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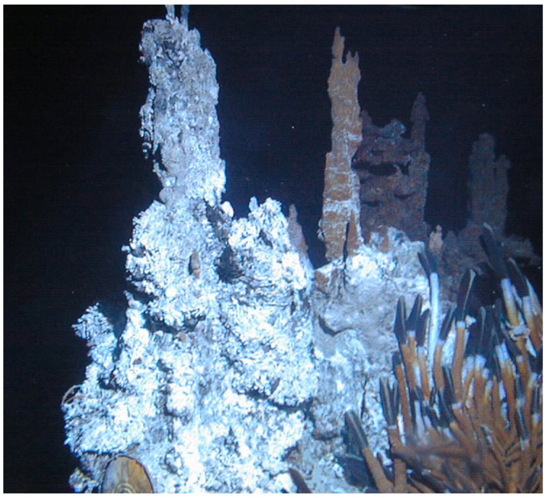

Developing a Framework for Regional Environmental Management Plans for Polymetallic Sulphide Deposits on Mid-Ocean Ridges

25th
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Developing a Framework for Regional Environmental Management Plans for Polymetallic Sulphide Deposits on Mid-Ocean Ridges

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International Seabed Authority | University Of Szczecin
27 - 29 June 2018, Szczecin, Poland

ISA TECHNICAL STUDY NO: 22

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International Seabed Authority
Developing a framework for regional environmental management plans (REMPS) for polymetallic sulphide deposits on mid-ocean ridges.

p. ; col. ill. ; cm - (ISA technical study, no. 22)

At head of title: Regional environmental management plan strategy of the International Seabed Authority.

ISBN 978-976-8241-67-2 (pbk)
ISBN 978-976-8241-68-9 (ebk)

1. Ocean mining – Environmental aspects
2. Ocean mining – Law and legislation
3. Environmental protection – Planning
4. Marine resources conservation – Law and legislation
5. Marine resources development – Law and legislation

I. Title II. Series

341.45 dc 23

International Seabed Authority
14-20 Port Royal Street
Kingston, Jamaica
Tel: +1 876 922-9105
Website: www.isa.org.jm

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ACRONYMS AND ABBREVIATIONS

ABMT	Area Based Management Tool
APEI	Area of Particular Environmental Interest
AUV	Autonomous Underwater Vehicle
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe
CBD	Convention on Biological Diversity
CCD	Carbonate Compensation Depth
CCZ	Clarion-Clipperton Zone
COMRA	China Ocean Mineral Resources Research and Development Association
CRC	Cobalt-Rich Crust
DO	Dissolved Oxygen
EBS	A Ecologically or Biologically Significant Marine Area
ECS	Extended Continental Shelf
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ERM	Environmental Resource Management
FAO	Food and Agriculture Organization
ICPC	International Cable Protection Committee
IFREMER	Institut français de recherche pour l'exploitation de la mer
IMO	International Maritime Organization
IOM	Interoceanmental Joint Organization
IRZ	Impact Reference Zone
ISA	International Seabed Authority
LTC	Legal and Technical Commission
MAR	Mid-Atlantic Ridge
MOR	Mid-Ocean Ridge
MSR	Marine Scientific Research
NGO	Non-governmental Organization
OEMMR	Office of Environmental Management and Mineral Resources
PMN	Polymetallic Nodules
PMS	Polymetallic Massive Sulphides
POC	Particulate Organic Carbon
PRZ	Preservation Reference Zone
PSSA	Particularly Sensitive Sea Area
REMP	Regional Environmental Management Plan
ROV	Remotely Operated Underwater Vehicle
SDG	Sustainable Development Goal
SEMPIA	Strategic Environmental Management Plan for deep seabed mineral exploration and exploitation in the Atlantic basin
SMS	Seafloor Massive Sulphides
SWIR	Southwest Indian Ridge
ToR	Terms of reference
VME	Vulnerable Marine Ecosystem
UNCLOS	United Nations Convention on the Law of the Sea
UN DOALOS	Division for Ocean Affairs and the Law of the Sea of the Office of Legal Affairs of the United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
WG	Working group

EXECUTIVE SUMMARY

The International Seabed Authority (ISA), in collaboration with the University of Szczecin, convened a workshop on developing a framework for the preparation of regional environmental management plans (REMPs) for polymetallic sulphide deposits on mid-ocean ridges on June 27-29, 2018 in Szczecin, Poland. Participating in the workshop were fifty experts and representatives from a range of stakeholder groups, including governments, contractors, scientific organizations, and non-governmental organizations. Workshop deliberations were undertaken in both plenary and working groups, resulting in a set of conclusions which are highlighted below.

Goals and objectives of REMP

The goals identified for the Clarion-Clipperton Zone-Environmental Management Plan (CCZ-EMP) are relevant for mid-ocean ridge systems including the primary goal of facilitating seabed mining while maintaining biodiversity, protecting unique and representative habitats, and preserving ecosystem function through both area-based management tools (ABMTs) and non-ABMTs (e.g. rules-based management measures).

- REMPs would also:
    - o provide a framework to guide contractors and researchers and ISA in the collection and compilation of environmental data and information to inform deep-sea environmental management;
    - o increase awareness of the ecological/biological value of deep-sea ecosystems; and
    - o contribute to internationally-agreed targets for ocean conservation and sustainable development (including the Aichi Biodiversity Targets and Sustainable Development Goal 14).

Key considerations for REMP design were highlighted as follows

- REMPs should be in place before exploitation begins. Discussions also ensued regarding the legal status of REMPs and references to REMPs in the draft regulations on exploitation were made.
- REMPs should involve ABMTs and rules-based management measures, where appropriate.
- REMP objectives for mid-ocean ridges should be adopted from those of the CCZ-REMP, with attention to strategic and operational definitions of conservation goals, objectives, and measurable targets.
- REMPs should be based on the best available scientific information, including biological and ecological characteristics.
- The geographic scope for REMPs should be based on natural biogeographic units and transitions.
- In addition to the protection of VMEs and a representative set of the full range of habitats and communities on mid-ocean ridges, REMPs should identify and protect other important areas on a regional scale, such as ecologically-important fracture zones, hybrid zones, and biogeographical transition zones.
- REMPs, including APEI networks, should recognize and respond to existing management measures put in place by competent authorities.
- The performance of REMPs towards achieving their conservation objectives should be assessed through the use of quantitative metrics.
- REMPs should inform how preservation reference zones (PRZs) will be implemented for polymetallic sulphide resources.
- REMPs should initially apply a precautionary approach and be adapted as scientific evidence becomes available and impacts are reassessed.
- Triggers for reviewing the performance of the REMPs should be articulated as part of the REMP development process.
- REMPs should be developed through broad stakeholder engagement.
- REMPs should guide the environmental impact assessment (EIA) process.

APEI design principles

APEI design on mid-ocean ridges should consider the following.

- The smaller dimensions and linear distribution of sulphide resources on mid-ocean ridges.
- The heterogeneous environment on mid-ocean ridges which encompasses different types of habitats.
- The existence of exploration blocks along much of the mid-ocean ridges in contract areas makes it challenging to place coherent and effective networks of APEIs without overlapping.
- The need for flexibility in relation to location, size, and shape of APEIs, as, in the final analysis, the network

design must meet the conservation objectives and targets of the REMP. The network design should, initially, be conservative and then adapted as scientific evidence becomes available and potential impacts of mining activities are re-assessed.
- Adaptations to the REMP should maintain or improve the performance of the REMP in achieving its conservation objectives.
- The replication of APEIs within a biogeographical region is a guiding principle for the network design.
- Assessment of proposed networks of APEIs should be based on how well they achieve conservation objectives using quantitative metrics to guide the final selection of network designs.
- Networks of APEIs should be reviewed periodically (or based on a trigger) and should persist longer than the final duration of mining impacts in the region.

