International Seabed Authority, Kingston, Jamaica, 2017.

71 ISA and COMRA to hold workshop on the development of a regional environmental management plan for the cobalt-rich ferromanganese crusts in the northwest Pacific Ocean (ISBA/PR/2018/008), International Seabed Authority, Kingston, Jamaica, 2018.

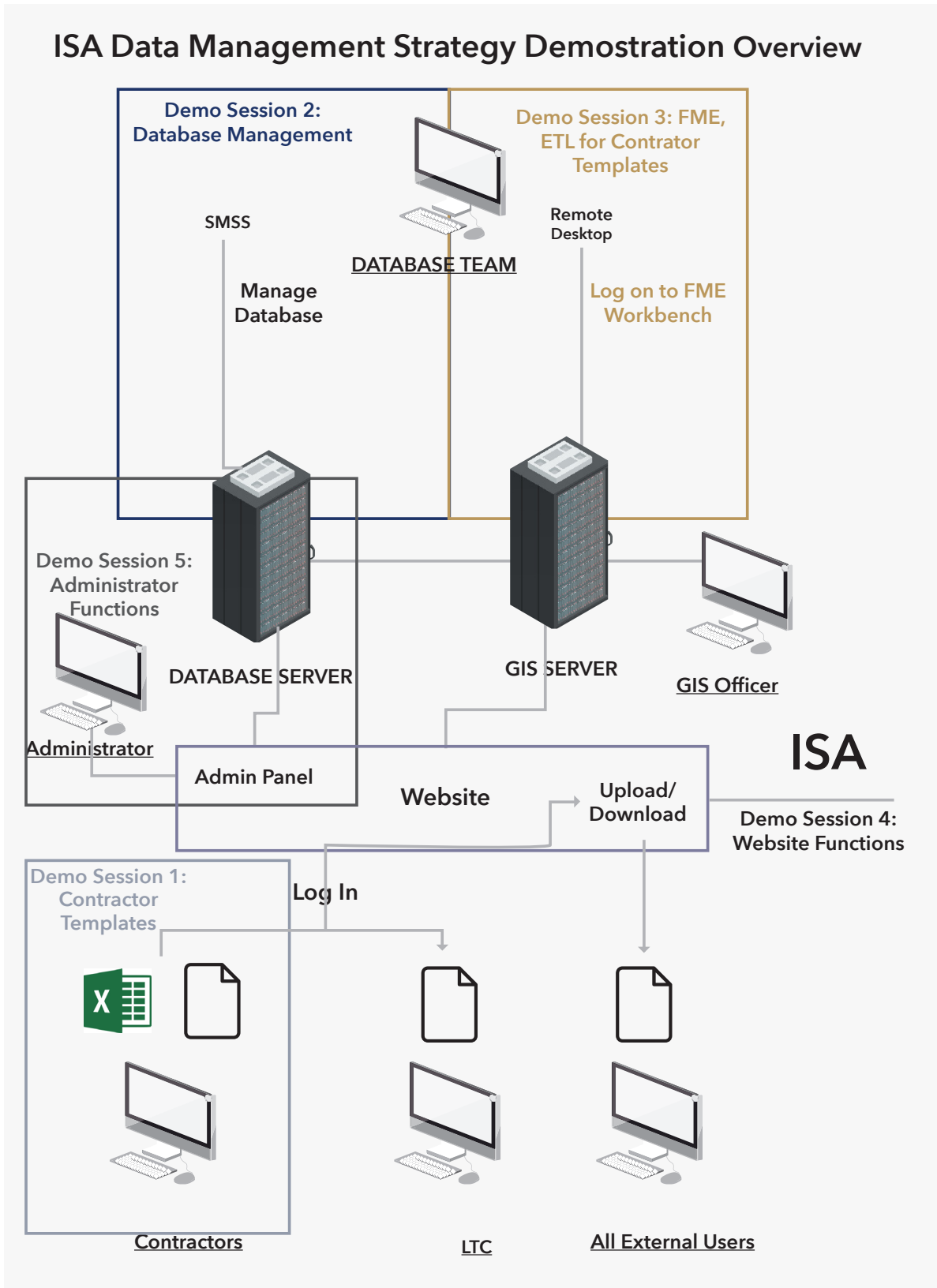


Fig. 9-1 ISA Database project



II. PRESENTATIONS

1. Implementation of ISA Data strategy

Dr. Sandor Mulsow, ISA Secretariat

Dr. Mulsow noted that the complex data, including numeric, spatial status, text, image, sound and variable status, submitted to ISA had to be converted, transformed, integrated, validated and migrated before uploading to the database. Thereafter, data could be displayed on geographic maps and shared by differential access.

