TABLE OF CONTENTS

Organizer

Chairman

Michael Lodge

Secretary-General

International Seabed Authority

Jamaica

Feng Liu

Secretary-General

China Ocean Mineral Resource R&D Association

China

Steering Committee

Xue-Wei Xu

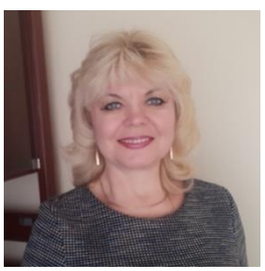
Second Institute of Oceanography, State Oceanic Administration

China

Sandor Mulsow

International Seabed Authority

Jamaica



Irina Ponomareva

JSC Yuzhmorgeologiya

Russia

Yoshiaki Igarashi

Japan Oil, Gas and Metals National Corporation

Japan

Sang Joon Pak

Korea Institute of Ocean Science & Technology

South Korea

Malcolm Clark

National Institute for Water and Atmospheric Research

New Zealand

Pei-Yuan Qian

Hong Kong University of Science and Technology

China

Welcome Message

1. Red tiles and green trees, blue sea and azure sky. In this beautiful season, we welcome you to Qingdao and join us in the “International Workshop on the REMP for the Cobalt-Rich Ferromanganese Crusts in Triangle Area in the Northwest Pacific Ocean”. We hope to provide a great opportunity to promote our communication and cooperation, and deepen mutual understanding and trust. At the end of the workshop, we expect to gain fruitful achievements and reach a preliminary consensus on the development of the REMP for the cobalt-rich ferromanganese crusts in Triangle Area in the northwest Pacific Ocean.

2. The United Nations Convention on the Law of the Sea declared that the area of the seabed, ocean floor and the subsoil thereof, beyond the limits of national jurisdiction, as well as its resources, are the common heritage of mankind. The International Seabed Authority exercises the Convention on behalf of all mankind. In the development and protection of marine resources in the Area, China has been actively responding to the policies and regulations of the Authority, and contributing the wisdom and the strength to the reform and construction of the global governance system. Chinese President Xi Jinping pointed out, “the construction of marine ecological civilization must be included in the general layout of marine development. We ought to insist in balances between the development and the protection, and between pollution prevention and ecological restoration. The marine resources must be exploited and utilized scientifically and rationally, and the capacity of marine natural reproduction should be maintained.” The China Ocean Mineral Resources Research and Development Association (COMRA) has been consistently advocating the balance between resource development and environmental protection, emphasizing that seabed mineral resources are the common heritage of mankind. The COMRA encourages and promotes the development of the resources and protection of the marine environment for achieving the fundamental goal of serving all mankind.

3. Finally, we wish the workshop a great success and all guests a pleasant stay in Qingdao.

Background

Introduction

1. The seamount region located in the northwest Pacific Ocean is an area with amongst the highest density of seamounts in the world. It contains the oldest oceanic crusts on the seabed and the oldest seamounts as well as the most enriched area of cobalt-rich crusts in the world. Cobalt-rich crusts are rich in cobalt, manganese, nickel, ruthenium, platinum and rare earth elements, which have potential for commercial development (Figure 1). Seamounts having cobalt-rich crusts not only provide an environment for marine life, but are also a recorder for ocean and climatic history over the past 60 million years (ISA Technical Study: No. 2), which has important scientific research value.

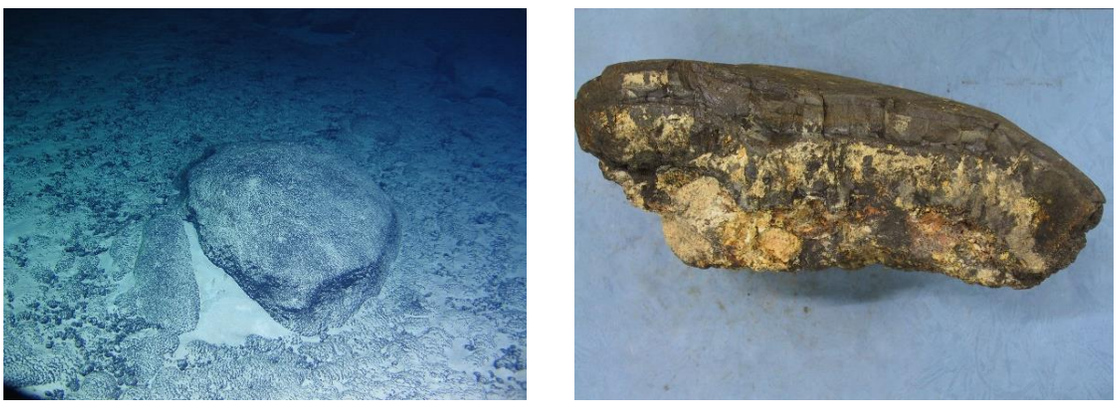


Figure 1. Cobalt-rich crusts in the northwest Pacific Ocean (left) and collected crust samples (right) (Photos by the COMRA)

2. In 1982, the United Nations Convention on the Law of the Sea (abbreviation: Convention) stipulated that “the Area” refers to the seabed, the ocean floor, and the subsoil beyond the jurisdiction of the state, and all rights to resources within the Area belong to all mankind. The International Seabed Authority (abbreviation: Authority) exercises the Convention on behalf of all mankind. In July 2012, the Authority approved the decision relating to the "Regulations on Prospecting and Exploration for Cobalt-rich Ferromanganese Crusts in the Area" (ISBA/18/A/11), which provided institutional guarantees for exploration of cobalt-rich crusts on the seabed. Up until April 2018, the Authority had signed exploration contracts for cobalt-rich crusts with five contractors. Four contracted areas (China, Russia, Japan and South Korea) are located on seamounts in the northwest Pacific (Figure 2). These areas are adjacent to Exclusive Economic Zones of Japan, Micronesia and the Marshall Islands as well as the United States National Marine Monument.