Knowledge Gaps

Knowledge gaps of particular relevance to REMPs were identified in the following categories:

- Environmental baselines (including models and validation) for the seabed and overlying water columns in the region, including descriptive-, process-, and ecosystem-services-oriented baselines and cumulative impact assessment;
- Relationships between REMPs and PRZs/ impact reference zones (IRZ) as mandated by the rules and regulations of ISA;
- Mining technologies and methods, including seabed and water column disturbance characteristics (spatial and temporal scales of impacts), monitoring approaches, triggers for stop actions;
- Stakeholder engagement and roles in development of REMPs; and
- Operational definitions of areas at risk of serious harm and means for their protection.

I. INTRODUCTION

The Council of ISA requested the Secretariat to advance the development of regional environmental management plans (REMPs; ISBA/24/C/3) similar to the REMP developed for the Clarion-Clipperton Zone (ISBA/17/LTC/7). The focus of these REMPs should be on other areas and mineral resources for which there were exploration contracts and should be developed under the auspices of ISA in a transparent manner with the engagement of all stakeholders.

In this context, ISA, in collaboration with the University of Szczecin, convened a workshop on developing a framework for REMPs for polymetallic sulphide deposits on mid-ocean ridges on 27-29 June, 2018 in Szczecin, Poland. Annex I contains the workshop programme.

The workshop was organized with financial resources from the University of Szczecin and ISA. A total of 50 participants attended. They represented a wide range of stakeholders/sectors: member States (17), contractors (14), LTC members (2); the scientific community (6), international institutions (2), NGOs (2), the private sector (3), UN DOALOS (1) and representatives of ISA (3). Annex II contains the list of participants.

The workshop comprised a series of plenary presentations on specific themes related to REMPs in the Area. It also included four practical working groups (WGs). WG 1 looked at REMP goals, objectives and targets; WG 2 examined the critical elements of REMPs; WG 3 explored design principles for ABMTs

and non-ABMTs in REMPs; and WG 4 outlined the roadmap for future REMPs timeline and activities.

This workshop aimed to provide the relevant organs of ISA, as well as contractors and their sponsoring States, with proactive ABMTs as well as other measures to support informed decision-making that balances resource development with conservation needs through the development of REMPs for polymetallic sulphides on mid-ocean ridges.

REMPs are intended to provide ISA with a mechanism to identify areas thought to be representative of the full range of habitats, biodiversity and ecosystem structures and functions within the relevant management area. REMPs should also provide those areas with appropriate levels of protection to ensure ISA's compliance in meeting internationally-agreed targets and goals, such as the Aichi Biodiversity Targets and SDG 14.

At this workshop, participants focused on reviewing the status of existing data and scientific initiatives as well as outlining steps for the development of REMPs under the auspices of ISA.

Further, the workshop facilitated the design of REMPs for mid-ocean ridges by bringing together international deep-sea scientists/experts on the different aspects of the mid-ocean ridges from geology, ecology and ecosystem functions, ISA contractors involved in the exploration of polymetallic massive sulphides, non-governmental organizations, member States and international institutions.

Specifically, the workshop was tasked with the following terms of reference (ToR): 1) define critical elements of a REMP; 2) outline the goals, objectives and targets for the REMPs; 3) design principles for ABMTs in REMPs; and 4) define a roadmap for developing REMPs in the mid-ocean ridges.

The results of the workshop are presented in this technical study. Drawing on the workshop outcomes, the next steps can be proposed to the relevant bodies of ISA for the development of REMPs for deep-sea areas with polymetallic massive sulphides.

II. WORKSHOP PLENARY

1) Opening remarks were made by the representative of the University of Szczecin of Poland and the Secretary- General of ISA.

2) Professor Marek Górski, Vice-Rector for Science and International Cooperation, welcomed workshop participants to Poland, to Szczecin and to his university on behalf of Professor Habhab Edward Wlodarczyk. He expressed his appreciation to ISA for locating the workshop in Poland. He noted that Poland had recently joined the group of ISA contractors from Germany, France, Russia, India, China and the Republic of Korea who had concluded contracts for exploration for polymetallic massive sulphide on mid-ocean ridges. He said his country was eager to learn from the experience of others and to contribute to expanding the body of knowledge on the resource and its environment in support of the Sustainable Development Goals (SDGs), particularly Goal 14 which is aimed at conserving and sustainably using the resources of the oceans and seas. He advised that the participants should pay attention to the contractors' obligations and interests, as well as to underscore the need to protect the invaluable environmental assets of the unique areas within mid-ocean ridges. Professor Gorski conveyed his hope that the workshop would pave the way towards ensuring the balance between the interests of the stakeholders and those of nature.

3) Mr. Michael W. Lodge, Secretary-General of ISA, delivered his opening remarks remotely. He welcomed workshop participants and thanked the Educational

and Research Centre for Natural Sciences of the Faculty of Sciences at the University of Szczecin for its contribution to the organization of this workshop. He also thanked the members of the steering committee for their contribution to the design and organization of the workshop.

Mr. Lodge explained that the workshop was intended to create a framework for the development of REMPs for polymetallic massive sulphide deposits on mid-ocean ridges. He emphasized that the United Nations Convention on the Law of the Sea and its 1994 Implementation Agreement had mandated ISA to develop the mineral resources of the deep seabed beyond national jurisdiction for the benefit of mankind as a whole, while also promoting the protection of the marine environment from the harmful effects which may arise from exploration and exploitation activities. He noted that it was envisioned that REMPs would be the primary vehicle used by ISA to ensure effective environmental protection while considering the different characteristics of the mineral resources found in the Area.

The first REMP for the Area was adopted for the CCZ in 2012. It included the designation of a network of nine APEI totaling 1.6 million square kilometres, representing one of the largest applications of an ABMT on earth. He shared that since 2012, the Council of ISA had, repeatedly, called upon the Secretariat and the Legal and Technical Commission (LTC) to apply similar REMPs in other parts of the Area, particularly where contracts for exploration currently exist. He said that these calls had also been reflected in the resolutions of the General Assembly. As a consequence, in March 2018, the Council proposed the development of REMPs for key provinces where exploration activities were currently taking place. It is anticipated that having REMPs in place in all mineral provinces where exploration occurs will contribute to the effective management of activities undertaken in the Area. The importance of this initiative is recognized in the draft strategic plan for ISA for the period 2019-2023 and reflected in the establishment of a dedicated work programme on REMPs in the budget of ISA for the period 2019-2020.

Mr. Lodge advised that the first step towards implementing this vision was taken in Qingdao, China in May 2018 at the workshop held in collaboration with COMRA to consider the development of a REMP for the so-called cobalt-rich crusts triangle area in the north-west Pacific. It had laid a solid foundation for scientific cooperation between contractors in this Area and other interested stakeholders in the future.

Mr. Lodge highlighted the objectives of the present workshop, by setting the geographical and scientific priorities for the development of these REMPs.

(1) REMP design would benefit from the many lessons to be drawn from the existing CCZ REMP including the guiding principles, implementation methodology, and design principles for APEIs. In each case, the different natures of the distribution of resources must be kept in mind and consideration given to how environmental management objectives would be progressed in keeping with the elements in the REMP for each mineral resource.
(2) Well-structured and organized information would be of utmost priority for the design of any REMP. Consequently, ISA's new database would be a critical asset in ensuring sound and efficient data management of information collected by contractors and independent scientific institutions worldwide. It would also host all the environmental information collected on APEIs as well as other baseline management tools defined

in REMPs. ISA would provide guidelines on the assessment and archiving of data and information from baseline studies.

(3) While the prime responsibility for REMPs lies with ISA, by reason of its exclusive mandate under the Convention, the design relies on the cooperation of stakeholders. The exploration activities by contractors, and, in particular, the scope of their environmental baseline studies, would determine the success of REMPS. In addition, any progress in identifying gaps in science to target research at the appropriate scale, would require collaboration among stakeholders.

4) Presentations1 were delivered by the representatives of contractors, and a summary of each presentation is provided below.