He said that the functions of the database were managed by a database team, administrator and GIS officer in the secretariat of ISA and the database could be accessed by the contractors, LTC members and all other external users (Fig. 9-1). The first demo was conducted in May 2018 and the project will end by the 1st quarter of 2019.

Dr. Mulsow also briefed workshop participants on the historical data.

2. Proposal of the Triangle Project for CRC in the Northwest Pacific

Dr. Xue-Wei Xu

In his presentation, Dr. Xue-Wei Xu introduced the background to the development of the REMP for CRC in the northwest Pacific Ocean, discussed some scientific questions related to seamount environments and outlined his preliminary thinking regarding the development of the REMP.

Substantial differences among the PMN, PMS and CRC areas were listed, such as typical topography, food resource and pattern, benthos distribution characteristics and complexity for connectivity, indicating that the scientific design principle of the REMP for the CRC would be different from that for PMN in CCZ as well as that for PMS.

To date, there are five CRC contactors. Four of them are located in the "Triangle Area" in the northwest Pacific Ocean (Fig. 9-2).



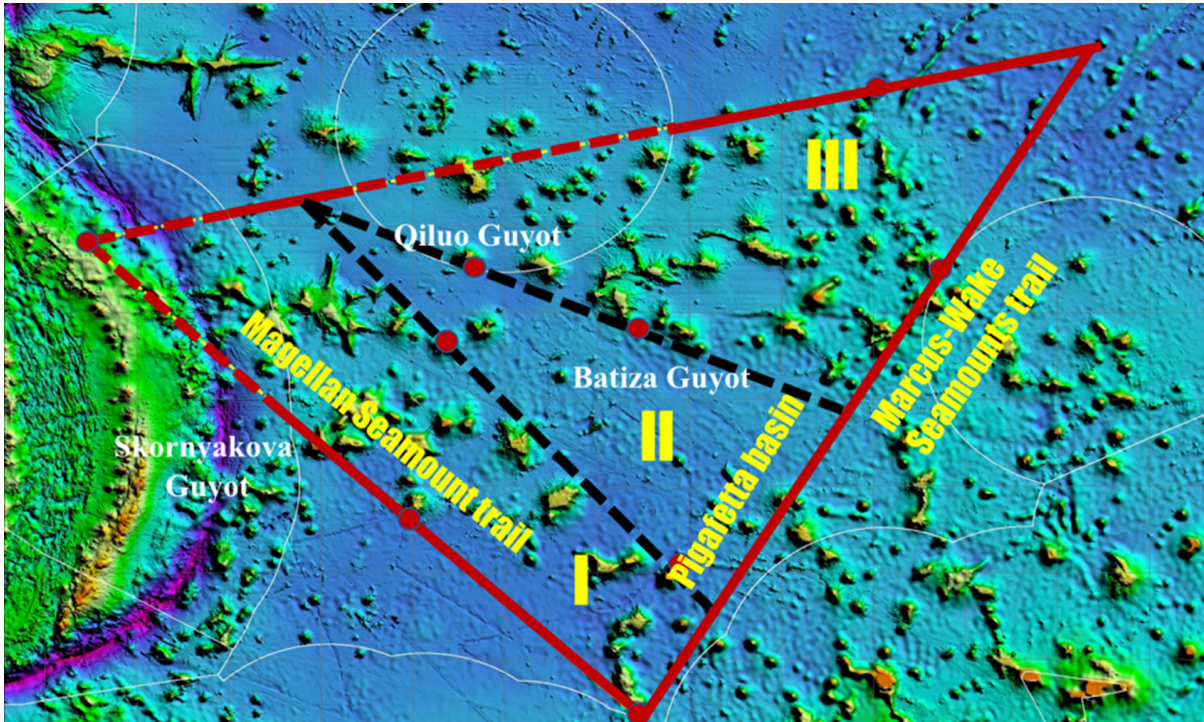


Fig. 9-2 Map of the "Triangle Area" in the northwest Pacific Ocean. White curves represent the areas within 200 miles of island, including EEZs and US monument.

