



# Design of IRZs and PRZs in Deep-Sea Mining Contract Areas

BRIEFING PAPER 02/2018



The workshop on the Design of Impact Reference Zones and Preservation Reference Zones in Deep Sea Mining Contract Areas was held in Berlin, Germany from 27-29 September 2017 with support from the Pew Charitable Trusts and the International Marine Minerals Society. It was a forum for the Authority, its contractors, and scientific and technical experts to exchange information and develop a common understanding of key elements of reference area design and monitoring principles applicable to exploration contracts for deep-sea minerals.

## INTRODUCTION

Under the 1982 United Nations Convention on the Law of the Sea, the Authority is required to adopt appropriate rules, regulations and procedures prescribing the necessary measures to be taken to ensure the effective protection for the marine environment from harmful effects which may arise from such activities. Such rules, regulations and procedures are designed to prevent, reduce and control pollution and other hazards to the marine environment, as well as to protect and conserve the natural resources of the Area, preventing damage to the flora and fauna.

Recognizing that technical guidance on what is required for the design and monitoring of

the two zones is lacking, the Secretariat and the Legal and Technical Commission proposed that a workshop be held to develop specific guidelines for the contractors for the establishment of impact and preservation reference zones to address a variety of issues and to ensure robust design and implementation of such zones.

- The goal of the workshop was to recommend a reproducible and transparent procedure that establishes minimum requirements to select impact and preservation reference zones and to perform monitoring from initiation of IRZs and PRZs designations, including post mining monitoring as part of closure plans and contractor commitment.

# WORKSHOP RECOMMENDATIONS

Note: From the start of the workshop, participants discussed and suggested renaming the Preservation Reference Zones (PRZ) to Control Reference Zones (CRZ) to avoid misunderstanding their function. However, in the interest of consistency, this Briefing Paper continues to use PRZ until the Guidance to Contractors will be updated.

## Recommendations for the Legal and Technical Commission to provide Guidance to Contractors on the Designation and Monitoring of IRZs and PRZs for Polymetallic Nodules in the Area

### Design

1. Design criteria should be simple and generic .
2. Each PRZ will be suitable to serve as a reference area containing a stable biota (within the natural range of variation) with representative habitats, biodiversity and ecological function potentially impacted by mining in the IRZ.
3. The (total) PRZ area(s) should be large enough to include representative biota,



*Relicanthus sp.*

habitats, biodiversity and ecological function potentially impacted by mining, and take into account the geographical ranges of the biota present.

- a. A PRZ may be a single large area. In this case, the PRZ should be large enough to include representative biota, habitats, biodiversity and ecological function potentially impacted by mining, and take into account the geographical ranges of the biota present.
- b. A PRZ may be a series of smaller areas. In this case, the total PRZ areas should be large enough to include representative biota, habitats, biodiversity and ecological function potentially impacted by mining, and take into account the geographical ranges of the biota present.
4. The longevity of the PRZ should be for the duration of the exploitation contract, which includes the closure plan period.
5. The PRZ should be an appropriate distance away from any seafloor mining activity to ensure that the PRZ is not impacted by any mining.
6. PRZs may need to be established outside the contract area.
7. PRZs could be shared between and among contractors, consistent with any sponsoring State obligations.
8. Where specific impacted habitats cannot be replicated within an appropriate contractor PRZ, they could be augmented with smaller PRZs, representing those specific habitats, including within APEIs, subject to consideration of potential cumulative impacts in the APEI and the outcomes of the Strategic Environmental Management Plan.
9. The IRZ should be defined as any area determined to be impacted by mining, extending to a distance where impact can



no longer be detected.

## Monitoring

10. It is recommended that the experiences from other sectors be leveraged in the development of monitoring approaches and designs.
11. It is recommended that collected biological samples are appropriately archived.
12. Data standards should be backward compatible.
13. Recommendations should focus on what needs to be achieved through monitoring, rather than prescribing how (e.g. the technology) to achieve it.
14. It is recommended that specialist workshops be considered to further refine monitoring variables to be measured and the spatial and temporal nature of the monitoring.
15. Impacts predicted in the EIA should be monitored at sites using stratified sampling design within IRZs to assess impact across all habitat types, direct and indirect impacts, and spatial scales. The contractor should consider, *inter alia*, the following key impacts to be monitored:

  - \* physical removal / direct alteration of substrate, sediment and biota;
  - \* change in geochemistry of the seabed substrate;
  - \* changes to seafloor integrity;
  - \* release of heavy metals and other contaminants as well as potential accumulation through the food chain;
  - \* effects on the organisms and communities by plumes (e.g. smothering, effects on suspension feeders);
  - \* potential effects on plankton or nekton and mesopelagic fishes from the seafloor or discharge plumes;
  - \* turbidity reducing visibility in the water column for predatory fish;
  - \* potential impacts on commercial fish, fisheries, marine mammals, and migratory vertebrates such as turtles and sharks;
  - \* noise and light;
  - \* changes in water column properties.