4.1 "Russian Federation: Some considerations on the establishment of APEIs on the Mid-Atlantic Ridge"

Andrey Gebruk (P.P. Shirshov Institute of Oceanology, RAS, Moscow, Russia) and Livia Ermakova (VNIIOkeangeologia, St. Petersburg, Russia)

The establishment of APEIs was identified as one of the key objectives of REMPs. It was noted that several scenarios relating to the designation of APEIs on the MAR had been previously considered by SEMPIA in a series of international workshops ("Development of a strategic Environmental Management Plan for deep seabed mineral exploration and exploitation in the Atlantic basin") (Dunn *et al.*, 2018). The scenarios had been developed for the MAR in compliance with best practices for networks of protected areas in a region and thus overlapped with exploration contracts.

It was noted that a large segment of the northern MAR was already under exploration contracts – Polish, French and Russian. This extended from the southern boundary of the Portuguese Extended Continental Shelf (ECS) claim at 32.84°N in the north to about 11°N in the south. The ridge segments between the contract areas were very short and would not effectively meet the precautionary objectives of the REMP. Unlike in the CCZ region, on the MAR, the APEIs could only be located along the ridge axis and not from east to west of the ridge, and leaving more than 20 degrees of the mid-Atlantic Ridge without APEIs would not be acceptable.

After a process of relinquishment during the exploration phase, 75 per cent of each contract area would be returned to the Area. These relinquished areas could be included in the network design of APEIs. In such cases, the information gained by contractors during environmental baseline studies could prove useful for design purposes. ISA would need to consider the legal aspects of this option as such an approach would restrict exploration/exploitation opportunities for future contracts. On the other hand, one possible benefit for contractors from APEIs on the ridge in areas adjacent to blocks kept by contractors for exploitation might be the opportunity for using parts of APEIs for PRZs.

Most of the hydrothermal fields/sulphide deposits on the MAR were unique in terms of size, water depth and location on the profile of the Rift Valley. Also, individual blocks proved to be too small (10x10 km) for needs of environmental protection. There are, thus, reasons to expect that finding a

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Copies of presentations are available at: [Website Developing a Framework for Regional Environmental Management Plans (REMPs) for polymetallic massive sulphide deposits on Mid-Ocean Ridges]

PRZ within 25 blocks kept by contractors for exploitation (test-mining) could be a great challenge. If APEIs were "opened" for PRZs, this could increase the chances of finding representative habitats and biota required for establishing a PRZ. The current regulations of ISA mandated that PRZs must be located within contract areas. So, the legal aspects of placing PRZs in APEIs would also require consideration by ISA.

The question of time was also considered – "Can we wait until 2022-2028 when the first parts of contract areas on the MAR will be relinquished?" Perhaps the need to develop REMPs for the MAR is more urgent. Different aspects of this proposal would require further detailed consideration. The final decision about the function and principles of designation of APEIs and decisions on acceptability of PRZs within APEIs would be the prerogative of ISA.

References
Dunn, D.C., C.L. Van Dover, R.J. Etter, C.R. Smith, L.A. Levin, T. Morato, A. Colaço, A.C. Dale, A.V. Gebruk, K.M. Gjerde, P.N. Halpin, K.L. Howell, D. Johnson, J.A.A. Perez, M.C. Ribeiro, H. Stuckas, P. Weaver and the SEMPIA Workshop Participants. A systematic and adaptable design for ABMT of mid-ocean ridges in the context of deep-sea mining. *Science Advances*. 2018

4.2. "People's Republic of China: COMRA's activities in the mid-ocean ridges"

Song Chengbing, COMRA, Beijing, Peoples Republic of China.

COMRA had continued its efforts in investigating potential mineral deposits in the contract areas in the Southwest-Indian Ocean, and substantial emphasis had been placed on understanding the benthic community and ecosystems of hydrothermal vent fields there in recent years. Over the last five years, COMRA had conducted seven cruises and obtained a substantial amount of information on biological communities and their temporal and spatial variations in the vent fields of SWIR, and some initial information on biological communities in the vent fields of other ocean ridges. Overall, the biological communities in the SWIR demonstrated many features similar to those in the Central Indian Ridge. The presentation looked at key findings in COMRA's contractual area and the areas of interest.

In striking a balance between the possible resource extraction and conservation of hydrothermal vent ecosystems, COMRA launched a large-scale environmental programme to conduct more intensive scientific investigation in the u-loop area. One of its objectives is to develop the REMP network in close collaboration with other contractors and stakeholders and ISA. A proposal based on the REMP workshops and the REMP network development would be presented in the u-loop area as discussed by COMRA and ISA, recently.

4.3 "India: Indian Polymetallic Sulphide Programme"

Parijat Roy, Ministry of Earth Sciences, Government of India

The Ministry of Earth Science, in the Government of India, and ISA signed a 15-year contract for the Exploration of Polymetallic Sulphides in the Indian Ocean region on 26 September 2016. The contract mandated the undertaking of a comprehensive programme for oceanographic and environmental baseline studies in the application area, in both the general and the reserved area. It also required the assessment of the possible environmental impact occasioned by the proposed exploration activities during the three phases of the plan of work – namely Phase I (0-5 years), Phase II (6-10 years) and Phase III (11-15 years). The study would be conducted in accordance with the rules, regulations and procedures established by ISA and take into account any recommendations issued by the Legal and Technical Commission. The proposed ecological/environmental study, broadly, included the establishment of environmental baselines, environmental monitoring programmes and the assessment of the possible impact of the proposed exploration activities. The study would cover both benthic and pelagic environments including microbial components of the application area. The activities were proposed to cover both active hydrothermal sites (particularly chemosynthesis) and dormant/inactive hydrothermal sites. The biodiversity will be studied for hydrothermal areas as well as adjoining areas outside the hydrothermal area during exploration campaigns. The study will consider qualitative as well as quantitative assessment of benthic and pelagic assemblages. Upon signing the contract, India carried out environmental baseline studies in the contract area as per ISA guidelines and generated baseline data on various parameters-physical, chemical, and biological parameters.

4.4 "Poland: 30 Years of Environmental Studies"

Tomasz Abramowski, Interocean-metal Joint Organization

The presentation summarized the environmental objectives of the IOM's exploration work. The legal framework for transition from exploration to exploitation, which parallels the environmental policy ensuring responsible extraction of marine minerals, was presented and the results of environmental baseline studies carried out in the exploration area discussed. The area-based and non-area based tools in support of goals and objectives of the REMP were described. It also addressed various issues relating to the implementation of REMPs. These included: consistency with other ISA regulations such as the role of IRZs and PRZs; anticipated performance of planned REMPs; overlapping with contractors' areas or buffer zones; and the implementation of long-term, independent monitoring programmes.

4.5 "Germany: Current Status of the German Polymetallic Sulphide Exploration and Environmental Investigations in the Western Indian Ocean"

R. Freitag, C. Kriete and U. Schwarz-Schampera (Federal Institute for Geosciences and Natural Resources)

It was noted that Germany had had a long history in marine research in the Indian Ocean. The first German scientific cruise took place in 1964, followed by several State-sponsored research cruises between 1983 and 1995 (GEMINO, HYDROTRUNC, HYDROCK) leading to the first discovery of polymetallic sulphides in the Indian Ocean. The research included regional environmental investigations, particularly oceanographic and sedimentary baseline studies. In 2010, BGR initiated the preparation of an exploration licence for polymetallic sulphides, and prospecting started in 2011. After three years of resource-oriented and environmental baseline studies, BGR applied for an exploration licence which was signed with ISA in 2015.

The German exploration programme for polymetallic sulphides along the southern central and the northern southeast-Indian Ridge spreading centres includes the collection of geological, geophysical, biological and additional environmental data for baseline studies, as well as the testing and implementation of successful exploration programme strategies. The exploration cruises routinely conduct detailed rock and regional sediment sampling programmes, measurements of oceanographic parameters (e.g., vertical and lateral mass transfers, water column analysis and bottom currents) and analysis of faunal biodiversity and habitats. The comprehensive review of these recent studies and results from earlier German and other research cruises provide temporal information on the variations in the observed parameters. The faunal baseline studies will be integrated in a so-called "INDEX tree of life" which potentially contributes to the development of a REMP for the spreading ridges in the Indian Ocean.

