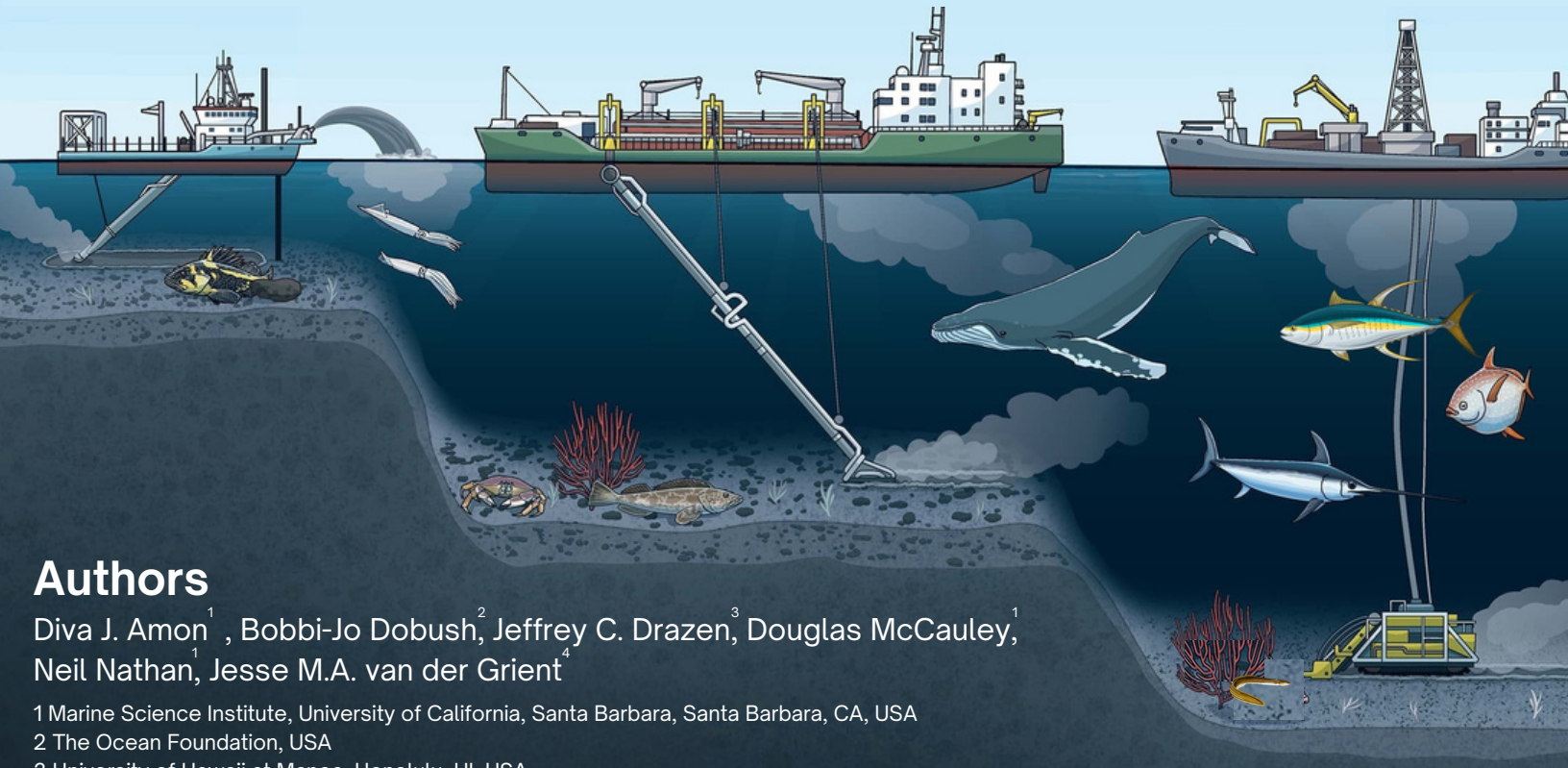
14th Meeting of the IATTC
Scientific Advisory Committee

Potential interactions between deep-sea mining and tuna fisheries

May 2023



Authors

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Prepared in collaboration with IATTC Observer, The Ocean Foundation

What is deep-sea mining?