Background

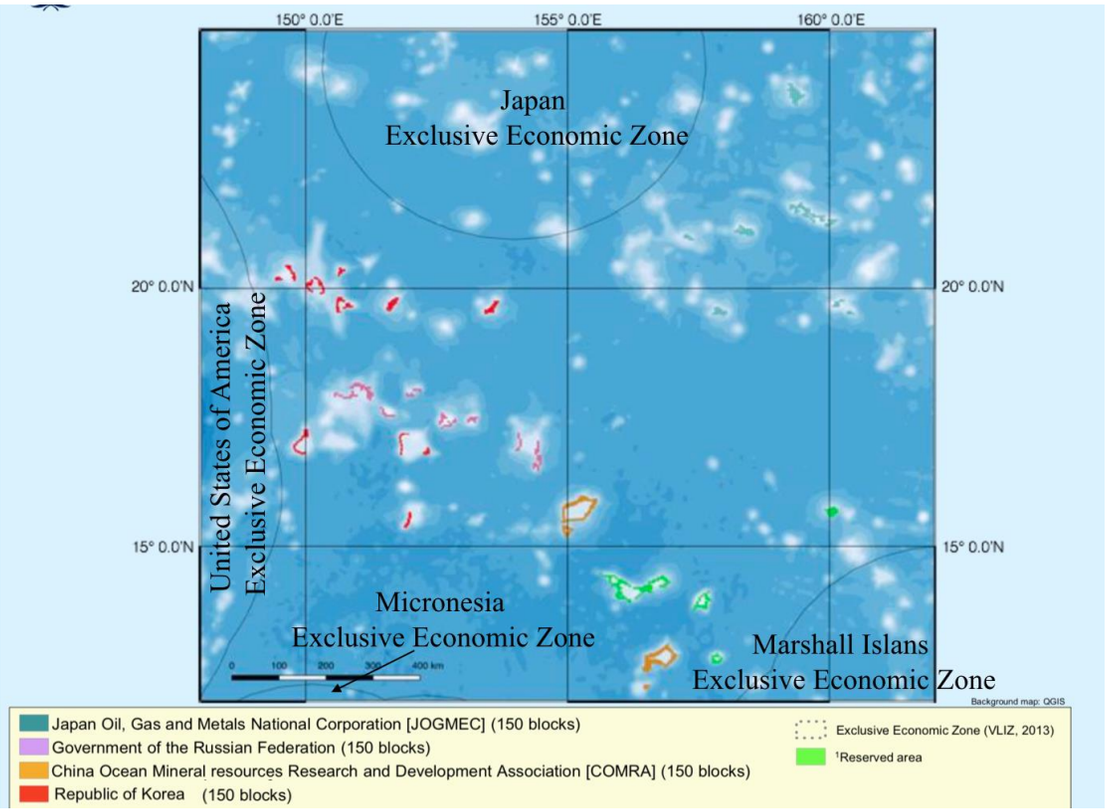


Figure 2. Cobalt-rich crusts on seamounts in the northwest Pacific Ocean (base map from ISBA/22/C/10)

3. The Authority has far-reaching obligations and responsibilities for the protection of the marine environment. In accordance with the provisions of the Convention, the Authority shall establish appropriate rules, regulations and procedures to ensure the effective protection of the marine environment. The Legal and Technical Commission (abbreviation: LTC) of the Authority shall make recommendations to the Council on the protection of the marine environment. The "Recommendations for the Guidance of Contractors for the Assessment of the Possible Environmental Impacts Arising from Exploration for Marine Minerals in the Area" (ISBA/19/LTC/8) states that the contractors who sign mineral exploration contracts in the Area have the obligation to protect the marine environment. It requires contractors to collect baseline data on the marine environment and biodiversity, establish an environmental baseline for comparison and assess the impact of their plan of activities for the exploration work. It also requires contractors to develop plans to monitor and report on these impacts.

4. Seamounts can have high biological diversity, and frequently host “rare species”, making seamount ecosystems very important in the deep sea. There may be extensive and complex linkages between different

seamount biomes (ISA Technical Study: No. 8). The impact of human activities (such as exploration and mining activities) on seamounts is multifaceted and could lead to the loss of biodiversity in the region and changes of ecosystem functions (Clark et al., 2010). Although existing knowledge is limited, the establishment of a regional environmental management plan (abbreviation: REMP) is an effective and necessary approach to reduce the risk of damage to the ecosystem from human activities.

5. The objective of the REMP is to provide proactive area-based management tools for relevant organs of the Authority as well as the contractors and their sponsoring States to support informed decision-making (ISBA/24/C/3) that balances resource development with conservation. The environmental management plan of the Clarion-Clipperton Fracture Zone is the first and the only REMP developed to date by the Authority (ISBA/17/LTC/7). The Council approved the plan at its 18th session in July 2012 and decided to implement it for the first three years (ISBA/18/C/22), and the LTC reviewed the plan at its 22nd session (ISBA/22/LTC/12) and is continuing to update this review in 2018. Recently, resolutions of the General Assembly of the United Nations (68/70, 69/245, and 70/235) invited the Authority to consider the development and approval of REMPs in other regions, especially the current exploration contract areas.

6. During the 23rd meeting of the Assembly of the Authority in August 2017, the China Ocean Mineral Resource R&D Association (Abbreviation: COMRA) held a side event regarding “Balance of Resources Exploitation and Environmental Protection”, the Secretary-General of the COMRA, Mr. Liu Feng, introduced recent activities in the cobalt-rich crusts contract area by the COMRA, and proposed an initiative of co-developing a REMP for region of cobalt-rich ferromanganese crusts in the “Triangle Area” in the northwest Pacific Ocean (Figure 3). The Secretary-General of the Authority and the Secretary-General of the COMRA held preliminary discussions for the REMP and agreed to conduct further discussions in due course (ISBA/23/C/8).

7. During the 24th meeting of the Council of the Authority in March 2018, a document regarding “Preliminary strategy for the development of regional environmental management plans for the Area” (ISBA/24/C/3) pointed out the broad objectives and guiding principles of the REMP, and the Secretary-General of the Authority welcomed the cooperation between the COMRA and other contractors and stakeholders to formulate a REMP for the cobalt-rich crust zone in the Pacific Ocean.

Background

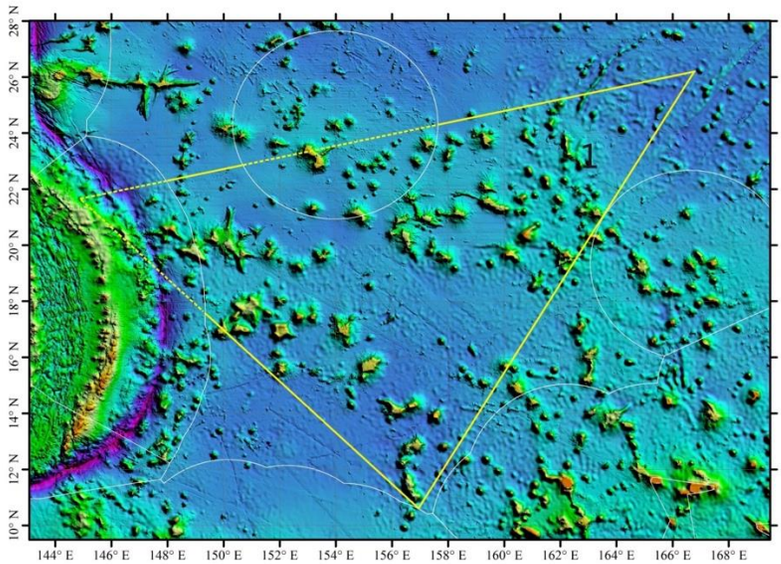


Figure 3. Location map of seamounts in the northwest Pacific Ocean (picture from the Second Institute of Oceanography, State Oceanic Administration)

8. The Authority and the COMRA have agreed to jointly organize an international workshop to progress development of a REMP for the cobalt-rich crusts in the northwest Pacific Ocean on May 26-29, 2018 in Qingdao, China (ISBA/PR/2018/008). The Council appreciated the workshop and also noted the challenges faced by the Authority. The integration and identification of existing data required significant input (ISBA/24/C/8).