The exploration for active and inactive polymetallic sulphides led to the identification of five areas of mineralization including seven active vents and 10 inactive sulphide fields. The ongoing programme aims at the localization of inactive seafloor massive sulphide occurrences, the estimation and measurement of the orebody dimensions, the analysis of metal concentrations and subsequently the identification of potentially economically-feasible deposits. Additional objectives are the conceptual development of mining techniques and the design of an optimized and zero-waste metallurgical process.

This presentation covered the exploration concepts and results from their environmental investigations after three years of exploration in the German licence area for polymetallic sulphides in the Indian Ocean.

4.6 "France: An update on IFREMER's exploration activities on its polymetallic sulphides exploration contract on the mid-Atlantic Ridge."

S. Ybert ; L. Menot ; M.A. Cambon-Bonavita ; Y. Fouquet ; E. Pelleter ; C. Cathalot ; F. Pradillon ; E. Roussel

IFREMER's polymetallic sulphides exploration contract, signed in 2014, covers an area ranging from 21° to 26° north along the mid-Atlantic ridge. IFREMER's exploration strategy is designed through three stages:

- Stage 1 involves regional mapping and exploration along with a qualitative study of the regional biodiversity.
- Stage 2 includes local exploration and detailed studies of targets identified during stage 1 as well as the quantification of the structure of assemblages and fauna-habitat relationships.
- Stage 3 involves the study of the deposits in their third dimension and of the functioning and dynamics of the ecosystems. It is only at the third stage that prospective sites, IRZs and PRZs can be defined.

Three exploration cruises with a few days during a transit of the R/V *l'Atalante*, have allowed them to significantly advance stage 1 and to initiate some of the stage 2 activities.

Regarding geoscience, 98 per cent of the contract area had been mapped and plume anomalies detected in various locations during the *Hermine* cruise (2017), substitutions for new hydrothermal fields in the contract area. At a local scale, high resolution mapping had been performed around the TAG and Snake Pit areas. Exploration and sampling of extinct SMS deposits in the TAG district would feed the geological and metallogenic studies of the deposits. A study of the TAG active mound hydrothermal plume had also been initiated.

Environmental studies of both vent and non-vent ecosystems were carried out simultaneously. As non-vent habitats were virtually unknown prior to exploration, studies at regional and local scales during the first two cruises aimed at providing a census of habitats and faunas. During the third cruise, the previous mapping of extinct SMS deposits allowed us to stratify biological sampling according to mineralisation in order to better describe and understand the structure of communities associated with inactive vents. At active vents, beyond the chemical and biological characterisation of benthic assemblages, a number of studies were carried out to address the physiological adaptations and resistance to toxic stresses, the host-symbiont relationships, the colonisation processes of meio- and macrobenthic communities as well as the life cycle of key species. In addition, interactions between vent and non-vent ecosystems are studied through two mechanisms: (i) the export of the hydrothermal plume and its consequences on the biogeochemistry in the water column as well as the benthic compartment, and (ii) the geo-microbial interactions in mineralisation at active and inactive vents.

The strategies for environmental management are currently being defined at IFREMER. While it is too early to set up IRZs and PRZs, the definition and management rules considered by IFREMER for VMEs are under development.

5) Presentations2 were delivered by individual experts from organizations and the representatives of ISA's Secretariat, and summary of each presentation is provided below.

5.1 "Working toward a Strategic Environmental Management Plan in the Atlantic."

Dunn, D.C., C.L. Van Dover, R.J. Etter, C.R. Smith, L.A. Levin, T. Morato, A. Colaço, A.C. Dale, A.V. Gebruk, K.M. Gjerde, P.N. Halpin, K.L. Howell, D. Johnson, J.A.A. Perez, M.C. Ribeiro, H. Stuckas, P. Weaver and the SEMPIA workshop participants

Mineral exploitation had spread rapidly from land to shallow coastal waters and is now being planned for the offshore and deep seabed. Approval is being given for the exploration for seafloor mineral deposits over large areas, creating an urgent need for REMPs. Networks of areas where mining and mining impacts are prohibited are expected to be key elements of such plans. The presentation described the adaptation of marine reserve design principles to the distinctive biophysical environment of mid-ocean ridges, offered a framework for the design and evaluation of such networks to support conservation of benthic ecosystems on mid-ocean ridges, and introduced projected climate-induced changes in the deep-sea to the evaluation of reserve design. It enumerated a suite of metrics to measure network performance against conservation targets and network design criteria promulgated by the Convention on Biological Diversity. These metrics were applied to network scenarios on the northern and equatorial mid-Atlantic Ridge where contractors are exploring for seafloor massive sulphide (SMS) deposits. A latitudinally distributed network of areas (extending ≥ 200 km along the ridge axis and 500 km to either side of the ridge axis) performed well at: i) capturing ecologically important areas and 30 to 50 per cent of the spreading ridge areas; ii) replicating representative areas; iii) maintaining along-ridge population connectivity; and iv) protecting areas potentially less impacted by climate-related changes. Critically, the presentation demonstrated that the network design was adaptive, allowing for refinement based on new knowledge and the location of mining sites, provided design principles and conservation targets were maintained. This framework could be applied along the global mid-ocean-ridge system as a precautionary measure to protect regional biodiversity and ecosystem function from impacts of SMS mining. A paper describing this approach is available (Open Access) at http://

Copies of presentations are available at: Webpage: Developing a Framework for Regional Environmental Management Plans (REMPs) for polymetallic massive sulphide deposits on Mid-Ocean Ridges advances.sciencemag.org/content/4/7/eaar4313.

5.2 "EASME Initiative: Regional Environmental Management Planning on the Mid-Atlantic Ridge"

P.P.E. Weaver, Seascape Consultants, UK; Kevin Murphy, Environmental Resources Management (ERM)

Regional environmental management planning aims to create and establish a more rational organization of the use of marine space, and enhance the interactions among different users, so that a balance can be achieved between resource development and conservation. Discussions on how this might look in the context of the Area, as controlled by ISA, have been ongoing for some time and it was a central theme of ISA's Berlin workshop in March, 2017. A REMP should deliver benefits for the managers, contractors and conservation organizations.

Polymetallic sulphides (PMS) differ significantly from manganese nodules and cobalt crusts as a resource being three-dimensional ore bodies, analogous to sulphide deposits on land. Consequently, the mine sizes will be relatively small – perhaps a few square kilometres – and could remain at the same location for several years. Unique to PMS deposits, however, are the hydrothermal vent biological communities that are located on active vent sites distributed along the ridge axis. These unique organisms occur in only a few places on the planet and will need to be considered very carefully in any REMP. The main issue is that exploration, to date, has been guided by identifying active vent sites and assessing their mineral potential. Disturbing or removing substantial amounts of vent habitat could have a major impact on the linear connectivity between vent sites if not carried out in an organised way. In addition, some vent communities may be so unique that they need protection from mining. In some places on ridges, but away from active vents, non-vent fauna can be abundant and is regarded by some bodies, such as the FAO (Food and Agriculture Organization), as being worth protecting from human impacts. Although mine sites will be small, plumes may spread particulates and toxic metals in low concentrations over wider areas that could impact significant areas of rich non-vent habitat and/or affect mid-water communities. Rules-based management approaches can be considered alongside spatial management measures, such as APEIs in a REMP which would allow for a flexible approach to environmental management meeting both development and conservation objectives. Rules-based management is a mechanism by which a set of rules relating to the management of an area are developed and applied, and which need to be fulfilled before development activities can proceed. The rules can be subject to periodic review on the basis of suitable data and evidence. Several industries and regulatory regimes have examples of rules-based management incorporated into the spatial management of an area.

A REMP for sulphide deposits should also anticipate the shift from exploring active vents to exploring off-ridge axis locations where ore bodies may be larger and fully cooled, but which may also lie under several meters of sediment cover.

The European Union has offered to fund the development of a REMP for the Atlantic Ocean north of 39°S. This project would be implemented in close collaboration with ISA's Secretariat. The project will engage a range of stakeholders as advised by ISA. This may be of particular importance in the Atlantic where there are many existing users of the ocean space and coastal

States with interests in the management of the region.