16. The contractor should consider, *inter alia*, assessing changes in:
  - \* composition, abundance of benthic and pelagic communities;
  - \* sediment properties (e.g. particle size and chemical composition) and geochemical characteristics;
  - \* water column characteristics (e.g. turbidity, dissolved oxygen, temperature, salinity, sedimentation rates, noise, etc.). Furthermore, the contractor should undertake regular CTD casts in both, IRZs and PRZs throughout the water column;

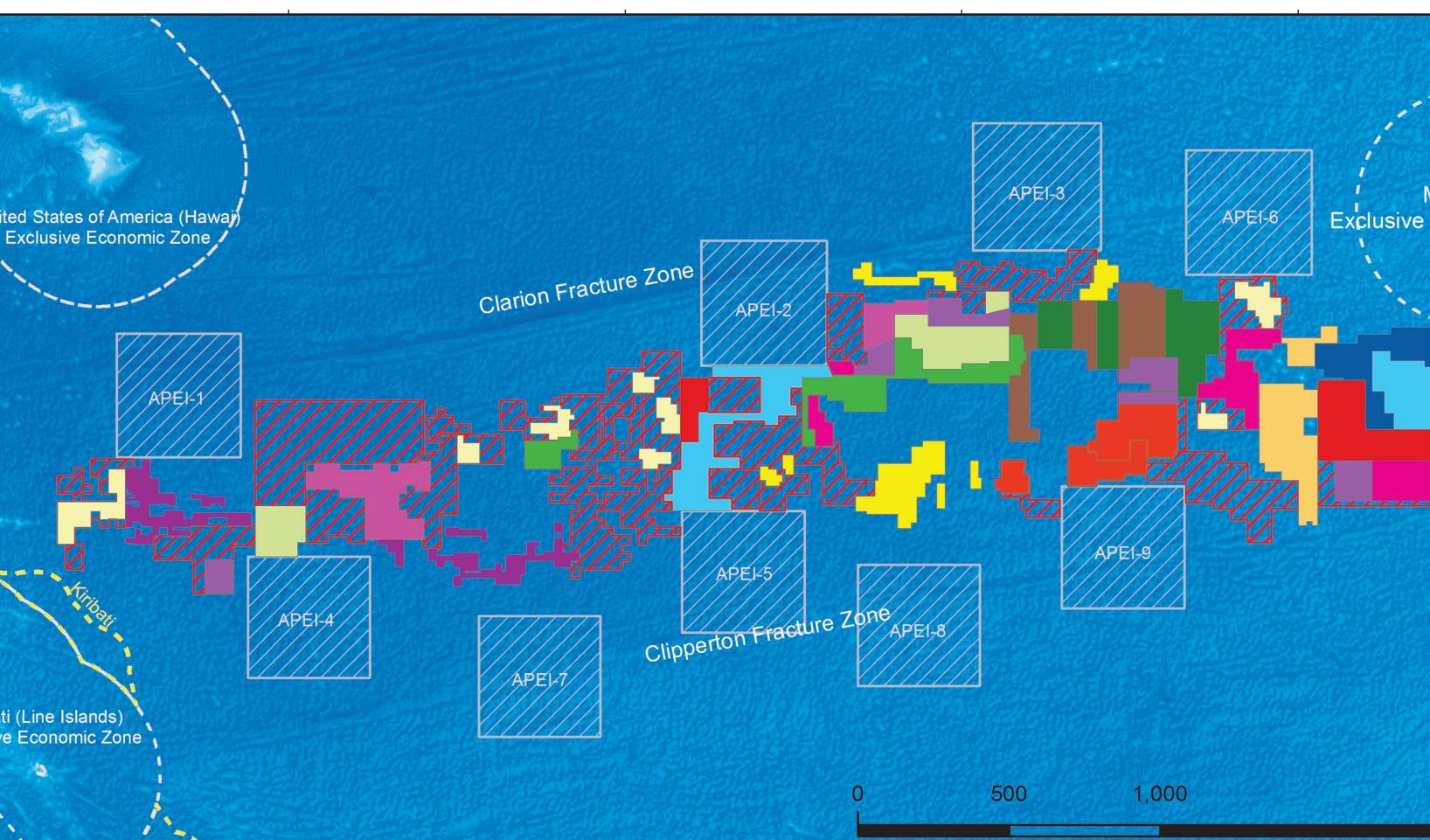
- \* concentrations of heavy metals and contaminants in the sediment and the water column;
  - \* biodiversity;
  - \* ecological function.
17. Contractors should consider variance and statistical power in PRZ and IRZ monitoring.