Workshop Objectives

9. The objectives of the workshop include:

- to share the available environmental data, and understand the national, regional and international policies and laws;
- to find a consensus on the design of the REMP as well as the preliminary ideas for its framework;
- to create a work plan for 2-3 years of scientific collaboration to collect additional data needed for the design of the REMP;
- to discuss and sign an agreement (MOU between the contractors and the Secretary-General) on future steps for the establishment and implementation of the REMP;
- to discuss mechanisms for communication and coordination and to establish an organizational structure, if needed.

Expected Outcomes from the Workshop

10. The workshop will discuss the co-development of the REMP for the cobalt-rich ferromanganese crusts in the "Triangle Area" in the northwest Pacific Ocean. The Authority and the COMRA invited the contractors of the Area, international legal and scientific experts, representatives from Asia and developing countries in the Pacific region, and representatives from non-government organizations. The workshop will discuss aspects of policy and law, seamount ecosystems and approaches for scientific protection as well as data sharing. The expected outcomes include:

- form a consensus on the preliminary design on the REMP for the cobalt-rich ferromanganese crusts in the "Triangle Area" in the northwest Pacific Ocean;
- develop a plan for cooperative mechanisms and research methods; this will include the COMRA presenting the accomplishments of this workshop in a side event during the Assembly of the Authority;
- discuss and potentially sign a MOU for creating and implementing a REMP in future and propose a 2-3 years international cooperation plan;
- propose a technical document for the REMP in the northwest Pacific Ocean to the LTC.

Legislative and Institutional Bases of REMPs

11. In July 2012, the Assembly of the Authority has approved the "Regulations on Prospecting and Exploration for Cobalt-rich Ferromanganese Crusts in the Area". It stipulates the full obligation of environmental protection for the countries and the stakeholders which are involved in the prospecting and exploration for cobalt-rich ferromanganese crusts in the Areas. At each stage of the activities in the Area, the contractors have the responsibility to evaluate and monitor the effects of their activities on the marine environments. In the Convention, Article 145 stipulates that necessary measures shall be taken with respect to activities in the Area to ensure effective protection for the marine environment from harmful effects which may arise from such activities. Article 162 stipulates that the Council of the Authority shall have the power to establish the specific policies to be pursued by the Authority on any question or matter within the competence of the Authority. And the Article 165 stipulates that the LTC shall make recommendations on questions and matters with regard to protection of marine environments upon the request of the Council (Convention, 1982). In accordance with the Convention and the Agreement relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982, a REMP should be developed under the auspices of the Authority in a transparent manner with engagement from all stakeholders (ISBA/24/C/8).

Characteristics of Seamount Ecosystems

12. Seamounts are defined as independent features that rise to at least 1000 m above the ocean seafloor (IHO, 2008) (although ecological definitions of "seamounts" include hills and knolls, Pitcher et al. 2007), and most are extinct volcanoes. Based on differences in the distance from the ocean surface to the top of seamounts and associated physical and ecological characteristics, seamounts are classified into: 1) shallow-water seamount (the summit reaches to the euphotic zone), middle-depth seamount (the summit is below the euphotic zone but above 400 m) and deep-ocean seamount (the summit is deeper than 400 m) (Genin, 2004). The number of seamounts globally is uncertain. However, many reports estimated the number and density of seamounts and knolls based on satellite altimetry (e.g., Kitchingman et al., 2007, Yesson et al., 2012), and extrapolated to poorly known areas (e.g., Wessel et al., 2010), indicating there are likely to be more than 200,000 seamounts and knolls in the world's oceans, with the density of seamounts being higher in the northwest Pacific Ocean than other regions (Wessel et al., 2010). Those with the cobalt-rich ferromanganese crusts in "Triangle Area" in the northwest Pacific Ocean are classified as deep-ocean seamounts.

13. The role and importance of seamounts in deep-sea ecosystems varies considerably, with no "rules" that apply to all of them (e.g., Clark et al., 2010, Rowden et al., 2010a), and much more scientific research is needed to improve understanding of the structure and function of seamount systems (Clark et al., 2012). Nevertheless, three important characteristics distinguish seamounts from the surrounding deep-sea habitats (Clark 2009). First, as "islands" of shallower sea floor, they provide a range of depths for different faunal communities. Second, their typical hard and often bare volcanic rock surfaces contrast with the fine, unconsolidated sediments that cover the majority of the seafloor. Thirdly, the physical structure of some seamounts alters local hydrography and currents to concentrate species and productivity over the seamount summit and upper flanks.

14. The topography of deep-ocean seamounts can affect ocean circulation, transferring the energy from large scale to small scale, and eventually may form regional eddy mixing. Under the effect of the geography and topography of seamounts, Taylor columns and eddies may form (e.g., Garrett, 2003; Beckmann and Mohn, 2002; Lavelle and Mohn, 2010). This complicated dynamic leads to biological communities of the water column and benthic environment that are different from other environments in the deep ocean. Properties include differences in primary productivity, biomass, richness and diversity of plankton, nekton and benthos sometimes called the "seamount effect" (Boehlert and Genin, 1987; de Forges et al., 2000; Hubbs, 1959).

15. High primary productivity caused by nutrient transport through upwelling and Taylor columns may occur for some shallow-water seamounts, mainly with, while when there is high biomass and primary productivity in regions with middle-depth and deep-ocean seamounts this is a result of the inflow and trapping of plankton from surrounding waters under the effect of current and topography of the seamounts (Dower and Mackas, 1996; Mienis et al., 2007; Genin and Dower, 2007). Diurnal migration of zooplankton can lead to them being trapped at the summit, and enhancing food availability for fish and benthos, resulting in high productivity on the seamount (Genin, 2004).

16. The benthic communities of seamounts are dominated by sessile and filter feeding fauna (Wilson and Kaufmann, 1987; Rogers, 1994; Smith et al., 2004, Clark et al., 2010), and abundance and biomass of taxa such as corals and sponges can be much higher than on the adjacent slope and plains (Rowden et al., 2010b). These large filter-feeders provide food resources for smaller invertebrates with strong moving ability, such as crustaceans and echinoderms (Roberts et al., 2006).

17. Species composition and spatial distribution of benthic assemblages are influenced by environmental factors, including primary production in the upper water, particulate organic carbon flux, hydrodynamic conditions, marine chemical profile characters, topography, geomorphology, geological history and ages, distance from continent and habitat heterogeneity. Among them, multiple factors are closely related to the water depth, therefore, which is usually considered as the key index to explain the differences of benthic community in seamounts (Thistle, 2003; O'Hara, 2007; Rogers et al., 2007; ISA Technical Study: No.8).

