DEEP DIVE

One year of Deep Dive – an immersive journey into the multidisciplinary knowledge of the deep sea

December 2024

Contents

Abbreviations

the Area	seabed and ocean floor, and their subsoil, beyond the limits of national jurisdiction
1994 Agreement	Agreement on the Implementation of Part XI of UNCLOS
ADSEA	African Academy for Deep Sea Diplomacy
CTP	Contractor Training Programme
EIA	environmental impact assessment
ISA	International Seabed Authority
UNCLOS	United Nations Convention on the Law of the Sea

Executive summary

In July 2023, the International Seabed Authority (ISA) launched Deep Dive, a groundbreaking e-learning platform. This innovative initiative aims to educate and empower individuals worldwide about the legal, scientific and technical aspects of deep-sea mining.

Deep Dive addresses a critical need for comprehensive knowledge and skills in deep-sea mining. By providing accessible and engaging learning materials, the platform seeks to enhance deep-sea literacy, promote awareness of environmental and economic implications, support research and innovation in marine science and technology and foster engagement among stakeholders.

Deep Dive offers a modular structure with three progressive levels: Dive 1 introduces foundational concepts of United Nations Convention on the Law of the Sea and the governance of the Area, Dive 2 delves deeper into marine mineral resources, marine scientific research and the work of ISA and Dive 3 provides an advanced overview of the legal, scientific and technological aspects of deep-sea mining. Each Dive consists of mandatory and elective lessons, allowing participants to tailor their learning experience.

The platform features video lectures from renowned experts, interactive tools for engagement and a flexible online format for convenient learning. Deep Dive fosters a global community of learners, enabling knowledge-sharing and networking.

Since its launch, Deep Dive has achieved significant milestones, including training over 130 participants from 47 countries, achieving an 80 per cent certification rate, encouraging diverse participation and forming strategic partnerships.

ISA is committed to further developing Deep Dive to meet the evolving needs of deep-sea mining. Plans include expanding the curriculum, improving the platform, seeking accreditation and strengthening partnerships.

Deep Dive is a powerful tool for capacity-building and education in the field of deep-sea mining. By empowering individuals with the knowledge and skills they need, Deep Dive is helping to shape a sustainable future for the ocean.

The annexes provide specific details on the lectures, lecturers and partners of Deep Dive.

I. Introduction

Deep Dive is the first e-learning platform developed by the International Seabed Authority (ISA) to expand participants' understanding of the legal, scientific and technical aspects of Part XI of the United Nations Convention on the Law of the Sea (UNCLOS) and the 1994 Agreement on the Implementation of Part XI of UNCLOS (1994 Agreement). Through engaging resources, expert insights and interactive tools, Deep Dive equips learners, researchers and ocean enthusiasts with the knowledge to explore, protect and sustainably manage the mineral resources of the seabed and ocean floor, and their subsoil, beyond the limits of national jurisdiction (the Area).

A flagship initiative under the ISA Capacity Development Strategy, Deep Dive was launched in July 2023 with the objective of enhancing deep-sea literacy, promoting awareness, increasing scientific knowledge, fostering engagement and supporting research in the field of activities in the Area. This capacity-building initiative targets ISA Member States, researchers and academics, policymakers and regulators, as well as the general public.

II. Programme overview

Deep Dive programme structure

Sixty internationally renowned experts contributed to Deep Dive for approximately 20 hours of video lectures. The Deep Dive online curriculum consists of a modular structure with three progressive levels (Dives 1, 2 and 3), each comprised of modules offering a mix of compulsory and elective lessons to ensure the successful transfer of foundational knowledge and a degree of flexibility to accommodate personal preferences. Divers are required to progress through a minimum of five mandatory lessons in each module. Each Diver is also requested to choose four elective lessons from the available options (Figure 1).

Dive 1 focuses on Module 1, laying the foundational principles of ocean governance introduces participants to UNCLOS and its role in the governance of the deep seabed. It covers the legal framework, rights and responsibilities associated with the use and protection of marine resources in the Area, providing a necessary base for further studies.

Dive 2 combines Module 1 with two additional modules to provide an intermediate understanding. Module 2 on marine mineral resources of the Area addresses the mineral wealth of the Area, exploring the types of resources found beneath the seabed, their economic potential and the processes used to access them. Emphasis is placed on the strategic importance of marine mineral resources and the environmental considerations that accompany their extraction. Module 3 on marine scientific research highlights the tools and techniques used in marine scientific research, including state-of-the-art equipment and methodologies for exploring and analyzing the oceanic environment. Participants will learn about the challenges and advancements in studying marine ecosystems and their relevance to global environmental health.