Deep-sea mining is a nascent industry that seeks to mine deposits that contain commercially valuable minerals such as manganese, copper, cobalt, nickel, zinc, and rare earth minerals from the deep seafloor. Proponents of this new industry state that these metals are critical for the green transition. However, this industry could also pose extensive environmental risks to the ocean ecosystem.

Currently, mining for polymetallic nodules has received the greatest interest. Polymetallic nodules are potato-sized 'rocks' that lie on the abyssal seafloor (3500-5500 meters deep), and have formed over millions of years at the seawater/sediment interface. Nodules are found in high densities with high metal content in a region called the Clarion-Clipperton Zone (CCZ) that spans the waters from Hawai'i to Mexico (Lusty & Murton, 2018). The International Seabed Authority (ISA), established by the United Nations to manage deep-sea mining as well as protect the marine environment from these activities, has issued 17 exploration licenses[1] in the CCZ that together cover over 1.5 million km^2. Nodules are also being sought from the Central Indian Ocean Basin, as well as the western Pacific, with one exploration license granted in each.

There are two further resources being sought after for deep-sea mining: polymetallic sulfides at or near hydrothermal vents and cobalt-rich ferromanganese crusts on seamounts. On the western side of the Pacific Ocean, the ISA has issued four exploration licenses for cobalt-rich ferromanganese crusts.[2] Such mining activity would likely take place in shallower waters compared to the abyssal seafloor. However, the technology and commercial interest to exploit crusts are not as far advanced as those to exploit polymetallic nodules. Seven exploration licenses have also been granted for polymetallic sulfides on the Mid-Atlantic Ridge.

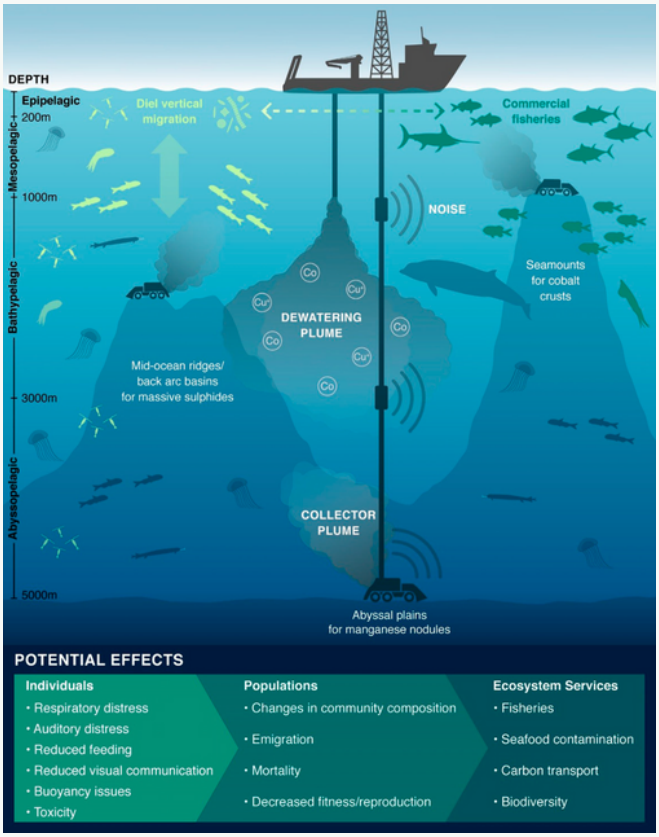

Figure 1. The potential impacts of deep-sea mining, with particular focus on pelagic taxa. Organisms and plume impacts are not to scale. Image credit: Drazen et al., 2020.