5.3 "Governance of the activities in the Area: Relevant principles and the role of the Division for Ocean Affairs and the Law of the Sea"

Mr Luigi Santosuosso, UN-DOALOS

This presentation provided an overview of the role of the Division for Ocean Affairs and the Law of the Sea of the Office of Legal Affairs of the United Nations. After offering a brief introduction to UNCLOS and its regime concerning maritime zones, the presentation described the role of the United Nations in oceans' governance. The presentation then outlined: (i) the activities of the Division as the functional unit of the United Nations Secretariat which discharges the responsibilities of the Secretary-General under the Convention and the United Nations Fish Stocks Agreement; and (ii) the mandates provided to the Division in General Assembly resolutions. In this connection, particular attention is devoted to the depositary and due-publicity functions discharged by the Division. Finally, the presentation outlined the legal framework established by the Convention for the protection and preservation of the marine environment.

5.4 "Regional Environmental Management Plan Strategy of the International Seabed Authority"

Dr. Sandor Mulsow, Director OEMMR, International Seabed Authority

The presentation described the role of ISA. It was said to be the only international organization mandated by the UNCLOS to administer, on behalf of the States Parties to the Convention, the mineral resources in the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction (the Area), and to supervise current exploration activities as well as future mining activities in the Area. As such, under international law, only ISA is designated to act on behalf of mankind as a whole. Under the Convention, State parties have a general obligation to protect and preserve the marine environment (Article 192; UNCLOS). This overarching obligation encompasses 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 activities under States Parties jurisdiction and control that may cause substantial pollution or significant and harmful changes to the marine environment.

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 a coordinated strategy outline for developing REMPs under the auspices of ISA, in line with relevant decisions of the Council. The strategy identified, on a preliminary basis, the following priority areas for development of REMPs in the Area: North West Pacific Ocean and South Atlantic (cobalt -rich ferromanganese crust) and mid-ocean ridges of Indian and North Atlantic Ocean (polymetallic massive sulphide deposits). The objectives of REMPS are to: a) ensure that relevant organs of ISA, as well as contractors and their sponsoring States, are provided with proactive area-based and non-ABMTs to support informed decision-making that balances resource developments with protection; b) contribute to the effective protection on the management of the biodiversity in marine areas 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) ensure that a clear and consistent mechanism is established to identify particular areas thought to be representative of the full range of habitats, biodiversity and ecosystems structures and functions, and provide those areas with appropriate levels of protection, including through APEIs.

The same guiding principles applied to the REMP of CCZ will be applied to the development of different REMPs. The following principles were highlighted.

- The Area and its resources are the common heritage of mankind. All rights to the resources of the Area are vested in humankind as a whole and on whose behalf ISA shall act.
- Precautionary approach, Principle 15 of the Rio Declaration on Environment and Development 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.
- All States have a duty to protect and preserve the marine environment. The prior assessment of activities that may have significant adverse impacts on the environment must be completed before any activities are begun.
- All States have a duty to conserve and sustainably use marine biodiversity.
- In the interest of transparency, ISA shall enable public participation in environmental decision-making procedures in accordance with the Convention on access to information, public participation in decision-making and access to justice in environmental matters.

ISA clearly has the mandate and legal framework to undertake REMPs in the Area. Polymetallic massive sulphides (active) are well defined as the siting scheme presents geographical constraints (blocks) and the ABMT for REMPs need to be carefully chosen. The REMP strategy is a dynamic one and must be updated constantly, not only in substance but in implementation and review. The REMP strategy calls for consensus on the recommendations of workshop outcomes (Qingdao and Szczecin) in designing methodologies, cost-effective data gathering (gap analysis) initiatives and others. The CCZ EMP will be reviewed and reshaped as an REMP and a workshop will be convened to implement it. An identical strategy will be used for Indian Ocean nodule fields with APEIs clearly defined on the protection and representativeness of the areas under intervention.

5.5 "Mid-Ocean Ridges: scales, geology and stakeholders"

Dr. Sandor Mulsow, Director OEMMR, ISA

Polymetallic massive sulphides deposits associated with active hydrothermal vents were discovered in the 1970s. There are 257 confirmed active vents and 284 inferred ones. In the case of inactive vents, only 56 have been confirmed. Fifty per cent of active vents are located in slow and ultra-slow spreading centres. Massive sulphide deposits are linked to slow and ultra-slow spreading centres (more than 80%). Morphologies are varied ranging from mound type (Galapagos) to vertical type (Endeavour type), in size not bigger than few 100m in diameter. Other stakeholders in the area must be acknowledged such as communication cables and other ABMTs. Chemosynthetic ecosystems are partially known, although much is not known about their function and relevance to preserve biodiversity.

Seafloor massive sulphides were discovered in the late 1970s. Slow and ultraslow spreading ridges and island arc systems are the most favourable settings with economic potential. Areas for SMS application are still available in the slow spreading ridges. Feasibility of cost-effective production of SMS had been elaborated not for the Area but for the EEZ. The first test mining of SMS in

2017 would have had a trigger effect for their development.

There had been several fractionations of the Area, geochemical, age, biogeographic and ecosystems criteria; abyssal provinces, spreading centre velocities: fast, slow and ultraslow spreading centres. The application of the CBD's scientific criteria for ecologically or biologically significant marine areas (EBSAs) represent a scientific and technical exercise.

5.6 "Mid-Ocean Ridges: Major ecological structures, distinctive features, and ecological functions."

Cindy Lee Van Dover, Duke University

The MOR system, extending about 64,000 km, was described as the largest, single geological feature on the planet with much of it being in the area beyond national jurisdiction. The MOR defines oceanic tectonic plate boundaries (seafloor spreading centres) where 'zero-age' ocean crust is formed. The MOR, thus, is a site of creation of hard substrata in an otherwise sedimented seafloor environment. The morphology of MORs varies along the length of the ridge axis, depending on the spreading rate of plate boundaries. Seabed morphology and correlates of spreading rate (e.g., depth, frequency and duration of hydrothermal activity) in turn influence the ecology of seabed ecosystems. The tectonic fabric of MORs varies from one region to another, and includes major cross-cutting features (such as the Romanche Fracture Zone) that serve as conduits for mass transport across the MOR and that host non-volcanic, submerged islands. MORs are dynamic systems, characterized by tectonic (seismic) and volcanic disturbances, and they are host to hydrothermal-vent ecosystems. Buoyant fluids exiting the seafloor at hydrothermal vents extend hundreds of metres into the water column before spreading laterally. The metal-rich plumes support autotrophic microbial communities and enriched zooplankton and fall-out from plumes can extend some hundreds of kms from the ridge axis, modifying the sediment environment and generating metalliferous muds. The frequency of hydrothermal vents on MORs has been positively correlated with spreading rate, though recent exploration suggests there may be more venting activity at slow-spreading rates than predicted. Most of the MOR comprises the 'lower bathyal' biogeographic province (800-3500 m), and most of this zone comprises sedimented environments. Global patterns in the biogeography of vent ecosystems are emerging, with up to 11 provinces recognized to date. Even within a biogeographic province, the geology, chemistry, and biology of vent ecosystems are variable, leading to striking faunal heterogeneity along a ridge axis. This heterogeneity and the extraordinary adaptations of many taxa to vent environments are among the scientific rationales for protection of active hydrothermal vents. The biology of inactive hydrothermal vents is only just beginning to be studied in detail. A critical area of study for MOR systems is the definition of natural management units, i.e., what are the natural boundaries between populations that are driven by oceanographic conditions. Seascape approaches that combine physical oceanographic, genetic, and life-history data will contribute to understanding resilience and best practices for environmental management. Environmental management practices on mid-ocean ridges include protection of VMEs (as defined by FAO), including active hydrothermal vents and cold-water corals, from bottom fisheries through fisheries closures.

III. WORKING GROUP DISCUSSION

Participants rotated among different WGs and contributed to all WG discussions. As such, the results of the WG discussions reflect a consensus by the workshop participants unless mentioned otherwise. Each WG discussion was facilitated by a moderator and a rapporteur, and guided by a series of questions. The results of the WG discussions are summarized below.