However, some key scientific questions were not addressed well. For instance, what factors determine the delineation of biogeographic provinces in the seamount area? How do topographic features affect biodiversity? How does hydrodynamics affect species dispersal? How to deal with other sea users in the area, e.g. submarine cables and commercial fishing activity that exist in the "Triangle Area".

A "Triangle Project" for the development of a REMP for the CRC in the northwest Pacific Ocean through a two to three year international partnership was suggested. In broad terms, the goals of the Triangle Project were reported as: 1) to solve the management problems of biodiversity and maintenance of ecosystem functions; 2) to emphasize the basic and key roles of science in the research of biodiversity at seamount areas; 3) to propose coordination, cooperation and communication among international organizations, contractors and experts; and 4) to provide scientific

principles for the framework of the REMP. Cooperation and sharing among international organizations, the contractors and ISA was considered necessary under the principles of extensive consultation, joint contribution and shared benefits.

In order to achieve the objectives of the Triangle Project, a clear organizational approach, scientific objectives and strong policy and supporting measures would be needed. Considering that the CRC "Triangle Area" is a unique environment which embodies various geological and biophysical features, the principles and approaches of developing a REMP in the "Triangle Area" should be based on the particular characteristics in the seamount area.

A roadmap was suggested in Fig. 9-3, which includes aspects of institutional arrangements (steering committee, liaison office, and working group), science and policy (principles, investigations and data