1.https://www.isa.org.jm/exploration-contracts/polymetallic-nodules/
2. https://www.isa.org.jm/exploration-contracts/cobalt-rich-ferromanganese-crusts/

The potential environmental risks of deep-sea mining

Scientists are working to understand the environmental risks of deep-sea mining but there are still many unknowns (Amon et al., 2022a). Mining polymetallic nodules involves large vehicles which will remove the nodules, along with seawater and the surface (~5-10 cm) layer of the sedimented seafloor. The nodules will then be transported to a surface ship via a long riser pipe (Figure 1). In the CCZ alone, some industry projections are to directly mine seafloor habitats over a total 500,000 km^2 (Paulikas et al. 2020; Amon et al. 2022b). Impacts will include direct habitat loss and effects from sediment plumes as well as noise and light. Biodiversity (including fish) and the ecosystem services they provide, such as climate regulation and underwater cultural heritage, will all be affected.

On the seafloor, at least 50% of the seafloor animals such as sponges, corals, anemones and some echinoderms live only on the nodules, with other fauna living within and under the nodules (Amon et al. 2016; Stratmann et al. 2021). The mining activity will remove their habitat which cannot regrow (at least not for millions of years). Animals within the sediment will be crushed, resulting in depletion of their populations and changes to the wider community composition unlikely to recover for decades or centuries (Gollner et al. 2017; Jones et al. 2017; Simon-Lledo et al. 2019). Small-scale mining tests have shown that some fishes do not return to the impacted area for decades likely because of the lack of prey (Drazen et al. 2019). Sediment plumes of fine mud, created by the seafloor mining vehicles, will raise the particle concentration in the water above the seafloor. Increased sediment concentrations are known to harm fish gills and respiration, interfere with the feeding of suspension feeders, and increase stress hormone levels (Wilber and Clarke 2001; Wenger et al 2018; van der Grient and Drazen 2022; Figure 1). These collector plumes are expected to drift for tens of kilometers (Aleynik et al. 2017, Ouillon et al. 2022b), settling and smothering animals beyond the mining tracks themselves (Smith et al. 2020).

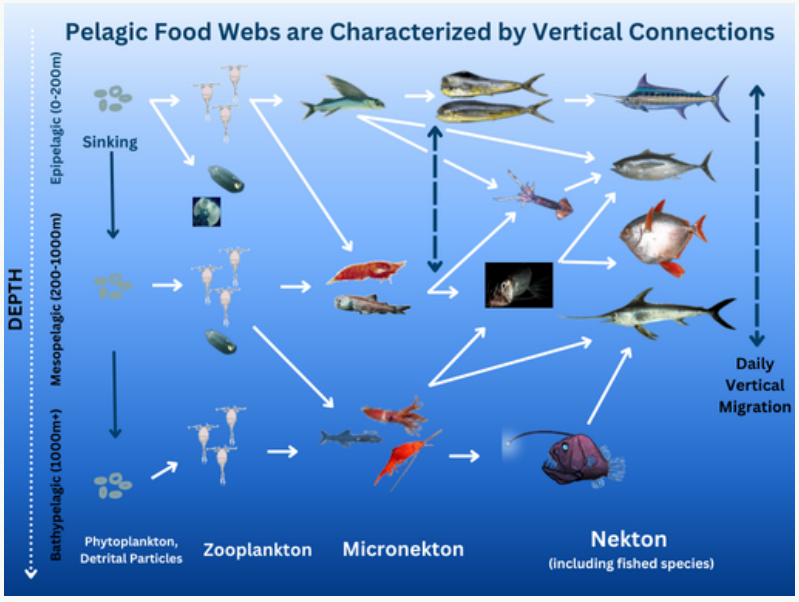

Figure 2. A simplified oceanic food web from primary producers to commercially exploited fish species.

Much of the work assessing mining risks has focused on the potential deep seafloor impacts, however it is likely that the ocean's sea surface and midwater could be affected as well (Drazen et al. 2020; Figure 1). Once ore and associated mud and seawater are transported from the seafloor collector vehicle to a ship, the ore will be retained and the sediment, mineral fines and water pumped back into the ocean. A rate of about 50,000m^3 per day (roughly the volume of a freight train) per mining operation is anticipated, which will likely create plumes that extend for tens of kilometers and affect very large volumes of the ocean (Muñoz-Royo et al. 2021; Ouillon et al. 2022a; Amon et al., 2022b). Similar to the collector plume, the discharge plume will raise the particle concentration in the water column, interfering and harming filter feeding apparatuses and gills of fishes and their suspension feeding prey (Figure 2), reducing visual communication, and increasing stress hormone levels (van der Grient & Drazen 2022). In addition, the discharge plume is expected to contain elevated concentrations of metals. As minerals are collected, they will likely fragment with some dissolving into seawater and some adhering to sediment or organic particles that could be ingested and incorporated into deep-sea food webs. The discharge depth of the secondary plume has not been regulated, nor is there an industry standard, but toxic metals could enter and bioaccumulate in our seafood supply (Drazen et al. 2020). Finally, mining noise could also be extensive and cause animals, from sea surface to deep seafloor, to alter their feeding and/or reproductive migrations (Williams et al. 2022) (Figure 1).