Working Group 1: REMP Goals, Objectives and Targets

Guiding question 1. What are the main goals of REMPs for PMS?

In broad terms, the objective of a REMP is to provide the relevant organs of ISA, as well as contractors and their sponsoring States, with proactive area- and rules-based management tools and measures to support informed decision-making that balances resource development with conservation through, *inter alia*:

- Providing ISA with a clear and consistent mechanism to identify particular areas thought to be representative of the full range of habitats, biodiversity and ecosystem structures and functions within the relevant management area, and providing those areas with appropriate levels of protection, thus helping ISA to meet internationally-agreed targets and goals, such as the Aichi Biodiversity Target 11 and SDG 14 to "conserve and sustainably use the oceans, seas and marine resources for sustainable development";
- Ensuring that exploitation of seabed mineral resources be undertaken in an environmentally-responsible manner, consistent with the legal framework and environmental guidelines of ISA for managing

deep-sea mining and protecting the deep-sea environment;

- Protecting regional biodiversity, ecosystem structure and function across and along MORs;
- Facilitating the application of the integrated ecosystem-based management for ISA in managing activities on MORs;
- Enabling the preservation of representative and rare/vulnerable marine ecosystems;
- Capitalizing on the available scientific knowledge and environmental data specific to the MORs, including environmental baseline studies; and
- Promoting environmental awareness among stakeholders.

REMPs contribute to the achievement of the internally-agreed goals and targets, such as the Aichi Biodiversity Targets and Sustainable Development Goal 14 by:

- Minimizing the loss of biodiversity;
- Establishing ecosystem-based approaches to management; and
- Applying other effective conservation measures, in accordance with international legal framework and based on the best scientific information available, including representative networks.

REMPs provide an important framework to guide contractors and researchers in the collection and compilation of the environmental data needed to manage deep-sea mining and other related activities in the marine environment.

REMPs facilitate cooperative research in MORs to inform the development of future rules, regulations and procedures, incorporating applicable standards for the protection and preservation of the marine environment.

REMP development includes the participation of developing countries and the multidisciplinary exchange of views on environmental management issues.

Within the REMPs, ABMTs, including APEIs, will be applied to protect biodiversity and serve as scientific reference areas for monitoring natural variability and long-term change in the marine environment which will be particularly important for enabling ISA to carry out its responsibility to manage the effects of mining activities.
Further deliberation is needed regarding how to deal with placement of APEIs with respect to contract areas, relinquished areas, reserved areas and any other conservation areas.

Guiding question 2. Who are the main stakeholders?

Given the mandate and role of ISA, in relation to the conduct of marine scientific research in the Area, it is important that REMPs be developed under the auspices of ISA, in a transparent manner, and with the effective engagement of the relevant stakeholders including, *inter alia*:

- o Contractors
- o Member States
- o Sponsoring States
- o Scientific community/scientific organisations
- o Relevant UN/International Organizations/MEAs (e.g. CBD)
- o Regional fisheries bodies/other regional economic bodies
- o Industries
- o NGOs
- o International Cable Protection Committee (ICPC).

Guiding question 3. What is needed to develop a REMP for PMS?

The WG noted that the most important objective in the development of the REMP was to ensure the effective protection of the marine environment from harmful effects that might arise from activities in the Area. This can be achieved through the following actions:

- Formulation of strategic and operational objectives
- Scientific research (e.g. operational definitions of biogeographic provinces, understanding of population and biological connectivity, including source/sink properties and fluxes), with identification of uncertainties and gaps
- Collection of baseline data (all available information)
- Application of area-based and rules-based management tools (e.g. APEIs)
- Recognition of existing management measures in the Area that have been implemented by competent authorities.

Working Group 2: Critical Elements of REMPS

Guiding question 1. What should be the key elements of a REMP for PMS?

Two key elements were highlighted for the preparation of REMPs for polymetallic massive sulphides.

- A systematic science-based strategy should guide the development of REMPs
- Environmental objectives for REMPs need to be specific, measurable, achievable, realistic, and time-sensitive (SMART), and formulated through:
    - o a comprehensive stakeholder engagement
    - o applying defined boundaries of management units based on natural biogeographic units, mineral resource distributions, and other relevant considerations
    - o management of multiple mineral resource types (e.g., PMS and CC in the Atlantic; PMS, CC, PMN resources in the Indian Ocean).

Additionally, the following issues and knowledge gaps needed to be addressed in designing REMPs:

- Characteristics of the mining plumes (seabed and discharge) and their impacts in the water column and at the seabed at PMS sites
- Dispersal of particles and release of biological active compounds (including metals) generated during seabed mining activities and in discharge plumes, plus comparison of natural vent plumes and mining-related plumes through field experiments and validation of the plume models
- Gaps in environmental baselines such as:
    - o off-field biology (benthic and pelagic; on the scale of potential indirect impacts), in addition to active, inactive vents
    - o data on microorganisms, meiofauna, macrofaunal, megafauna, marine vertebrates;
    - o mapping and characterization of sediment/hard substratum/seamount and other environments (to identify representative environments); and
    - o water column parameters (including but not limited to CCD, DO).

- Characteristics of the sulphide ecosystems - active and especially inactive sulphides including:
    - o biology, life histories, adaptations, biodiversity, trophic interactions
    - o biogeochemistry
    - o physiology (including natural metal exposure and organisms response (at protein and cellular level) on larval stages and other pelagic organisms).

- Ecosystem structure and function for sulphide ecosystems (active and inactive) and non-sulphide (off-field) environments, including pelagic ecosystems
- Changes in biodiversity with depth (also POC flux, T – e.g., for ground-truthing of proxy models)
- Location and role of oceanic fronts on biodiversity/ biogeography
- The relationship (genetic connectivity) between off-field faunas and continental margin faunas or even among ocean basins - some taxa are shared taxa mid-ocean ridges and continental margins:
  - (i) ocean dynamics including, but not limited to, large-scale circulation and connectivity;
  - (ii) source-sink dynamics; and
  - (iii) internal waves? Episodic larval events? Scouring?
- Distribution of VMEs on MORs (including, but not limited to coral, sponge, active vents, foraminifera)
- Role of episodic events – e.g., larval recruitment events driven by physical and biological factors (addressed through time-series studies)
- Natural variability (assessed by time-series studies)
- Cumulative impact assessment - not just multiple mining events, but including climate change, and also other human activities; addressed through modeling etc. (feeds into cumulative impact assessment as well as spatial planning
- Seismic activity - informs disturbance regimes within ecosystems
- Sensor development relative to assessment and monitoring needs
- Technical/operational components of massive sulphide's mining gaps
- Better understanding of the mining targets/potential? (e.g., number of realistic mine sites in a region)
- Location of vents in management areas – inactive and active
- Better understanding of mining technology and mitigation potential
- Location and impacts of current and projected activities in the area (e.g. shipping, cables, MSR
- The access and application of modern technologies for monitoring and assessment – robotic systems (ROVs and AUVs (e.g., gliders), ARGO floats, etc.), sensors - and application of core measures and best practices
- Use of modelling and best knowledge to fill gaps (use of biophysical proxies for biogeography; plume models, hydrographic and hydrodynamics models)
- Operational definition of active vs inactive vents
- Clarification of ISA's operational definition of areas at risk of serious harm (comparable to FAO's vulnerable marine ecosystems (VMEs)
- Identification of gaps that are specific and essential for the development of REMPs from those that are scientific gaps.
- Clarification of spatial and temporal scales for knowledge gaps.
- Stakeholder engagement strategy, including definition of stakeholders; how, when stakeholder engagement will be considered in the development, management, and review of the REMP; communicating the need for REMPS to stakeholders and the public
- Establishing a mechanism to facilitate access to new scientific knowledge by ISA
- Operational triggers for review and updating of REMPs
- Prevention of significant adverse change to VMEs (including within contract areas), e.g. using small-scale area-based and/or rules-based management tools
- Relationships among PRZs, IRZs sitting and other ABMT tools used while designing a REMP.