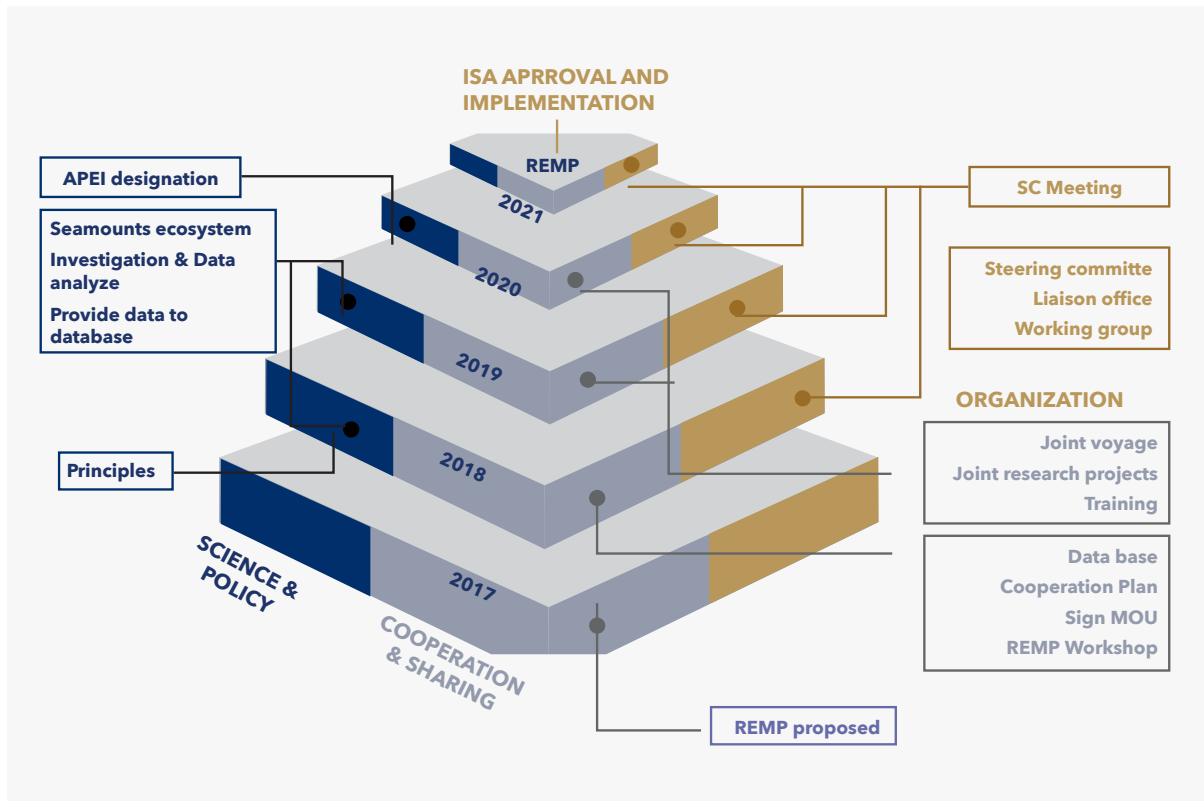


Fig. 9-3 Suggested roadmap to achieve objectives of the Triangle project.

analysis, APEI designation, etc.), as well as cooperation and sharing (workshops, database, collaborative voyage and projects, training, etc.).

III. WORLD CAFÉ DISCUSSIONS

(Presented by Dr. Pedro Madureira, co-organized by Dr. Harald Brekke, Dr. Sandor Mulsow, Dr. Georgy Cherkashov, Dr. Yeon Jee Suh and Dr. Xue-Wei Xu)

1. Background

General obligations on marine data collection and sharing

Under the UNCLOS, ISA shall promote and encourage marine scientific research in the Area and shall coordinate and disseminate the results of such research and analysis when available. The States shall cooperate, directly or through competent international organizations, for the purpose

of promoting studies and encouraging the exchange of information and data acquired relating to the marine environment.

Specific ways include but are not limited to:

- Participation in international programmes and encouragement of cooperation in marine scientific research by personnel of different countries and of ISA; and
- Development of programmes for the benefit of developing States and technologically less developed States to strengthen their research capabilities, and to disseminate the results of research and analysis effectively.

The resolution adopted by the General Assembly also calls upon all stakeholders to conserve and sustainably use the oceans, seas and marine resources

for sustainable development, and to dedicate more resources to marine scientific research. Specific efforts should be made to accomplish this aim, including the strengthening of interdisciplinary research and sustained ocean and coastal observation, promotion of decision-making based on the best available science, encouragement of scientific and technological innovation, as well as enhancement of the contribution of marine biodiversity to the development of developing countries, in particular Small Island Developing States and least developed countries.

Obligations of contractors on data submission in contract areas

There is a clear provision for the data collected in the contract areas. Contractors should provide ISA with all relevant data, data standards and inventories, including raw environmental data in the format agreed with ISA. Metadata that details the analytical techniques, error analyses, descriptions of failures, techniques and technologies to avoid, comments on sufficiency of data and other relevant descriptors should be included with the

actual data. Collaborative research may provide additional data for the protection of the marine environment and may be a cost-effective option for contractors.

ISA's Database project

Expanding the breadth and depth of its strategic partnerships with relevant organizations and researchers will be a key aim for the Secretariat of ISA. In this regard, ISA's database will play a critical role as the permanent and authoritative host for data relating to the Area, thus creating a data archive that is available to present and future generations.

ISA has set up a working group to facilitate the establishment of environmental databases using data from contractors and selected external sources and retained a set of expert consultants to facilitate data standardization. As a preliminary phase, the Secretariat has assembled information concerning the form and availability of relevant data within 18 institutions worldwide. It commenced the project in 2001 with the collection of data and information related to PMN and CRC. The data collection was enriched in



late 2002 with the receipt of data pertaining to hydrothermal vent systems and PMS.

Roadmap of the REMP for the “Triangle Area” in the northwest Pacific Ocean

Considering the current status of exploration in the Area, northwest Pacific Ocean has been identified as one of the priority areas for development of REMPs on a preliminary basis.

It is suggested that the development of a REMP in the “Triangle Area”, under the auspice of ISA, should account for the next few years. Consequently, the REMP strategy must be reviewed and updated periodically.

The implementation of REMP requires the establishment of an effective institutional framework and extensive cooperation and communication between ISA, contractors and other international organizations.