Increasing overlap between deep-sea mining and tuna fisheries

If deep-sea mining moves to exploitation, chances of conflict between fisheries and deep-sea mining will increase, especially given the existing spatial overlap between the two industries. Note also that impacts, including sediment plumes, noise and light, are expected to travel outside of the zones of direct impact. The five countries that obtained the highest average annual tuna catches (in tonnes) in the water column over the licensed mining areas are Mexico, Venezuela, Nicaragua, Panama, and Colombia (van der Grient & Drazen, 2021). Overlap can also be determined by the percentage catch of the IATTC derived from within and around the CCZ (van der Grient and Drazen, 2021) (Figure 3). The spatial overlap of IATTC tuna catches in the CCZ varies between States. Mexico, for example, obtains 11-21% of their tuna in the mining areas, while Venezuela obtains between 5-10% of their tuna in mining areas. Nations that may not fish the most in the licensed mining areas may still derive a moderate proportion of their RFMO tuna catches from mining areas. For example, and depending on the zone of influence of mining, China may obtain between 8-17% of their tuna in the mining areas, while Belize and Nicaragua can obtain up to 11% of their tuna catches from

mining areas in the 200-km zone. This overlap will likely increase in the future given historic expansion of fishing but also as tunas and billfishes change their distribution in response to climate change (Coulter et al. 2020; Bell et al. 2021; Amon et al. in review).

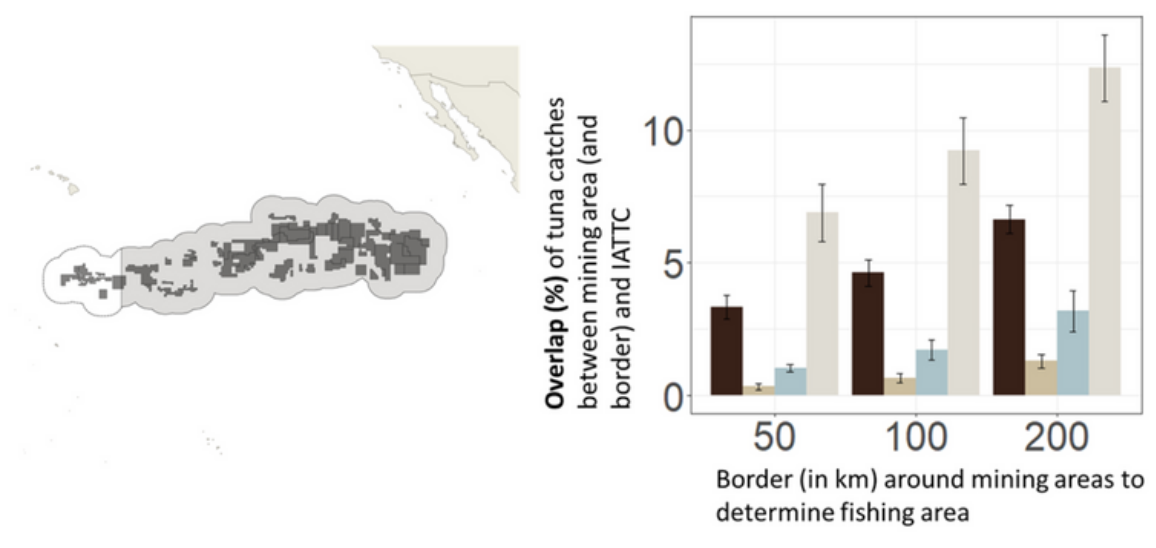

Figure 3. Left: The overlap between the IATTC and the exploration contract areas issued by the ISA (dark grey) surrounded by a 200-km buffer zone (light grey within a black outline). Right: Average annual proportion (over 2005-2015) of total tuna catch (black), bigeye tuna (brown), skipjack tuna (blue) and yellowfin (beige) catches from the IATTC derived from the mining contract areas and zones around these areas. Error bars represent one standard error.