Dive 3 encompasses all five modules, offering a comprehensive dive into every aspect of ocean governance, resources and technology. Module 4 on the protection of the marine environment focuses on preserving the ocean's biodiversity and ecological balance. Topics include the impact of human activity on marine life, conservation strategies and international agreements aimed at safeguarding marine ecosystems for future generations. Finally, Module 5 on technology development provides insights into the technological innovations driving ocean exploration and monitoring. From autonomous underwater vehicles to advanced data-gathering tools, participants will gain an understanding of the role technology plays in sustainable resource management and environmental protection.

Figure 1. Deep Dive programme structure

In-person meetings between the experts and Divers further enhance the Deep Dive experience. These meetings also create a platform for Divers to provide feedback and share insights on trends and challenges in their subject areas with experts. This continuous dialogue has generated valuable insights into the changing needs of students, allowing the programme to adjust its content and delivery methods accordingly. Overall, these collaborative meetings have cultivated a dynamic learning environment, boosting student engagement and ensuring the programme remains relevant and effective in preparing graduates for successful careers. A complete list of lectures and experts is available in Annexes I and II to this information note.

Deep Dive has partnered with experts, bringing a diverse and extensive range of technical expertise, ensuring that learners receive cutting-edge insights and practical knowledge. This multidisciplinary team of experts and partners comprises maritime law experts, diplomats or government policy advisers, environmental policy analysts, marine geologists, economists and mineralogists. Their expertise spans multiple industries, including marine science, metals oil, government, deep-sea mining and oceanography, allowing them to provide specialized insights that bridge theory and practice. This breadth of technical know-how ensures that participants not only gain a strong foundation in the fundamentals but also learn the latest trends, tools and best practices in automation and control systems, positioning them to thrive in a rapidly evolving technological landscape. Annex III provides a full list of our partners.

Programme objectives

Through its comprehensive and diversified programme, Deep Dive seeks to

a) educate by providing comprehensive information on the regime applicable to the Area and its resources, as well as the role of ISA in the regulation and management of such resources

b) promote awareness by focusing on the importance of the global governance of the mineral resources of the Area and the role and responsibility entrusted to ISA under UNCLOS and the 1994 Agreement to this end
c) foster engagement by encouraging public interest, stakeholder involvement and informed decision-making in the responsible management of deep-seabed resources
d) support research by serving as a training hub for researchers and governments, offering access to self-paced studies and expert analysis on seabed minerals and deep-sea ecosystems.

III. Cohort statistics to date

Enrolment statistics

Two months before the start of each cohort, the ISA Secretariat issues a call for applications and advertises it through ISA communications channels. Since its launch, Deep Dive has enrolled four cohorts of students for a total of 133 Divers.

ISA contractors are legally required to provide and fund training for personnel from developing States ISA (UNCLOS, Article VII). This requirement to equip personnel from these States with the necessary operational skills for deep-seabed mining is included in standard contract terms. Deep Dive also received sponsorship from ISA contractors.

Applications for enrolment are received under general admissions and sponsorship from the Contractor Training Programme (CTP). Table 1 shows Deep Dive attracted considerable interest from the public.

Table 1. Deep Dive application overview by cohort and CTP sponsorship

Cohort	**Application period**	**Applications received**	**Period**	**Divers enrolled**	**CTP enrollments**
I	10 August-17 September 2023	83	October-December 2023	23	3
II	1 November- 10 December 2024	56	January-March 2024	30	6
III	12 March-15 April 2024	74	May-July 2024	28	8
IV	17 June-13 July 2024	84	September-November 2024	35	n/a
Total		**297**		**133**	**17**

Sponsorships for cohorts I, II and III were received by the following contractors

- Marawa Research and Exploration Ltd.: three Divers sponsored for Dive 1 and three for Dive 3
- Cook Islands Investment Corporation: two Divers sponsored for Dive 1
- German Federal Institute for Geosciences and Natural Resources of the Federal Republic of Germany: one Diver sponsored for Dive 1 and three for Dive 3

- The Ministry of Oceans and Fisheries of the Republic of Korea: four Divers sponsored for Dive 3.

Figures 1 to 5 below show statistics of cohorts I to IV and include the comparison of the applications received for cohorts I – IV, the regions represented, the male-to-female ratio and the certified Divers.