18. The role of cobalt-rich crust in determining the composition and abundance of benthic communities is uncertain. Schlacher et al. (2013) built on data from the ISA Technical Study: No.8 to examine patterns of community structure along seamounts of the Hawaiian-Emperor seamount chain inside and outside the Pacific cobalt-rich crusts zone. It is indicated that benthic assemblages of invertebrates were structurally different between seamounts inside and outside the cobalt-rich crusts zone. This spatial contrast resulted from variations in species composition and relative abundance of species, rather than differences in species richness, challenging historical notions of an impoverished cobalt-rich crust fauna in the region. A similar study by Morgan et al. (2015) on the Necker Ridge showed a discontinuous and patchy nature of benthic communities adding to growing evidence that cobalt-rich seamounts are highly heterogeneous habitats. These recent studies

suggested that ecological and evolutionary processes may vary considerably on a single seamount, and emphasis that regional variation must be evaluated.

19. Clark (2017) in a presentation to an ISA Workshop of IRZ/PRZ design summarized some of the current knowledge of cobalt-rich crust ecosystems, and highlighted that certain specific characteristics of seamount environments need to be considered in conservation design which is relevant to Area of Particular Environmental Interest (abbreviation: APEI) selection. These mainly included (1) location (depth, substrate composition, current flow connectivity); (2) size (site specific, Schlacher et al. (2013) suggested variability at spatial scales less than 2 km); (3) number (need to encompass representative heterogeneity and multiple patches of biogenic taxa); (4) separation (benthic communities can change over short distances, impact dispersal distances of sediment plume are important, and extent of larval connectivity); (5) longevity (seasonal and annual variability on oceanic seamounts can be high, several years necessary to characterize the community dynamics on a seamount).

The "Triangle Project" in the Northwest Pacific Ocean

20. The Authority has signed exploration contracts for cobalt-rich crusts in the northwest Pacific Ocean with COMRA, Ministry of Natural Resources and Environment of the Russian Federation, Japan Oil, Gas and Metals National Corporation and the Republic of Korea. In the South Atlantic Ocean, there is one contract with Companhia De Pesquisa de Recursos Minerals in Brazil. These contractors have conducted several cruises for resource exploration and environmental survey by which much data and information was obtained. The Authority is currently collecting and organizing environmental data, constructing an environmental database for the contract areas as a data platform for supporting the REMP scientifically. The Authority hopes to cooperate with contractors, international organizations, and scientific and legal experts in future, using information from the environmental baseline survey data in the contract zone and surrounding environments, to propose and design the REMP, especially the delineation of APEIs, for better implementing environmental conservation in the Area and protecting the common heritage of mankind.

Acknowledgement

We would like to express our heartfelt gratitude to Dr. Stefan Bräger (International Seabed Authority), who contributed a lot in the discussion about organization of this workshop.

References

Beckmann A., Mohn C. The upper ocean circulation at Great Meteor seamount: Part II. Retention potential of the seamount-induced circulation. Ocean Dynamics, 2002, 52: 194-204.

Boehlert G. W., Genin A. A review of the effects of seamounts on biological processes. In. Keating B. H., Fryer P., Batiza R., Boehlert G. W. (eds). Seamounts, islands, and atolls, 1987, pp. 319-334.

Clark M. R. Seamounts: biology. In. Gillespie R. G., Clague D. A. (eds). Encyclopaedia of islands. University of California Press, 2009, pp. 818-821.

Clark M. R. Cobalt-rich crusts: ecosystem characteristics of seamounts relevant to zone design. Invited oral presentation to ISA IRZ-PRZ Workshop, Berlin, September 2017.

Clark M. R., Schlacher, T. A., Rowden A. A., Stocks K. I., Consalvey M. Science priorities for seamounts: research links to conservation and management. PLoS ONE, 2012, 7(1): e29232.

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

de Forges R. B., Koslow J. A., Poore G. C. B. Diversity and endemism of the benthic seamount fauna in the southwest Pacific. Nature, 2000, 405(6789): 944-947.

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

Garrett C. Internal tides and ocean mixing. Science, 2003, 301: 1858-1859.

General Assembly of the United Nations. Resolution 68/70. http://www.un.org/zh/ga/68/res/all1.shtml, 2013.

General Assembly of the United Nations. Resolution 69/245. http://www.un.org/zh/ga/69/res/all1.shtml, 2014.

General Assembly of the United Nations. Resolution 70/235. http://www.un.org/zh/ga/70/res/all1.shtml, 2015.

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

Genin A., Dower J. F. Seamount plankton dynamics. In. Pitcher T. J., Morato T., Hart P. J. B., Clark M. R., Haggan N., Santos R.S. (eds). Seamounts: ecology, fisheries, and conservation. Blackwell Fisheries and Aquatic Resources Series 12. Blackwell Publishing, Oxford, 2007, pp. 85-100.

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

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

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

International Seabed Authority. Decision of the Assembly of the International Seabed Authority relating to the Regulations on Prospecting and Exploration for Cobalt-rich Ferromanganese Crusts in the Area (ISBA/18/A/11), International Seabed Authority, 2012, Kingston, Jamaica.

International Seabed Authority. Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area (ISBA/19/LTC/8). International Seabed Authority, 2013, Kingston, Jamaica.

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

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

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

Background

International Seabed Authority. Statement by the President of the Council on the work of the Council during the first part of the twenty-fourth session (ISBA/24/C/8). International Seabed Authority, 2018, Kingston, Jamaica.

International Seabed Authority. Polymetallic Massive Sulphides and Cobalt-Rich Ferromanganese Crusts: Status and Prospects (Technical Study: No. 2). International Seabed Authority, 2000, Kingston, Jamaica.

International Seabed Authority. Fauna of Cobalt-Rich Ferromanganese Crust Seamounts (Technical Study: No. 8). International Seabed Authority, 2011, Kingston, Jamaica.

Kitchingman A., Lai S., Morato T., Pauly D. How many seamounts are there, and where are they located? In. Pitcher T. J., Morato T., Hart P. J. B., Clark M. R., Haggan N., Santos R.S. (eds). Seamounts: ecology, fisheries, and conservation. Blackwell Fisheries and Aquatic Resources Series 12. Blackwell Publishing, Oxford, 2007, pp. 527.

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

Mienis F., de Stigter H. C., White M., et al. Hydrodynamic controls on cold-water coral growth and carbonate-mound development at the SW and SE rockall trough margin, NE Atlantic Ocean. Deep Sea Research Part I, 2007, 54(9): 1655-1674.

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

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

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

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

Rogers A. D. The biology of seamounts. Advances in Marine Biology, 1994, 30: 305-351.

Rogers A. D., Baco A., Griffiths H., et al. Corals on seamounts. In. Pitcher T. J., Morato T., Hart P. J. B., Clark M. R., Haggan N., Santos R.S. (eds). Seamounts: ecology, fisheries, and conservation. Blackwell Fisheries and Aquatic Resources Series 12. Blackwell Publishing, Oxford, 2007, pp. 141-169.