2. Summary of discussions (conclusions and recommendations)

The REMP is one of the appropriate and necessary measures to ensure the effective protection of the marine environment of the Area from harmful effects that might arise from activities in the Area. Working Group 3 focused on the role of ISA in sharing public environmental information and the development of the REMP for the CRC “Triangle Area” in the northwest Pacific Ocean.

Working Group 3 met on 29 May 2018 and was divided into two subgroups placed in two rooms (Caiwei Hall and Weijia Hall). Caiwei Hall focused on the topic of data resources and ISA’s role in sharing public environmental information. The discussions in Caiwei Hall were moderated by Dr. Harald Brekke, Prof. Pedro Madureira and Dr. Sandor Mulsow. The discussions in Weijia Hall were moderated by Mr. Georgy Cherkashov, Ms. Yeon Jee Suh and Mr. Xue-Wei Xu.

The working Group reached the following conclusions

- (a) Environmental data sharing should be realized as soon as possible to promote the development of the REMP. Types of data should include environmental baseline data, biological data, images and others.
- (b) ISA, contractors, and other organizations should carry out a range of cooperation and coordination activities in order to promote data sharing, including collaborative voyage and joint projects, and international workshops on important scientific issues and data standardization.
- (c) Training programmes in respect of data, technology and management should be encouraged for developing countries, especially the Small Island Developing States around the “Triangle Area”.
- (d) It is necessary to set clear objectives of and establish corresponding mechanism for development of the REMP.
- (e) Due to the uniqueness of the “Triangle Area”, specialized environmental parameters should be investigated according to the environmental guidelines of ISA and a long-term observation be established outside the contract areas in the “Triangle Area”.
- (f) Lessons should be drawn from international cooperation experience and sufficient financial support should be rendered to international cooperation.

The Working Group made the following recommendations.

- (a) ISA should share historical environmental data of the CRC in the “Triangle Area” in the northwest Pacific Ocean with the relevant contractors as soon as possible. This

- action is included in the strategy of implementing an efficient digital database in ISA, where all environmental data should be available to the general public. However, it would be good to specify what confidential and non-confidential environmental data/measurements are, as there are many types of environmental data.
- (b) Contractors and the scientists, who are the major collectors of the data of the contract areas, should have priority in using the data for publications. The contractors and countries in/around the "Triangle Area" should be encouraged to work together to provide data from areas beyond contract areas. There should be cooperation through international programmes, such as the Argo, which count on the participation and support of all countries sponsoring ISA contractors in the "Triangle Area" who can provide valuable data to the REMP development. Existing frameworks and expert databases may be valuable resources for collaboration between scientific community and stakeholders.
- (c) There should be wider communication with the developing countries, including providing scientific and technical assistance to developing countries by inviting them on the collaborative voyages, providing capacity-building in environmental survey technology and helping to develop deep-sea curriculum in universities.
- (d) A REMP Steering Committee, a liaison office and a working group should be set up to coordinate the development of the REMP programme, and more attention should be paid to the dissemination of appropriate information to the public.
- (e) The investigation of environmental parameters outside contract areas in the "Triangle Area" should include: physical oceanography (currents, temperature, salinity, turbidity, energy flux and other characteristics water column), chemical oceanography (pH value, dissolved oxygen, nutrient concentrations, dissolved and particulate organic carbon, estimation of mass flux, chlorophyll a, etc.), characteristics of biological communities and biodiversity, as well as information on geology. The scope and time limits of confidential data should be defined.
- (f) An international partnership should be established to promote the REMP development. In line with the relevant procedures, the expenditures for the environmental work outside the contract area could be put into the contractors' development costs. The funding and support of the scientific community should be exerted, and the role of the contractor should be given full play, with a stable ISA level fund support.