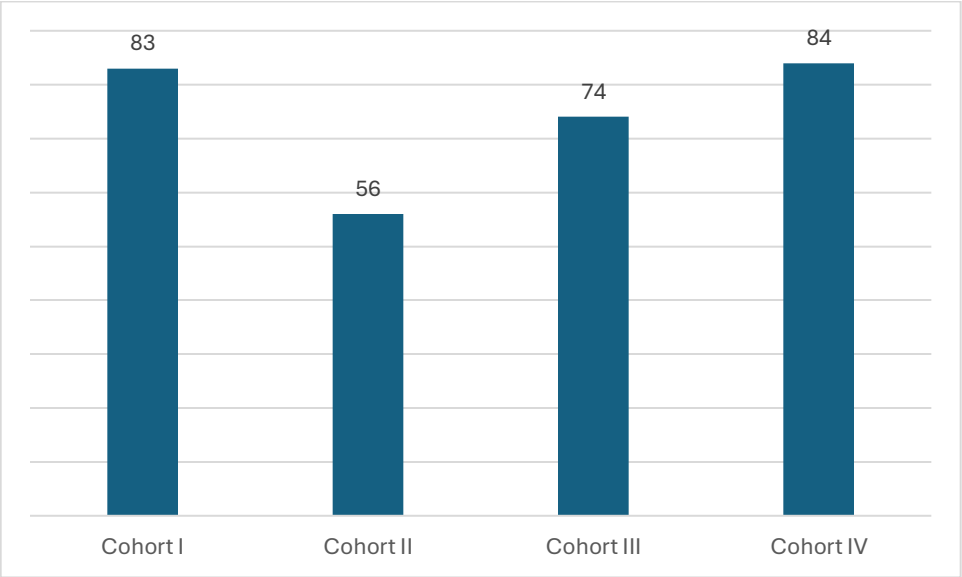


Figure 2. Applications received for Deep Dive cohorts I to IV

Only Dive 1 was available for cohort I. Dives 1 and 2 were available for cohort II. Dives 1, 2 and 3 were made available from cohort III to date. Figure 3 shows the number of Divers enrolled for cohorts I to IV.

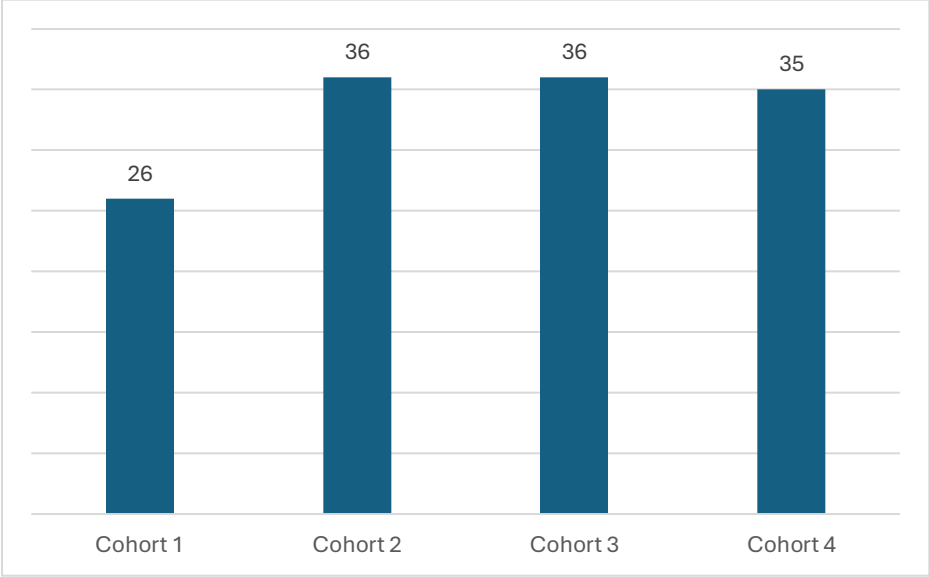


Figure 3. Enrolment in Deep Dive cohorts I-IV

Cohorts I to III included enrolment derived from sponsorships from CTP (Figure 4).