Rowden A. A., Dower J. F., Schlacher T. A., Consalvey M., Clark, M. R. Paradigms in seamount ecology: fact, fiction, and future. Marine Ecology, 2010a, 31: 226-239.

Rowden A. A., Schlacher T. A., Williams A., et al. A test of the seamount oasis hypothesis: seamounts support higher epibenthic megafaunal biomass than adjacent slopes. Marine Ecology, 2010b, 31: 95-106.

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

Thistle D. The deep-sea floor: An overview. In. Tyler P. A. (eds). Ecosystems of the world. Elsevier, New York, 2003, pp. 1-37.

Smith P. J., McVeagh S. M., Mingoia J. T., et al. Mitochondrial DNA sequence variation in deep-sea bamboo coral (Keratoisidinae) species in the southwest and northwest Pacific Ocean. Marine Biology, 2004, 144: 253-261.

United Nations Convention on the Law of the Sea. 1982, Jamaica.

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

Wilson R. R., Kaufmann R. S. Seamount biota and biogeography. In. Keating B., Fryer P., Batiza R., Boehlert G. W. (eds). Seamounts, islands, and atolls., Geophysical Monograph Series 43. American Geophysical Union, Washington, DC., 1987, pp. 355-377.

Yesson C., Clark M. R., Taylor M., Rogers A. D. The global distribution of seamounts based on 30-second bathymetry data. Deep Sea Research I, 2011, 58: 442-453.

Workshop Agenda

Date	Time	Activity	Responsible	Room
Day 1: 26 May 2018 Saturday	12:00 - 20:00	Registration (up till to 9:00 – 12:00 on 27 May 2018)	On site/COMRA	Hotel Lobby
Day 2: 27 May 2018 Sunday	14:00 - 16:00	Visit National Deep Sea Center	On site/COMRA	
	19:00 - 20:00	Welcome Reception	On site/COMRA	Sunshine Global Restaurant
Day 3: 28 May 2018 Monday	9:00 - 9:50	**Opening Remarks (Moderator: Feng Liu)**		
		Representative of Ministry of Natural Resources	Shanqing Lin	Nanshan Hall
		Representative of ISA	Michael Lodge, Secretary-General	
		Representative of local government		
		Group Photo		
	9:50 - 10:30	**Plenary Presentations (Moderator: Jian Kang)**		
		China's deep sea environment policy and practice	Feng Liu	Nanshan Hall
		Towards the development and implementation of an Environmental Management Plan Strategy for the Area	Sandor Mulsow	
	10:30 - 11:00	**Coffee break**		
	11:00 - 11:30	**Session 1: Legal Framework (Moderator: Sandor Mulsow)**		
		Legal and regulatory framework for REMP	Yongsheng Cai	Nanshan Hall
		Frameworks for REMPs: the CCZ nodule example	Cindy Lee Van Dover	
	11:30 - 12:00	**Working Group 1: Legal and Scientific Framework**		
		Working Group 1: Legal and scientific framework for CFC REMP in the northwest Pacific Ocean	Moderator: Russell Howorth (Caiwei Hall) / Cindy Lee Van Dover (Weijia Hall) Rapporteur: Luigi Santosuosso / Linlin Li	Caiwei Hall & Weijia Hall
	12:00 - 13:30	**Lunch (Sunshine Global Restaurant)**		

Workshop Agenda

Date	Time	Activity	Responsible	Room
Day 3: 28 May 2018 Monday	13:30 - 13:50	Report on WG 1 conclusion/recommendations	Rapporteur: Luigi Santosuosso / Linlin Li	Nanshan Hall
	13:50 - 16:00	**Session 2: CFC Habitat (Moderator: Xue-Wei Xu / Qian Liu)**		
		Structure and functional characteristics of seamounts ecosystem	Tina Molodtsova	Nanshan Hall
		Major factors influencing seamount niches	Tomohiko Fukushima	
		Megafauna community structure, distribution and impact factors on the northwest pacific seamounts	Chunsheng Wang	
		Exploration plan for Co-rich Ferromanganese Crust in Korean Contract Area- Environmental Research and Management Plan	Se-Jong Ju	
		Environmental studies of the cobalt-rich ferromanganese crusts on Russian exploration area	Melnik Viacheslav	
		Confirming the validity of ADCP velocity measurements for physical environmental assessments in Marcus-Wake Seamount group for cobalt-rich ferromanganese crusts	Akira Iguchi	
	16:00 - 16:30	**Coffee Break**		
	16:30 - 17:30	**Working Group 2: Seamount Ecosystem and Impacts of Mining Activities (World Café Approach)**		
		Characteristics of seamount ecosystems, impacts of human activities and approaches of the scientific protection	Moderator: Tina Molodtsova / Tomohiko Fukushima / Chunsheng Wang	Caiwei Hall
		Current scientific knowledges, APEI proposal principles, future survey methods and research orientations of the environments in the northwest Pacific	Moderator: Pei-Yuan Qian / Se-Jong Ju / Alison Swaddling	Weijia Hall
	18:00 - 20:00	**Dinner (Sunshine Global Restaurant)**		
	20:00 - 21:00	Closed working meeting (ISA and contractors)	Moderator: Michael Lodge	Nan Lou Meeting Room