18. The contractor should monitor IRZs and PRZs for at least, the duration of any mining activity. In the context of the closure plan there should then be a review to assess the relative importance of mining impacts and evaluate if any longer term effects need to be monitored for a reasonable period after the closure of the mine.

## Recommendations for the Legal and Technical Commission to provide Guidance to Contractors on the Designation and Monitoring of IRZs and PRZs for Polymetallic Sulphides in the Area

### Design

1. Criteria to operationalise the objectives of impact and preservation reference zones at polymetallic sulphides should be defined. These should not yet be prescriptive, but guided by general principles in the absence of more site-specific information, and should be updated in light of new information.
2. Comprehensive environmental baselines and the environmental impact assessment should be the basis for monitoring programmes to assess effects of mining



*Areas of Particular Environmental Interest (APEIs) in the Clarion-Clipperton Zone*

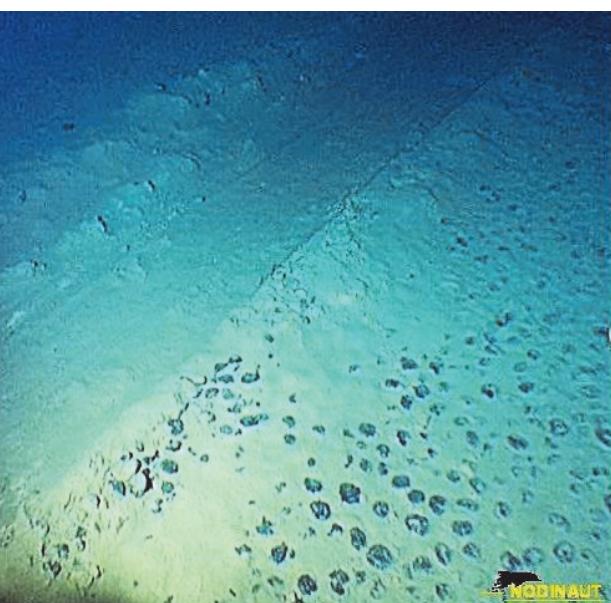
- activities on the marine environment. The design of the monitoring programmes should include the designation of IRZs and PRZs which should be on a site-specific basis to account for high heterogeneity between and within polymetallic sulphide deposit habitats.
3. Reference zone design should follow current best-environmental and statistical practice e.g. a before-after-control impact (BACI) design.
  4. The IRZ should be defined as any area determined to be impacted by mining, extending to a distance where impact can no longer be detected.
  5. A PRZ is a control area to measure natural variability against which future changes in the IRZ are to be compared. It should not be changed or abandoned until the monitoring programme is complete.
  6. To capture the range in natural variability across heterogeneous environments and replicates to allow for statistical robustness, there should be [multiple] PRZ[s] that collectively include all habitats and their connections. The use of multiple control sites is best-environmental practice to and should be followed for PRZs.

This was the only recommendation not agreed to by all workshop participants.

7. Each new mining site should have its own IRZ, and may be compared with existing PRZs, subject to it being ecologically representative of all habitats impacted by mining activities.
8. The PRZs should not be impacted by any mining activities. The IRZ should not be a source population for the PRZs. Preservation reference zones should not be designated in an area that has been previously impacted by mining.