The interactions with tuna fisheries will be mostly influenced by the depth of the release of discharge. That is, the shallower the release depth, the greater the chance that sediment and toxic metals will enter food webs and affect commercially important species (Figure 2). The mesopelagic zone (200-1000 meters depth) hosts many diurnal vertical migrators, which are important prey species for deep-diving tuna (e.g., bigeye tuna) (Musyl et al., 2003; Dagorn et al., 2000; Young et al., 2010; Josse et al., 1998; Sutton 2013; Drazen et al., 2020; Perelman et al., 2021).

Future challenges and considerations

S**cientific knowledge gaps:** There are critical unresolved questions about the deep sea and how it will be impacted by deep-sea mining. This includes mining technology, the depth of discharge, and cumulative or synergistic impacts between deep-sea mining, fisheries and climate change. These knowledge gaps greatly limit the effective management of this industry (Amon et al. 2022a).

The Mining Code is not yet finalized: Significant work is still needed to develop robust rules, regulations and procedures that encapsulate the Mining Code.

Fisheries excluded thus far from ISA negotiations: Fishing nations, industries, and/or RFMOs have not been adequately considered, engaged or consulted with by the ISA thus far.

Lack of holistic approach to ocean management: The fragmented patchwork of sectoral management bodies currently lack the capacity to embrace a holistic, cooperative and ecosystem-based approach to managing human activities, especially with regard to shifting stocks.

Unresolved equity issues: For example, mining by large developed States could lead to Small Island Developing States and other developing coastal States losing food security and income from tuna fisheries.

Seafood statement calling for a precautionary pause: Downstream users of fisheries are beginning to voice their concerns about deep-sea mining and the impact it may have on the quality and quantity of global seafood supply. The health and safety of seafood is of paramount importance to consumers, with levels of toxins (e.g., mercury, cadmium, lead) already closely monitored (Bosch et. al 2016). The possibility of deep-sea mining releasing large concentrations of heavy metals that may increase bioaccumulation of toxins in economically-important species has led seafood market groups to issue a statement calling for a precautionary pause on deep-sea mining until there is a clear understanding of the impacts the industry may have on the marine environment, its living resources, and those dependent on them. Signatories include seafood wholesalers, sustainable seafood NGOs, and large industry groups such as the Global Tuna Alliance, with more expected in the coming months.

Further information

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Appendix

State delegates from IATTC member countries and co-operating non-member countries who attended the 28th Council Session of the International Seabed Authority.