Workshop Agenda

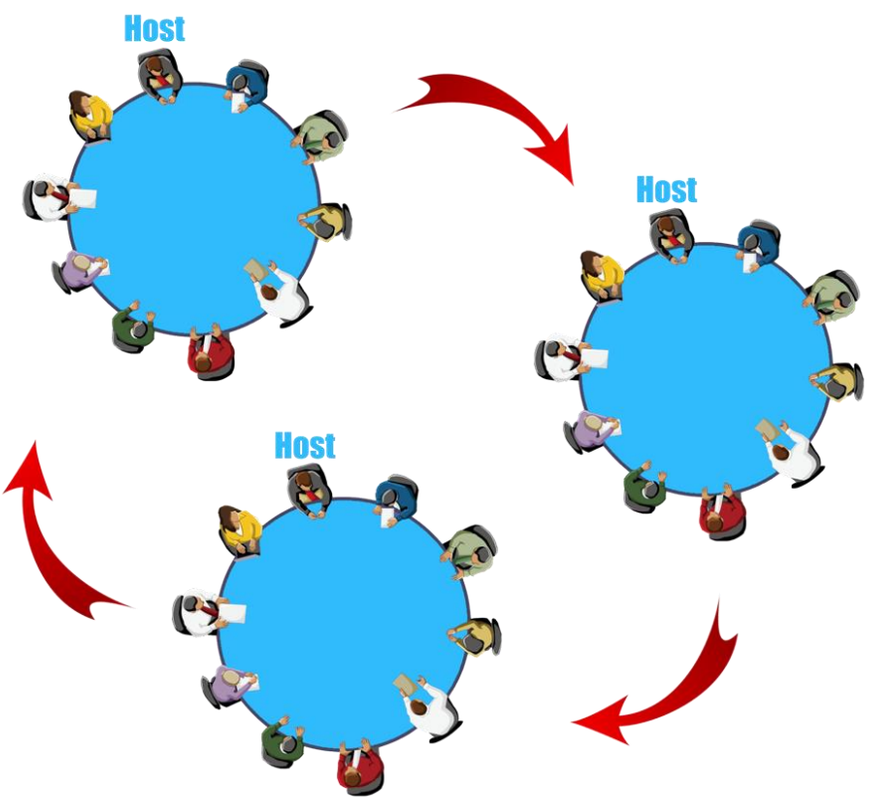
Date	Time	Activity	Responsible	Room
Day 4: 29 May 2018 Tuesday	9:00 - 9:30	Report on WG 2: conclusions/recommendations	Rapporteur: Pei-Yuan Qian / Tina Molodtsova	Nanshan Hall
	9:30 - 9:55	**Session 3: REMP Proposal and Perspective (Moderator: Xiangyang Li)**		
		Proposal of the TRIANGLE PROJECT for cobalt-rich ferromanganese crusts in the northwest Pacific Ocean	Xue-Wei Xu	Nanshan Hall
		ISA database implementation	Sandor Mulsow	
	10:00 - 10:40	**Working Group 3: REMP Proposal (World Café Approach)**		
		Data resources, ISA role in sharing public environmental information	Moderator: Harald Brekke / Pedro Madureira / Sandor Mulsow	Caiwei Hall
		Roadmap to implement REMP for CFC in the northwest Pacific Ocean	Moderator: Georgy Cherkashov / Yeon Jee Suh / Xue-Wei Xu	Weijia Hall
	10:40 - 11:20	**Coffee break**		
	11:20 - 11:30	Report on WG 3: conclusions/recommendations	Rapporteur: Pedro Madureira / Yeon Jee Suh	Nanshan Hall
	11:30 - 12:00	**Closing Remarks (Moderator: Yongsheng Cai)**		
		Working Group 1: Final report	Luigi Santosuosso	Nanshan Hall
		Working Group 2: Final report	Pei-Yuan Qian	
		Working Group 3: Final report	Pedro Madureira	
		SG of COMRA	Feng Liu	
		SG of ISA	Michael Lodge	
	12:10 - 13:30	**Lunch (Sunshine Global Restaurant)**		
	14:00 - 16:00	Departure or Visit China Ocean Sample Repository		

※ **For participants who have registered the visit to National Deep Sea Center, please gather in the hotel lobby at 14:00, May 27.**

World Café Approach

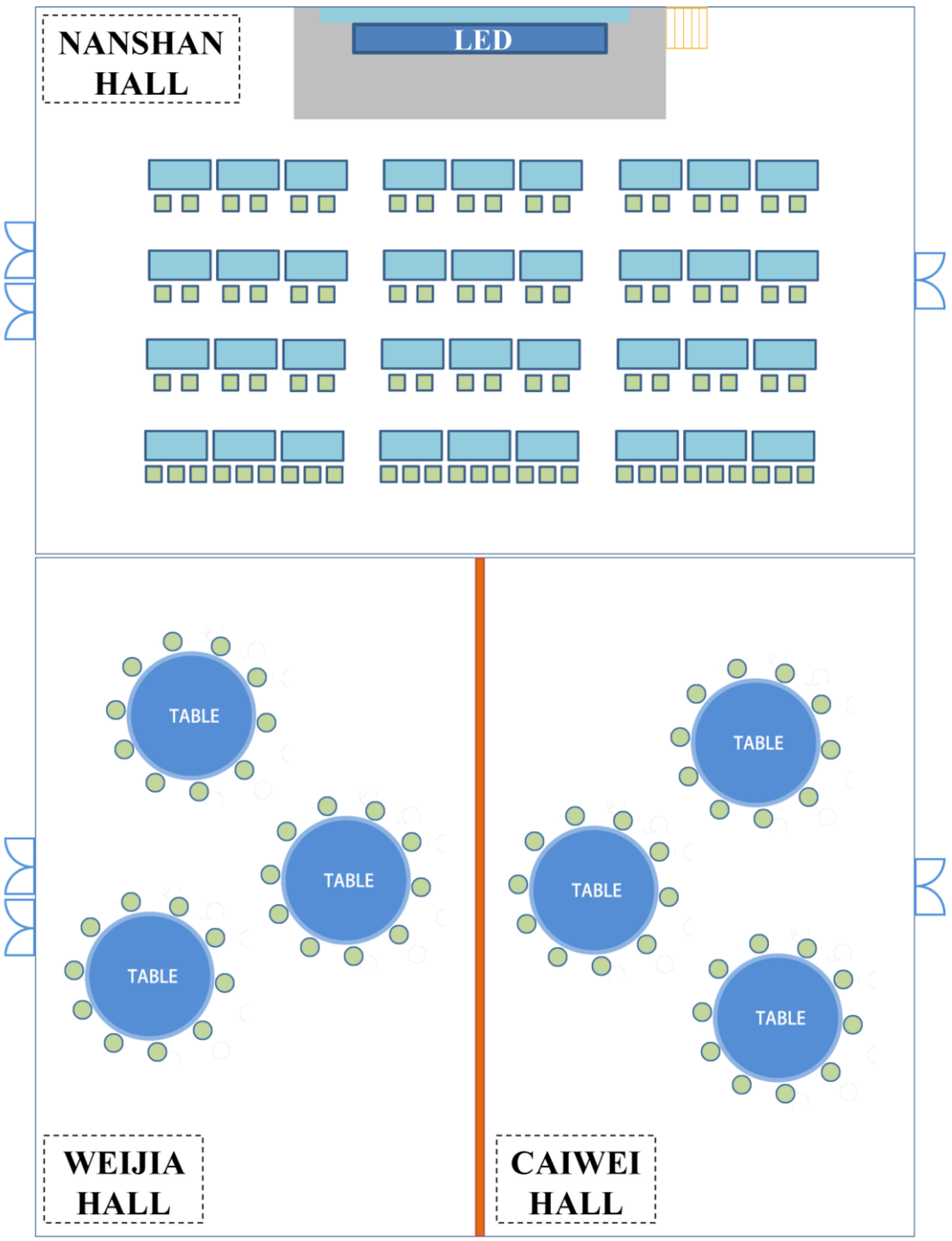
1. The World Café approach is an efficient way for sharing knowledge and ideas. Basically, participants work together on individual questions in small groups around a table and move to a new table at regular intervals. Each table has the same moderator to host the discussion, who needs to lead and summarize the previous outcomes of the discussion to the new guests. Thus, the new discussions are cross-fertilized with ideas generated in former conversations. At the end of the process, the main ideas are summarized in a plenary session and follow-up possibilities are discussed.

2. In this case, we will separate the participants (~50-60 persons) into 2 rooms. In each room, there will be approximately 30 participants and three table discussions will take place, but with different questions at each table. Each table discussion will last for 10-20 minutes and the participants will move to the next table within the room. A total of 100 minutes will be used for this session.