ANNEX I. WORKSHOP PROGRAMME

Date - 2018	Time	Activity	Speaker/Moderator
26 May	12:00 - 20:00	Registration	
27 May	14:00 - 16:00	Visit National Deep Sea Center	
	19:00 - 20:00	Welcome Reception	
28 May	9:00 - 9:50	Opening Remarks (Moderator: Feng Liu)	
		Representative of Ministry of Natural Resources	Shanqing Lin
		Representative of ISA	Michael Lodge, Secretary-General
		Representative of local government	
		Group Photo	
	9:50 - 10:30	Plenary Presentations (Moderator: Jian Kang)	
		China's deep sea environment policy and practice	Feng Liu
		Towards the development and implementation of an Environmental Management Plan Strategy for the Area	Sandor Mulsow
	10:30 - 11:00	Coffee break	
	11:00 - 11:30	Session 1: Legal Framework (Moderator: Sandor Mulsow)	
		Legal and regulatory framework for REMP	Yongsheng Cai
		Frameworks for REMPs: the CCZ nodule example	Cindy Lee Van Dover
	11:30 - 12:00	Working Group 1: Legal and Scientific Framework	
Working Group 1: Legal and scientific framework for CRC REMP in the northwest Pacific Ocean		Moderator: Russell Howorth (Caiwei Hall) / Cindy Lee Van Dover (Weijia Hall) Rapporteur: Luigi Santosuosso / Linlin Li	
12:00 - 13:30	Lunch		

28 May	13:30 - 13:50	Report on WG 1 conclusion/ recommendations	Rapporteur: Luigi Santosuosso / Linlin Li
	13:50 - 16:00	Session 2: CRC Habitat (Moderator: Xue-Wei Xu / Qian Liu)	
		Structure and functional characteristics of seamounts ecosystem	Tina Molodtsova
		Major factors influencing seamount niches	Tomohiko Fukushima
		Megafauna community structure, distribution and impact factors on the northwest pacific seamounts	Chunsheng Wang
		Exploration plan for Co-rich Ferromanganese Crust in Korean Contract Area- Environmental Research and Management Plan	Se-Jong Ju
		Environmental studies of the cobalt- rich ferromanganese crusts on Russian exploration area	Viacheslav Melnik
		Confirming the validity of ADCP velocity measurements for physical environmental assessments in Marcus-Wake Seamount group for cobalt-rich ferromanganese crusts	Akira Iguchi
	16:00 - 16:30	Coffee Break	
	16:30 - 17:30	Working Group 2: Seamount Ecosystem and APEI Designing Principles (World Café Approach)	
Characteristics of seamount ecosystems, impacts of human activities and approaches of the scientific protection		Moderator: Tina Molodtsova / Tomohiko Fukushima / Chunsheng Wang	
Current scientific knowledges, APEI designing principles, future survey methods and research orientations of the environments in the northwest Pacific		Moderator: Pei-Yuan Qian / Se-Jong Ju / Alison Swaddling	
18:00 - 20:00	Dinner		
20:00 - 21:00	Closed working meeting (ISA and contractors)	Moderator: Michael Lodge	
29 May 2018	9:00 - 9:30	Report on WG 2: conclusions/ recommendations	Rapporteur: Pei-Yuan Qian / Tina Molodtsova
	9:30 - 9:55	Session 3: REMP Proposal and Perspective (Moderator: Xiangyang Li)	
		Proposal of the Triangle Project for cobalt- rich ferromanganese crusts in the northwest Pacific Ocean	Xue-Wei Xu
		ISA database implementation	Sandor Mulsow

10:00 - 10:40	Working Group 3: REMP Proposal (World Café Approach)	
	Data resources, ISA role in sharing public environmental information	Moderator: Harald Brekke / Pedro Madureira / Sandor Mulsow
	Roadmap to implement REMP for CRC in the northwest Pacific Ocean	Moderator: Georgy Cherkashov / Yeon Jee Suh / Xue-Wei Xu
10:40 - 11:20	Coffee break	
11:20 - 11:30	Report on WG 3: conclusions/ recommendations	Rapporteur: Pedro Madureira / Yeon Jee Suh
11:30 - 12:00	Closing Remarks (Moderator: Yongsheng Cai)	
	Working Group 1: Final report	Luigi Santosuosso
	Working Group 2: Final report	Pei-Yuan Qian
	Working Group 3: Final report	Pedro Madureira
	SG of COMRA	Feng Liu
	SG of ISA	Michael Lodge
12:10 - 13:30	Lunch	
14:00 - 16:00	Departure or Visit China Ocean Sample Repository	

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