The consensus was that while gaps might persist the REMP needed to be in place before exploitation began.

Guiding question 2. What key elements are best addressed by contractors and by ISA?

- APEIs: design principles for massive sulphide, manganese nodules and cobalt crusts
- Objective(s) as defined in the EMP for the CCZ (ISBA/17/LTC/7)
- Considerations in designing the REMPs include:
  - (a) The linear, heterogeneous system of MORs as opposed to the relatively homogeneous area of the CCZ
  - (b) Small size of potential mine sites - (on the order of < km2), localized, and three-dimensional on MORs
  - (c) Need to finalize guidelines for PRZs in MORs
  - (d) More limited dimensions of the APEI buffer zone for PMS than that for nodules
  - (e) APEI design (locations, shapes, sizes, dimensions of the buffer zone) may be adaptive, so long as the APEI network meets the REMP environmental goals and objectives.

Guiding question 3. Key elements of REMPs on MORs (massive sulphide)?

- Environmental objectives should include protection of VMEs (e.g. active vent ecosystems, coral beds and sponge gardens) from activities in the Area, through both area-based tools and non-area based tools (e.g. rules-based management measures with thresholds) as well as the EIA and environmental monitoring activities.

Working Group 3: Design Principles for ABMT And Non-ABMT in REMPS

WG 3 focused on the following guiding questions:

a) What are the mechanisms through which REMPs consider FAO's work on VMEs, CBD's work on EBSAs and IMO's work on PSSAs, other conservation areas?
b) How might the cumulative impacts of ABMT (including climate change), other activities (e.g. comm. cables, shipping, fishing) best be accounted for by a REMP for PMS?
c) In developing REMPs for PMS, is there any lesson to be learnt from the CCZ REMP implementation?
d) How should EEZ and regional Conventions be taken into account?
e) Is the basis for the delineation of APEIs (if appropriate) in the polymetallic sulphide deposits different from other regions (e.g. polymetallic nodule / CRC regions)?
f) How should the APEI (if appropriate) in polymetallic sulphides deposit areas be scientifically designed in order to protect the integrity of the hydrothermal vent ecosystem? Will they be the same ones for the mid-Atlantic Ridge and for the central and southwest Indian Ridges?
g) Should the design and delineation of an APEI (if appropriate) at a polymetallic sulphide area consider the differences among ecosystems of various locations along a ridge?
h) Could an APEI (if appropriate) be established near polymetallic sulphides deposits within exploration areas under contracts for exploration and/or exploitation of polymetallic sulphides? What is the basis?
i) What is the area of an APEI (if appropriate) at deposits near

hydrothermal vents areas, the entire area or parts of the area?

j) What is the size of the core area and buffer zone of an APEI (if appropriate) in view of the size of the contract areas? If the borders are straight lines, do they need to be parallel to the latitude or longitude?
k) Review of CCFZ design criteria – what is applicable to the design of REMPs for SMS? What is missing?

The WG reviewed objectives and criteria from the CCZ REMP (ISBA/18/C/22) and identified the following lessons learned.

a) CCFZ Guiding Principles are relevant to the development of REMPs for SMS but need to be expanded to cover additional issues.
b) The opportunity exists to build on experiences of other competent authorities and international organizations, including UNESCO's work on marine spatial planning and the CBD's guidance on representative networks of marine protected areas, to support the development of REMPs.
c) Guiding principles need to be elaborated for consideration of population connectivity between conservation areas.
d) Clear conservation goals and objectives need to be in place.
e) Mining will take place in a different scale and for different types of mineral resources from those in CCFZ, and thus would require additional considerations for designing REMPs, as management may be scale dependent.
f) Management needs to be adaptive, over time, and reflect the heterogeneous environment, which would require establishing protocols for dealing with alterations or timely review within appropriate ISA processes.
g) A holistic approach to management and conservation of the region, taking into consideration other uses of the marine environment and any management measures being applied by relevant competent intergovernmental organizations, should be taken.

In addition to the establishment of an APEI network, REMPs can incorporate many other environmental management measures and instruments, such as a rules-based management approach. This WG on REMPs highlighted the following considerations.

- REMPS should be in place before exploitation begins. Discussions also ensued regarding the legal status of REMPs and references regarding REMPs in the draft regulations on exploitation.
- REMPs should involve ABMTs and rules-based management measures, where appropriate.
- REMP objectives for mid-ocean ridges should be adopted from those of the CCZ-REMP, with attention to strategic and operational definitions of conservation goals, objectives, and measurable targets.
- REMPs should be based on the best available scientific information, including biological and ecological characteristics.
- The geographic scope for REMPs should be based on natural biogeographic units and transitions.
- In addition to the protection of vulnerable marine ecosystems (VMEs) and a representative set of the full range of habitats and communities on mid-ocean ridges, REMPs should identify and protect other important areas on a regional scale, such as ecologically important fracture zones, hybrid zones, and biogeographical transition zones.
- REMPs, including APEI networks, should recognize and respond to existing management measures put in place by competent authorities.
- The performance of REMPs towards achieving their conservation objectives should be assessed through the use of quantitative metrics.

- REMPs should inform how PRZ will be implemented for polymetallic sulphide resources. REMPs should initially apply a precautionary approach and be adapted as scientific evidence becomes available and impacts are reassessed.
- Triggers for review of REMPs should be articulated, including relinquishment.
- REMPs should be developed through broad stakeholder engagement.
- REMPs should guide the EIA process.
- Representative areas are included in the existing guiding principle from the CCZ EMP.
- Precautionary and adaptive management approaches should be applied in developing the REMPs. Size and location of APEIs and buffers should be flexible, but need to be managed in an adaptive manner as scientific evidence becomes available and potential impacts are re-assessed.
- APEIs can be of different sizes and shapes so long as the network continues to meet the conservation objectives of the REMP
- Adaptations to the REMP should maintain or improve performance of the REMP in achieving its conservation objectives
- Understanding potential impacts from climate change is important in assessing natural and anthropogenic impacts. This is key to achieving long-term conservation goals. Climate change should be taken into account in the design and placement of area-based management measures including APEIs.
- Buffers can be variable, based on local conditions, if evidence of differential potential impacts are provided and assessed.
- Proposed networks of APEIs should be assessed for performance using quantitative metrics to inform selection of final networks designs.
- Networks of APEIs should be reviewed periodically or based on a trigger, and should persist longer than the duration of the mining impacts in the region.
- Replication of APEIs within a biogeographic region should be considered as a guiding principle in the development of networks of APEIs. Quantitative metrics of replication are scale-dependent and should be applied based on best available scientific information.

Working Group 4: Roadmap for the Design and Implementation of REMPS

Guiding question 1. Which experiences from previous international cooperation in hydrothermal vent survey can we refer to?

- Future work should build on European initiative such as SEMPIA – North Atlantic as well as various other relevant initiatives (e.g. ATLAS, SPONGES, MERCES in North Atlantic)

Guiding question 2: Is an international project needed to promote the establishment and implementation of a REMP for the MAR/central and southwest Indian Ridges?

- A scoping paper on data gap analysis is needed; at present the knowledge on South Atlantic ridge areas is scarce compared to the North Atlantic. The same applies to SEIR compared to SWIR and CIR.
    a. A "JPI Oceans" international initiative or other forms of collaboration is needed for increasing knowledge at the regional level for PMS sites, in particular addressing biogeographic regions.
    b. An international partnership initiative that could acquire

new data for refinement and improvement of APEI design for the regions of interest.

- Standardization of methods and protocols for environmental studies at MAR is needed.
- Effective involvement of member States and other stakeholders in a transparent manner is critical, considering geographic balance.
- Coordinated and coherent approaches need to be applied to the process of developing REMPs.

Summary: Indicative Steps to Move Forward

Building on the WG discussions detailed above, the workshop participants concluded that the following indicative steps can be considered for the design and implementation of REMPs for polymetallic massive sulphides.