## Monitoring

9. The contractor should monitor IRZs and PRZs for, at least, the duration of any mining activity. In the context of the closure plan, there should then be a review to assess the relative importance of mining impacts and an evaluation of whether any longer-term effects need to be monitored for a reasonable period after the closure of the mine.
10. Stratified sampling design to monitor within IRZs and PRZs should be used to assess impact across all habitat and impact types. See Recommendation no. 9 for Cobalt-Rich Crusts for additional guidance.
11. Impact Reference Zones should be designated and monitored to assess all impacts from mining activities within and outside the contract area.
12. Stability of control zones should be defined as persistence of the natural patterns of variability including those due to natural levels of disturbance. Stability should be determined by monitoring the physical, chemical and biological characteristics and should be determined before mining activities commence. Impacts predicted in the EIA should be monitored at sites using stratified sampling design within IRZs to assess impact across all habitat types, direct and indirect impacts, and spatial scales. It is recommended that contractors consider monitoring, *inter alia*, the following:
  - Substrate removal
  - Plume – operational and discharge
  - Noise



Test mining track in the Clarion-Clipperton Zone

- Light
  - Changes in fluid flux
  - Sediment alteration/removal
  - Faunal removal
  - Trophic Ecology
  - Habitat loss or change
  - Homogenization of habitat
  - Taxonomic composition change
  - Homogenization of habitat
  - Smothering
  - Ecotoxicology
  - Sediment restructuring
  - Marine Mammal Populations
  - Community structure
  - Community function
  - Productivity
- 5. The patchiness of the benthic fauna requires a detailed benthic survey to determine community distribution and guide appropriate placement of PRZs.**
- 6. Where possible, each seamount should be treated as an ecological unit and managed as a single entity with its relevant PRZs and IRZs located on it.**
- 7. Oceanographic characteristics of seamounts may extend impacts into the water column, and IRZs and PRZs need to cover this three-dimensional aspect.**
- 8. The contractor should note that the design will be affected by the characteristics of the individual seamount.**

## Monitoring

- 9. Impacts predicted in the environmental impact assessment should be monitored at sites using stratified sampling design within IRZs to assess impact across all habitat types, direct and indirect impacts, and spatial scales. The contractor should consider the following key impacts, *inter alia*, to be monitored:**
- a. Physical removal of crusts, sediment and animals
  - b. Change in texture and geochemistry of the seabed substrate
  - c. Release of heavy metals and other contaminants as well as potential accumulation through the food chain
  - d. Smothering or other effects on the biology of benthic animals by sediment from the plume
  - e. Potential effects on plankton, nekton, and mesopelagic fishes from the seafloor or discharge plumes
  - f. Turbidity reducing visibility in the water column for predatory fish

## Recommendations for the Legal and Technical Commission to provide Guidance to Contractors on the Designation and Monitoring of IRZs and PRZs for Cobalt-Rich Crusts in the Area

1. The IRZ should be defined as any area determined to be impacted by mining, extending to a distance where impact can no longer be detected.
2. The contractor should ensure that the PRZs are sufficient in size, e.g., covering 10-20% of the total claim area with stable communities and ecological functions (within natural range of variation). This proportion may change with increasing scientific knowledge.
3. The contractor should ensure that the IRZs and associated PRZs are ecologically as similar as possible and located at the similar water depth, substrate type and topography.
4. The placement of PRZs should be based on detailed current measurements to describe potential hydrographic complexity of the seamount. Care must be taken that the PRZ is well clear of any effects of the variability in current flow affecting the dispersal of the sediment plume.

**In addition to the recommendations for the three minerals, workshop participants had some general suggestions regarding overall implementation issues**

In the event that a contractor cannot delineate PRZs within their contract area, the LTC should consider whether the Commission or contractor may designate a PRZ outside of the contract area?

2. IRZs should not contain an area "for mining" if the contractor cannot find representative PRZs. This should be identified during the EIA process. We encourage the LTC to consider how to address a scenario where no PRZs can be identified, with the potential for relocating a block.
3. IRZs and PRZs should continue to be monitored after the end of a contract and/or mine closure or relinquishment, as part of the monitoring programme to maintain their integrity. The length of time reference zones should exist and be monitored after these points will depend on the polymetallic sulphides system and will need to be defined with additional scientific information (e.g. natural disturbance levels). The party responsible for any monitoring beyond the closure plan period will be determined by the Authority.

IRZs and PRZs should be used to monitor whether a contractor is complying with thresholds and limits assigned to prevent serious harm to the marine environment from their mining activities. The contractor should adhere to the limits determined in their approved plan of work or those established by the Authority. The Regulations should define these thresholds for serious harm based on scientific evidence.