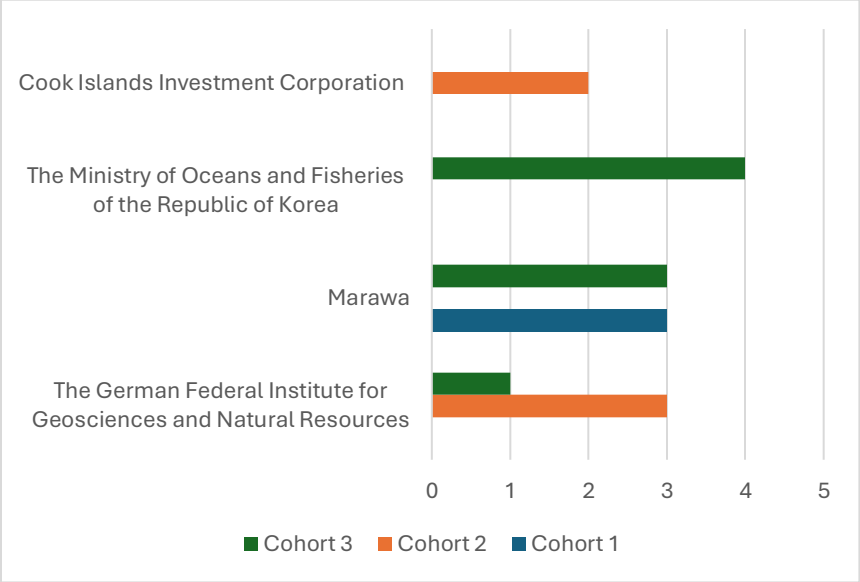


Figure 4. CTP sponsorship for Deep Dive cohorts I-IV

In cohorts I-IV, 47 countries were represented (Figure 5).

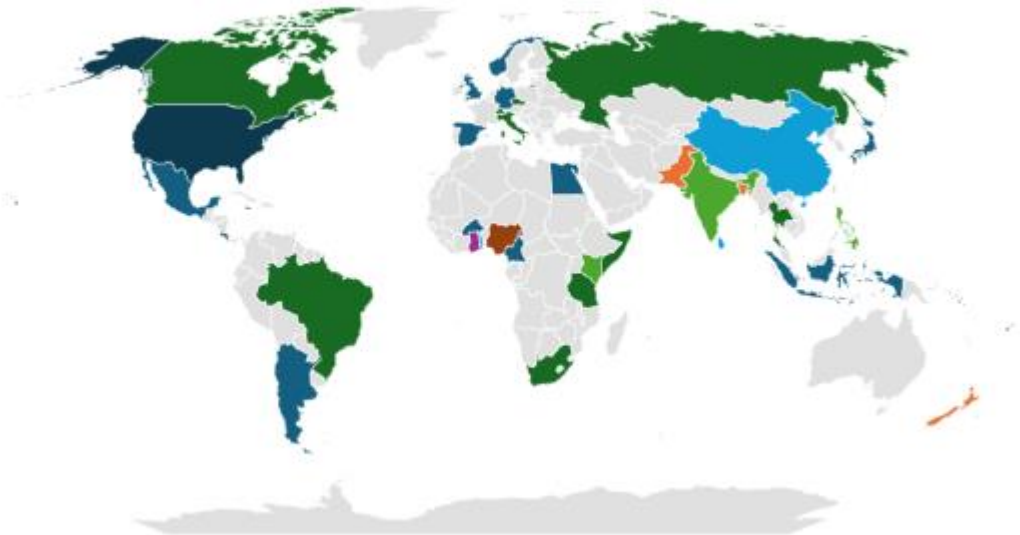


Figure 5. Country representation in Deep Dive cohorts I-IV

As to the regional groups, the highest number of Divers come from the Asia-Pacific group.