2019

- Further articulation of REMP goals through a case study region using area- and rules-based approaches
- Identifying principles and developing approaches for quality assessment of APEI networks in the u-loop area, with a focus on the Indian Ocean ridge system
- Elaborating on the definitions of active and inactive vents and identifying knowledge gaps regarding the ecology and biology of inactive sulfide ecosystem
- Articulating principles and guidelines for the design of a North Atlantic REMP

2020

- Undertaking standardization of methodologies and protocols by which APEIs will inform EIAs for each region
- Establishing guidelines, rules and regulations for ABMT and non-ABMT to inform deep sea mining (exploitation)

TBD

- Mapping natural biogeographic regions and transitions to support operational definitions of regions for ISA;
- Elaborating on the operational definition of VMEs in relation to the activities in the Area;
- Developing approaches to expert-driven identification of categories and examples of “Important Areas” on a regional scale;
- Articulating operational targets and quantitative metrics against which REMP and APEI network performance toward achieving conservation objectives can be assessed;
- Defining standards and thresholds for rules-based approaches to environmental management on mid-ocean ridges.

ANNEX 1. WORKSHOP PROGRAMME

Agenda

Dates: 27-29 June, 2018

Day 1: 27 June, 2018	08:30 - 09:00	Registration		
	09:00 - 09:15	Welcome: Polish Authority		Szczecin University's President (Rector)
	09:15 - 09:30	Introduction: Secretary-General		Mr. Lodge - Video (ISA)
	09:30 - 09:45	DOALOS and their activities in the area		V. Jares (DOALOS)
	09:55 - 10:05	ISA Strategic Environmental Management Plan		S. Mulsow (ISA)
	10:05 - 10:25	Coffee break		
		REMP in the Area: Moderator: T. Radziejewska (Poland) Rapporteur: P. Qian (China)		
	10:25 - 10:45	Mid-Ocean Ridges definition: scales, geology and stakeholders		S. Mulsow (ISA)
	10:45 - 11:05	Major ecological structures, distinctive features, and ecological functions of Mid- Ocean Ridges		Dr. Van Dover (USA)
	11:05 - 11:20	CCZ EMP historical review lessons learnt		G. Le Gurun (ISA)
	11:20 - 11:35	Russia Experiences		Contractor (Russia)
	11:35 - 11:50	China Experiences		Contractor (China)
	11:50 - 12:05	India Experiences		Contractor (India)
	12:05 - 13:05	Lunch		
	13:05 - 13:20	Views on REMPS		Contractor (Poland)
	13:20 - 13:35	Germany Experiences		Contractor (Germany)
	13:35 - 13:50	France Experiences		Contractor (France)
	13:50 - 14:05	Korean Experiences		Contractor (Korea)
	14:05 - 14:25	SEMPIA initiative to proposed APEI for Mid-Ocean Ridges		D. Dunn (USA)
	14:25 - 15:05	EASME Initiative/proposal private engagement: EU initiative		P. Weaver (Seascape PTY)
	15:05 - 15:25	Coffee break		
	15:25 - 15:35	Definition of operational working groups		T. Radziejewska and G. Le Gurun
	15:35 - 17:30	Group 1	Environmental Management Goals, objectives, target.	Moderator: T. Radziejewska Rapporteur: L. Ermakova
		Group 2	Critical elements of REMPS	Moderator: C. Van Dover Rapporteur: T. Joyini (LTC)
		Group 3	Design principles for area-based and non- area based environmental management in REMP	Moderator: D. Dunn Rapporteur: G. Paterson (LTC)
		Group 4	Roadmap for future REMPs; timeline and activities	Moderator: M. Colaço Rapporteur: G. Le Gurun (ISA)

Day 2: 28 June, 2018	09:00 - 09:30	EMP in the Area. Report to plenary: major findings/gaps/proposals	Rapporteur: C. Van Dover Moderator: S. Mulsow
	09:30 - 10:30	Resume Working Groups 1, 2, 3 and 4 with an exchange of participants	
	10:30 - 11:00	Coffee break	
	11:00 - 11:30	WG 1: Reporting to Plenary, public discussion	Moderator: T. Radziejewska Rapporteur: L. Ermakova
	11:30 - 12:00	WG 2: Reporting to plenary, public discussion	Moderator: C. Van Dover Rapporteur: T. Joyini (LTC)
	12:00 - 13:00	Lunch	
	13:00 - 13:30	WG 3: Reporting to Plenary, public discussion	Moderator: D. Dunn Rapporteur: G. Paterson (LTC)
	13:30 -16:00	WG 4: Reporting to Plenary, public discussion	Moderator: M. Colaço Rapporteur: G. Le Gurun (ISA)
	16:00 - 16:20	Coffee break	
	16:20 - 17:30	Working Group Discussions continue	
	18:00 - 20:00	Reception	
Day 3: 29 June, 2018	09:00 - 09:30	WG 1: concluding remarks and summary of discussion	Moderator: T. Radziejewska Rapporteur: L. Ermakova
	9:30 - 10:00	WG 2: concluding remarks and summary of discussion	Moderator: C. Van Dover Rapporteur: T. Joyini (LTC)
	10:00 - 10:30	WG 3: concluding remarks and summary of discussion	Moderator: D. Dunn Rapporteur: G. Paterson (LTC)
	10:30 - 11:00	WG 4: concluding remarks and summary of discussion	Moderator: M. Colaço Rapporteur: G. Le Gurun (ISA)
	11:00 - 11:30	Final statement	Polish Representative and ISA Representative

ANNEX II. LIST OF PARTICIPANTS

Abramowski Tomasz	IOM
Andrew Penawa	Department of Mineral Policy & Geohazards Management – Papua New Guinea
Badal Rezah	Ministry of Defence (Mauritius)
Bartosz Jasiński	Ministry of the Environment, Poland
Billett David	Deep Seas Environmental Solutions Ltd.
Borkowski Przemyslaw	Polish Geological Institute
Boschen-Rose Rachel	Seascape Consultants Ltd
Colaço Ana	Institute of Marine Research
Dajek Michal	Ministry of the Environment
Damian Hans-Peter	Germany
Dunn Daniel	Duke University
Eggleton Jacqueline	CEFAS
Ermakova Livia	VNIIOkeangeologia
Frietag Ralf	BGR
Gianni Matthew	Deep Sea Conservation Coalition
Gregory Shanique	International Seabed Authority
Han Xiqui	Second Institute of Oceanography, State Oceanic Administration
Jędrysek Mariusz Orion	Ministry of the Environment, Poland
Jerzy-Mostashova Julia	IOM
Joyini Thembile	LTC Member/ South African Permanent Mission
Kotrys Bartosz	Polish Geological Institute
Kozlowska-Roman Agata	Polish Geological Institute
Kriete Cornelia	BGR
Le Gurun Gwenaelle	International Seabed Authority
Li Chuanshun	First Institute of Oceanography, State Oceanic Administration
Lonsdale Jemma	CEFAS
Marciniak Konrad	Ministry of Foreign Affairs
Menot Lenaick	IFREMER
Mianowicz Kamila	IOM
Mulsow Sandor	International Seabed Authority
Nowak Piotr	Ministry of the Environment
Pasternak Grzegorz	KGHM Polska Miedz S.A.
Paterson Gordon	National History Museum, London
Przybycin Andrzej	National Atomic Energy Agency

Qian Pei-Yuan	Hong Kong University of Science and Technology
Radziejewska Teresa	University of Szczecin
Roberts Guinnevere	The Pew Charitable Trusts
Roy Parijat	India
Santosuosso Luigi	DOALOS
Shi Xuefa	First Institute of Oceanography, State Oceanic Administration
Skowronek Artur	Polish Geological Institute
Song Chengbing	COMRA
Stenlokk Jan	Norwegian Petroleum Directorate
Swaddling Alison	The Commonwealth Secretariat
Tao Chunhui	COMRA
Tu'ivai Lesieli	Department of Environment -Tonga
Van Dover Cindy	Duke University
Villanueva Maria-Sofia	European Union (EU)
Weaver Phil	Seascape Consultants Ltd
Ybert Sebastien	IFREMER

ISBN 978-976-8241-68-9