- g. Potential impacts on commercial fish, fisheries, marine mammals, and migratory vertebrates such as turtles and sharks.
  - h. Noise and light
  - i. Changes in water column properties
10. The contractor should consider, *inter alia*, assessing changes in the following key metrics:
- a. Composition, abundance and condition of epibenthic species, sediment properties such as physical (e.g., sediment thickness, particle size) and geochemical characteristics.
  - b. Water column characteristics such as turbidity and dissolved oxygen measured by sensors on CTDs or moorings (landers) with a variety of sensors (such as turbidity sensors, dissolved oxygen, temperature, salinity, current meter or ADCP, sediment traps and hydrophone for acoustic monitoring of a change in behaviour or distribution of marine mammals). Furthermore, the Contractor should undertake regular CTD casts in both, IRZs and PRZs throughout the water column.
  - c. The concentrations of heavy metals and contaminants in the sediment and the water column.
  - d. Composition and abundance of plankton if there are oceanographic retention situations such as closed-circulation cells (Taylor columns) which may also lead to increased bioaccumulation in sessile filter-feeders, plankton and predatory fish.
11. The contractor should monitor IRZs and PRZs for, at least, the duration of any mining activity. In the context of the closure plan, there should then be a review to assess the relative importance of mining impacts and evaluate if any longer-term effects need to be monitored for a reasonable period after the closure of the mine.

## Workshop Participants

### Contractors:

Guifeng Wu & Chengbing Song • China Ocean Mineral Resources Research and Development Association (COMRA)

Michael Henry & Paul Lynch • Cook Islands Investment Corporation (CIIC)

Soichiro Tanaka & Akira Tsune • Deep Ocean Resources Development Co., Ltd (DORD), Japan

Annemiek Vink & Carsten Röhleman • Federal Institute for Geosciences and Natural Resources (BGR), Germany

Tom De Wachter & François Charlet • G-Tec Sea Mineral Resources NV (GSR), Belgium

Lenaick Menot & Sébastien Ybert • Institut français de recherche pour l'exploitation de la mer (Ifremer)

Valcana Stoyanova & Ivo Dreiseitl • Interoceanmetal Joint Organization (IOM)

Hideki Sugishima & Fumi Yakabe • Japan Oil, Gas and Metals National Corporation (JOGMEC)

Lilia Ermakova • Ministry of Natural Resources and Environment of the Russian Federation (MNRE)

Samantha Smith • Nauru Ocean Resources Inc. (NORI)

Teresa Radziejewska & Andrzej Przybycin • Minister of the Environment of the Republic of Poland (MARP)

Wonnyon Kim & Chan Min • KIOST, Government of the Republic of Korea (RoK)

John Parianos • Tonga Offshore Mining Limited (TOML)

Jennifer Warren & Christopher Williams • United Kingdom Seabed Resources Ltd (UKSRL)

Valery Yubko • State Enterprise Yuzhmorgeologiya (YMG), Russia

### Invited experts:

Harald Brekke (LTC observer), Malcolm Clark (LTC observer), Laleta Davis Mattis (funded by Pew), Daniel Dunn (funded by ISA), Andrey Gebruk (funded by Pew), Judith Gobin (funded by Pew), Anna Metaxas (funded by ISA), Greg Rouse (funded by ISA), Craig Smith (funded by ISA), and Andrew Sweetman (funded by ISA)

### Government representatives:

Chunsheng Wang • China State Oceanic Administration

Hans-Peter Damian • Federal Environmental Agency, Germany

Ellen De Zwart • Belgian Federal Public Service of Environment

Linlin Li & Lei Ju • Ministry of Foreign Affairs, China

Jemma Lonsdale • Centre for Environment Fisheries and Aquaculture Science, UK

### Additional experts:

Jeff Ardron (Commonwealth Secretariat), Rob Christie (NIWA), Kristina Gjerde (IUCN), Renee Grogan (Gro Sustainability Pty Ltd.), Guinnever Roberts (Pew), Ann Vanreusel (DOSI)



*The International Seabed Authority is an autonomous international organization established under the 1982 United Nations Convention on the Law of the Sea and the 1994 Agreement relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea. The Authority is the organization through which States Parties to the Convention shall, in accordance with the regime for the seabed and ocean floor and subsoil thereof beyond the limits of national jurisdiction (the Area) established in Part XI and the Agreement, organize and control activities in the Area, particularly with a view to administering the resources of the Area.*

International Seabed Authority, 14-20 Port Royal Street Kingston, Jamaica

Tel: +1 876 922-9105 | Fax: +1 876 922-0195

[www.isa.org.jm](http://www.isa.org.jm)