ISA Member States

- Belize
  - Not present
- Canada
  - Representatives
    - Mr. Patrice Laquerre, Deputy Director, Oceans Law, Oceans, Environment and Aerospace Law Division, Global Affairs Canada, Government of Canada (Head of Delegation)
    - Ms. Emina Tudakovic, High Commissioner of Canada in Jamaica and The Bahamas and Non-resident Consul General to the Turks and Caicos Islands and the Cayman Islands, High Commission of Canada in Jamaica
    - Mr. Daniel Hill, Senior Policy Adviser, International Affairs and Trade Division, Policy and Economics Branch, Lands and Minerals Sector, Natural Resources Canada
    - Mr. James Lauer, Director, Extractive Sector Transparency and Taxation Division, Explosives, Regulatory and Business Services Branch, Natural Resources Canada 4/23
    - Mr. Richard Vaughan, Policy Adviser, International Oceans Policy, Fisheries and Oceans Canada, Government of Canada
- Chile
  - Representatives
    - Sr. José Antonio Cabedo, Embajadora, Representante Permanente de Chile ante la Autoridad Internacional de los Fondos Marinos (Jefe de delegación)
    - Sra. Josefa Arce, Trecer Secretario, Embajada de Chile en Jamaica
    - Sr. Salvador Vega Telias, División de Medio Ambiente, Cambio Climático y Océanos, Ministerio de Relaciones Exteriores
    - Sra. Gloria Ramos, Abogada, Dirección General de Asuntos Jurídicos, Ministerio de Relaciones Exteriores
    - Sra. Valeria Chiappini, Abogada, Dirección General de Asuntos Jurídicos, Ministerio de Relaciones Exteriores
- China
  - Representative
    - Mr. Daojiang Chen
  - Deputy Representatives
    - Mr. Jingsheng Fan
    - Mr. Jun Jiang
    - Ms. Wenting ZHAO
- Costa Rica
  - Representatives
    - H.E. Sra. Georgina Guillén Grillo, Embajadora, Directora General de Política Exterior, Ministerio de Relaciones Exteriores y Culto (Jefe de delegación)
    - Sr. José David Sánchez Cedeño, Ministro Consejero, Embajada de Costa Rica en Jamaica
    - Sra. Mariamalia Jiménez Coto, Asesora, Departamento de Desarrollo Sostenible y Medio Ambiente, Dirección General de Política Exterior
- Ecuador
  - Not present
- European Union
  - Representatives
    - H.E. Ms. Marianne Van Steen, Ambassador, Permanent Representative of the European Union to Jamaica, Belize, The Bahamas, Turks and Caicos and the Cayman Islands to the International Seabed Authority (Head of delegation)
    - Mr. Piotr Byczkowski, Head of Political, Press and Information section, Delegation of the European Union to Jamaica, Belize, The Bahamas, Turks and Caicos and the Cayman Islands

Appendix

- France
  - Representatives
    - M. Olivier Guyonvarch, Ambassadeur, Représentant permanent de la France auprès de l'Autorité internationale des fonds marins (Chef de délégation)
    - Mme Caroline Krajka, Sous-directrice du droit de la mer, du droit fluvial et des pôles, Ministère de l'Europe et des Affaires étrangères
    - Mme Cécile Caron, Chargée de mission, sous-direction de la protection et de la gestion de l'eau, des ressources minérales et des écosystèmes aquatiques, ministère de la Transition écologique et de la Cohésion des territoires
    - M. Vincent Szleper, Adjoint à la sous-directrice, Sous-direction Écosystèmes littoraux et marins, Ministère de la Transition ècologique et de la Cohésion des territoires
- Guatemala
  - Not present
- Japan
  - Representative
    - H.E. Mr. Yasuhiro Atsumi, Permanent Representative of Japan to the International Seabed Authority, Ambassador Extraordinary and Plenipotentiary of Japan to Jamaica (Head of delegation)
  - Alternate Representatives
    - Mr. Masatoshi Sugiura, Director, Law of the Sea Division, International Legal Affairs Bureau, Ministry of Foreign Affairs
    - Ms. Fumie Maruyama, Deputy Director, Law of the Sea Division, International Legal Affairs Bureau, Ministry of Foreign Affairs
    - Mr. Ichiro Shimogaite, Deputy Director, Law of the Sea Division, International Legal Affairs Bureau, Ministry of Foreign Affairs
    - Ms. Ayaka Takahashi, Assistant Director, Law of the Sea Division, International Legal Affairs Bureau, Ministry of Foreign Affairs
    - Ms. Shoko Fujimoto, First Secretary, Embassy of Japan in Cambodia
    - Mr. Hirofumi Hariu, Deputy Director, Mineral and Natural Resources Division, Natural Resources and Fuel Department, Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry
    - Mr. Yusuke Kawahara, Chief, Mineral and Natural Resources Division, Natural Resources and Fuel Department, Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry
    - Mr. Ken Nakamura, Counsellor, Embassy of Japan in Jamaica
    - Ms. Noriko Oshima, First Secretary, Embassy of Japan in Jamaica
- Kiribati
  - Not present
- Mexico
  - Representatives
    - H.E. Mr. Juan José González Mijares, Embajador, Representante Permanente de México ante la Autoridad Internacional de los Fondos Marinos, Embajada de México en Jamaica (Jefe de la delegación)
    - Ms. Anais Aushadi Vivanco Gutiérrez, Directora de Derecho Internacional I, Secretaría de Relaciones Exteriores
    - Ms. Marcelino Miranda Aceves, Segundo Secretario, Representante Permanente Alterno de México ante la Autoridad Internacional de los Fondos Marinos, Embajada de México en Jamaica
    - Ms. Susana Lira Audelo, Tercer Secretario, Encargado de Asuntos Económicos-Comerciales y de Promoción y Asuntos Culturales, Embajada de México en Jamaica
- Nicaragua
  - Not present
- Panama
  - Representatives
    - Su Excelencia Lasford E. Douglas B., Embajador Extraordinario y Plenipotenciario de la República de Panamá ante el Gobierno de Jamaica (Jefe de la delegación)
    - Su Señoría Roger R. González M., Segundo Secretario de Carrera Diplomática y Consular, Embajada de Panamá en Jamaica (Jefe suplente de la delegación)