An illustration to help understand the World Café Approach

Workshop Floor Plan



※ **If you need any technical assistance, please contact Zhen CUI (+86-13808994676) or Fanxu MENG (+86-15168217682).**

Wi-Fi Access Method

※ **If you have any problem with Wi-Fi access, please contact the Grand Mercure Hotel Operator (+86-532-85056888).**

Transportation

1. Qingdao Liuting International Airport is the main international airport serving the city of Qingdao. It is about 43 kilometers (27 miles) away from Grand Mercure Qingdao Nanshan Resort, about 31 kilometers (19 miles) away from the city center. Taxis are available for a meter rate depending on vehicle selected. The journey to the hotel takes approximately 45 minutes. The fare is approximately 180 RMB with additional charges depending on traffic conditions.

2. Qingdao North Railway Station commenced operation in Jan, 2014. It is situated in Licang District, about 58 kilometers (36 miles) away from Grand Mercure Qingdao Nanshan Resort, 12 kilometers (7.5 miles) from the city center, and 7 miles from the Qingdao Liuting International Airport. The journey to the hotel takes approximately 55 minutes. The fare is approximately 165 RMB with additional charges depending on traffic conditions.

3. Qingdao Railway Station was first built in 1899 and reconstructed in 1994. It is 65 kilometers (40.4 miles) away from Grand Mercure Qingdao Nanshan Resort, and 15 miles (24 kilometers) from Qingdao Liuting International Airport, but only 7.5 kilometers (4.5 miles) from the city center. It is noticed that only a limited number of trains go through Qingdao Railway Station now. The journey to the hotel takes approximately one hour and ten minutes. The fare is approximately 210 RMB with additional charges depending on traffic conditions.

※ **If you have any problem with transportation, please contact Peng ZHOU (+86-15967102736).**

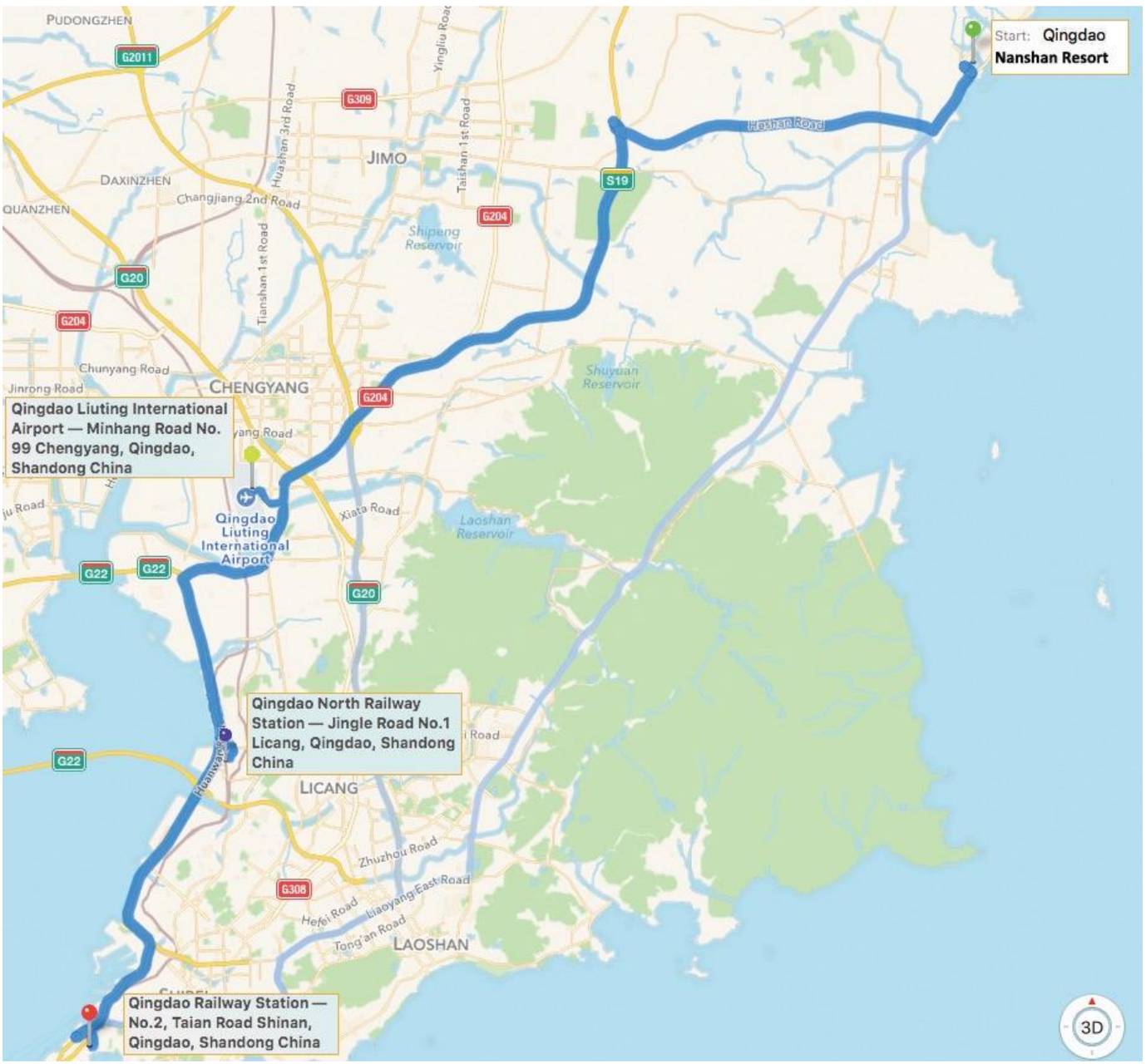
Transportation

Take a taxi to:

1. Qingdao Liuting International Airport (青岛流亭国际机场)

2. Qingdao North Railway Station (青岛北站)

3. Qingdao Railway Station (青岛站)



Workshop Participants

No.	NAME	AFFILIATION	EMAIL
1	Barboza de Assis, Hortencia Maria	Companhia De Pesquisa de Recursos Minerais of Brazil / Brazil	hortencia.assis@cprm.gov.br
2	Brekke, Harald	Legal and Technical Commission, International Seabed Authority / Norway	harald.brekke@npd.no
3	Cai, Yongsheng	International Seabed Authority	yshcai@isa.org.jm
4	Cherkashev, Georgy	Legal and Technical Commission, International Seabed Authority / Russia	gcherkashov@gmail.com
5	Currie, Duncan	Deep Sea Conservation Coalition / New Zealand	duncanc@globelaw.com
6	Ding, Zhongjun	National Deep Sea Center / China	dzj@ndsc.org.cn
7	Dong, Jihai	Nanjing University of Information Science & Technology / China	jihai_dong@nuist.edu.cn
8	Ermakova, Livia	VNIIOkeangeologia / Russia	livia77@inbox.ru
9	Fukushima, Tomohiko	Japan Agency for Marine-Earth Science and Technology / Japan	fukushimat@jamstec.go.jp
10	Gao, Yan	China Ocean Mineral Resources R&D Association / China	realgaoxin@163.com
11	Howorth, Russell	Legal and Technical Commission, International Seabed Authority /Fiji	matadrevula@gmail.com
12	Huang, Hao	Third Institute of Oceanography / China	huanghao@tio.org.cn
13	Hyeong, Ki Seong	Korea Institute of Ocean and Science Technology / Republic of Korea	kshyeong@kiost.ac.kr
14	Igarashi, Yoshiaki	Japan Oil, Gas and Metals National Corporation / Japan	igarashi-yoshiaki@jogmec.go.jp
15	Iguchi, Akira	National Institute of Advanced Industrial Science and Technology / Japan	iguchi.a@aist.go.jp
16	Ju, Lei	Ministry of Foreign Affairs / China	ju_lei@mfa.gov.cn
17	Ju, Se-Jong	Korea Institute of Ocean and Science Technology / Republic of Korea	sjju@kiost.ac.kr
18	Kang, Jian	China Ocean Mineral Resources R&D Association / China	kangjian@comra.org
19	Kato, Shogo	Japan Oil, Gas and Metals National Corporation / Japan	kato-shogo@jogmec.go.jp

Workshop Participants

No.	NAME	AFFILIATION	EMAIL
20	Li, Chaolun	Institute of Oceanology, Chinese Academy of Sciences / China	lcl@qdio.ac.cn
21	Li, Chuanshun	First Institute of Oceanography / China	lichuanshun@fio.org.cn
22	Li, Linlin	Ministry of Foreign Affairs / China	li_linlin@mfa.gov.cn
23	Li, Weilu	National Marine Information Center / China	liweilu@nmdis.org.cn
24	Li, Xiangyang	China Ocean Mineral Resources R&D Association / China	lixy@comra.org
25	Liang, Fengkui	Department of International Cooperation, State Oceanic Administration / China	liangfengkuisoa@163.com
26	Lin, Shanqing	Ministry of Natural Resources / China	
27	Lin, Mao	Third Institute of Oceanography / China	linmao@tio.org.cn
28	Liu, Baohua	National Deep Sea Center / China	bhliu@ndsc.org.cn
29	Liu, Baotao	North China Sea Branch of State Oceanic Administration / China	kjc@bhfj.gov.cn
30	Liu, Feng	China Ocean Mineral Resources R&D Association / China	liufeng@comra.org
31	Liu, Qian	Second Institute of Oceanography / China	liuqian@sio.org.cn
32	Liu, Yin	Publicty and Education Center of the State Oceanic Administration / China	shadowtuant@163.com
33	Luan, Shaojiang	Qingdao Oceantec Valley Administration Bureau / China	hylgfwzx3327@163.com
34	Lodge, Michael	International Seabed Authority	mlodge@isa.org.jm
35	Madureira, Pedro	Legal and Technical Commission, International Seabed Authority / Portugal	pedro.madureira@emepc.mm.gov.pt
36	Melnik, Viacheslav	Joint Stock Company Yuzhmorgeologia / Russia	melnikvf@ymg.ru
37	Molodtsova, Tina	P.P. Shirshov Institute of Oceanology RAS / Russia	tina@ocean.ru
38	Mulsow, Sandor	International Seabed Authority	smulsow@isa.org.jm
39	Nugent, Conn	Pew Charitable Trusts / USA	cnugent@pewtrusts.org

Workshop Participants

No.	NAME	AFFILIATION	EMAIL
40	Qian, Pei-Yuan	Hong Kong University of Science and Technology / China	boqianpy@ust.hk
41	Qiu, Wanfei	China Institute for Marine Affairs / China	qiuwanfei@cima.gov.cn
42	Ren, Xiangwen	First Institute of Oceanography / China	renxiangwen@163.com
43	Rezende de Souza, Claudia Maria	Companhia De Pesquisa de Recursos Minerais of Brazil / Brazil	claudia.rezende@cprm.gov.br
44	Santosuosso, Luigi	Division for Ocean Affairs and the Law of the Sea, United Nations	santosuosso@un.org
45	Shi, Xianpeng	National Deep Sea Center / China	xpsh@ndsc.org.cn
46	Song, Chengbing	China Ocean Mineral Resources R&D Association / China	song_cb@163.com
47	Suh, Yeon Jee	Korea Institute of Ocean and Science Technology / Republic of Korea	yjsuh@kiost.ac.kr
48	Swaddling, Alison	The Commonwealth Secretariat / Australia	a.swaddling@commonwealth.int
49	Van Dover, Cindy Lee	Duke University / USA	c.vandover@duke.edu
50	Wang, Chunsheng	Second Institute of Oceanography / China	wangsio@sio.org.cn
51	Wu, Changbin	National Deep Sea Center / China	cbwu@comra.org
52	Wu, Guanghai	Second Institute of Oceanography / China	wugh6866@aliyun.com
53	Wu, Guifeng	China Ocean Mineral Resources R&D Association / China	wuguifeng@comra.org
54	Wu, Jingchao	Department of International Cooperation, State Oceanic Administration / China	wujingchao@cima.gov.cn
55	Wu, Jun	North China Sea Branch of State Oceanic Administration / China	wujun@caa.gov.cn
56	Xu, Kuidong	Institute of Oceanology, Chinese Academy of Sciences / China	kxu@qdio.ac.cn
57	Xu, Xue-Wei	Second Institute of Oceanography / China	xuxw@sio.org.cn
58	Xue, Guifang	Shanghai Jiao Tong University / China	juliaxue@sjtu.edu.cn
59	Yang, Yaomin	National Deep Sea Center / China	yym@ndsc.org.cn

Workshop Participants

No.	NAME	AFFILIATION	EMAIL
60	Yu, Hongjun	National Deep Sea Center / China	hjyu@ndsc.org.cn
61	Zhang, Guobin	Shanghai Jiao Tong University / China	zhangguobin1988@126.com
62	Zhang, Huatian	Changsha Research Institute of Mining and Metallurgy, Co. Ltd. / China	zhang_ht@minmetals.com
63	Zhang, Jiwei	Third Institute of Oceanography / China	zjwfruit@tio.org.cn
64	Zhang, Zhaohui	First Institute of Oceanography / China	zhang@fio.org.cn
65	Zheng, Miaozhuang	China Institute for Marine Affairs / China	zhengmiaozhuang@cima.gov.cn
66	Zheng, Yulong	Second Institute of Oceanography / China	siosoa@sio.org.cn
67	Zhou, Peng	Second Institute of Oceanography / China	hockeyextremophiles@yahoo.com
68	Zhou, Yun	Changsha Research Institute of Mining and Metallurgy, Co. Ltd. / China	zhouyun289@vip.sina.com
69	Zhuo, Xiaojun	Changsha Research Institute of Mining and Metallurgy, Co. Ltd. / China	zhuoxj@minmetals.com

※ **Participants who will register on site are not included in the list above.**