Appendix

- Republic of Korea
  - Representative
    - Mr. Kim Jin-wook, Permanent Representative of the Republic of Korea to the International Seabed Authority (Head of delegation)
  - Alternate Representatives
    - Ms. Kim Jung-Eun, Second Scretary, International Legal Affairs Division, Ministry of Foreign Affairs
    - Ms. Kim Jeeyoung, Third Secretary, Embassy of the Republic of Korea in Jamaica
    - Mr. Kim Sang Yeob, Senior Researcher, Embassy of the Republic of Korea in Jamaica
- Vanuatu
  - Representatives
    - H.E. Mr. Odo Tevi, Ambassador, Permanent Representative of Vanuatu to the United Nations, New York
    - Mr. Sylvain Kalsakau, Head, United Nations Division, Department of Foreign Affairs and International Cooperation, Ministry of Foreign Affairs, International Cooperation and External Trade
    - Mr. Sanlan William, Deputy Permanent Representative, Permanent Mission of Vanuatu to the United Nations, New York
    - Ms. Majorie Wells, Desk Officer, Treaties and Convention Division, Department of Foreign Affairs and International Cooperation
    - Mr. Siddharth Shekhar Yadav, Adviser to the Ambassador on Climate and Ocean Affairs, Permanent Mission of Vanuatu to the United Nations

ISA Observer States

- Colombia
  - Not present
- El Salvador
  - Not present
- Peru
  - Not present
- United States
  - Representatives
    - Mr. Gregory O'Brien, Senior Oceans Policy Adviser, Office of Ocean and Polar Affairs, Bureau of Oceans and International Environmental and Scientific Affairs, U.S. Department of State (Head of delegation)
    - Mr. James Gresser, Attorney-Adviser, Office of the Legal Adviser, U.S. Department of State (Alternate Head of delegation)
    - Ms. Amy Gartman, Research Oceanographer, Pacific Coastal and Marine Science Center, United States Geological Survey, U.S. Department of Interior
    - Mr. Paul Knorr, Critical Minerals Geologist, Office of Strategic Resources, Marine Minerals Division, Bureau of Ocean Energy Management, U.S. Department of the Interior
    - Ms. Iris Lowery, Attorney-Adviser, Office of General Counsel, International Section, National Oceanic and Atmospheric Administration, U.S. Department of Commerce
    - Ms. Kira Mizell, Research Oceanographer, Office of Global Marine Minerals, Pacific Coastal and Marine Science Center, U.S. Geological Survey, U.S. Department of the Interior
    - Ms. Laura Strickler, International Affairs Officer, Office of Strategic Policy and International Affairs, Bureau of Ocean Energy Management, U.S. Department of the Interior
    - Ms. Ellen Ward, International Affairs Specialist, Office of International Affairs, National Oceanic and Atmospheric Administration, U.S. Department of Commerce
    - Ms. Nicole Weber, Counselor for Political and Economic Affairs, Political and Economic Section, United States Embassy Kingston, U.S. Department of State
    - Mr. Joe James, Economic/Commercial Officer, Political and Economic Section, United States Embassy Kingston, U.S. Department of State
- Venezuela
  - Not present