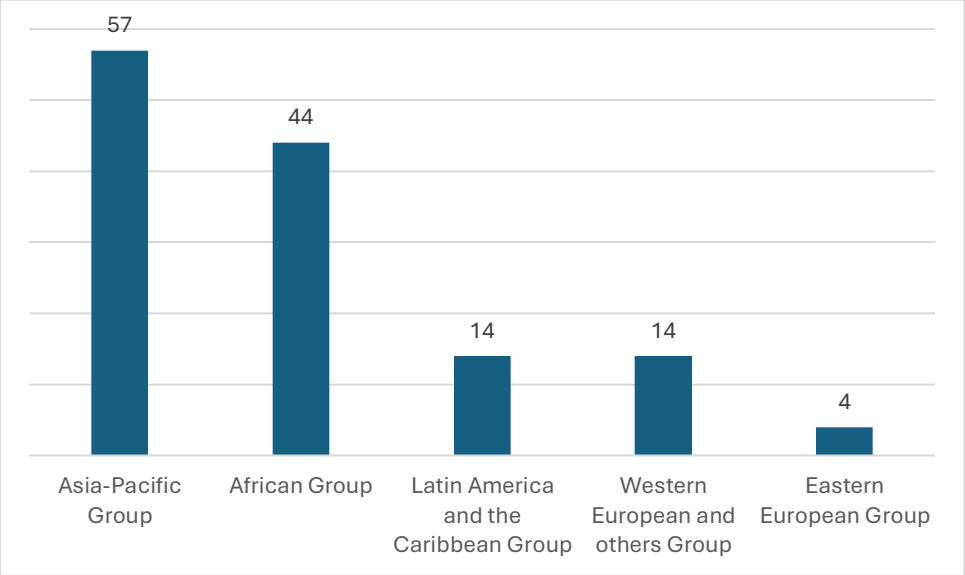


Figure 6. Regional group representation in Deep Dive cohorts I-IV

In pursuing its efforts to ensure the full participation of special interest groups from the landlocked developing countries, least developed countries and Big Ocean States, Deep Dive has been made available to 38 from these categories (Figure 7).

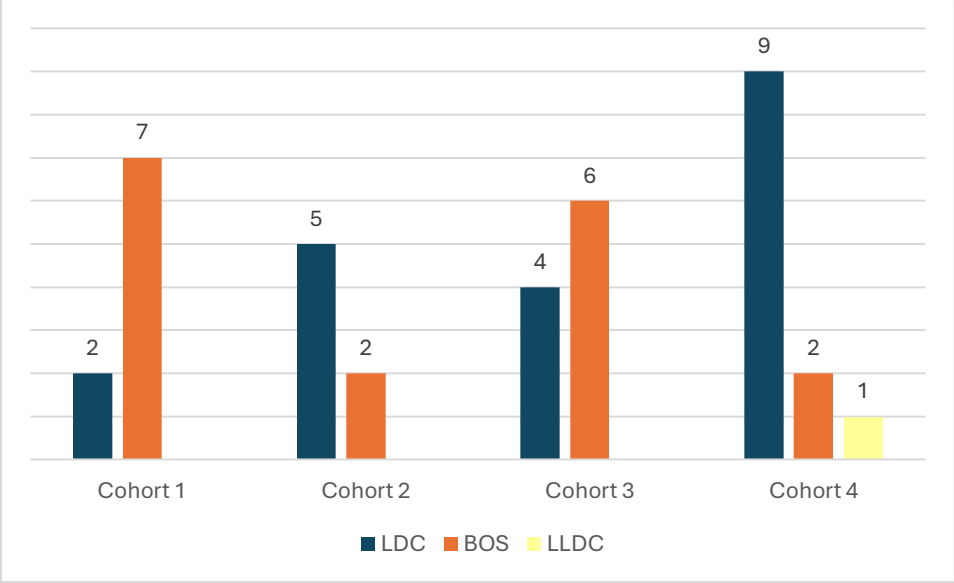


Figure 7. Special interest group representation in Deep Dive cohorts I-IV

ISA is committed to advancing women's empowerment and leadership in marine scientific research. Deep Dive is dedicated to fostering inclusivity by actively encouraging and supporting the participation of women in marine science. This commitment to inclusion not only empowers women to excel in marine science but also enriches the field with a wider range of perspectives and innovations essential for addressing today's environmental challenges (Figure 8).

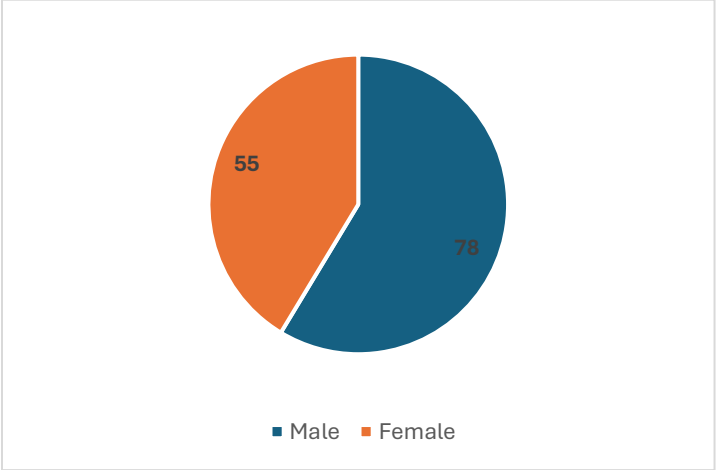


Figure 8. Cumulative gender representation in Deep Dive cohorts I-IV

Figure 9 shows a further breakdown of the gender representation for each cohort.

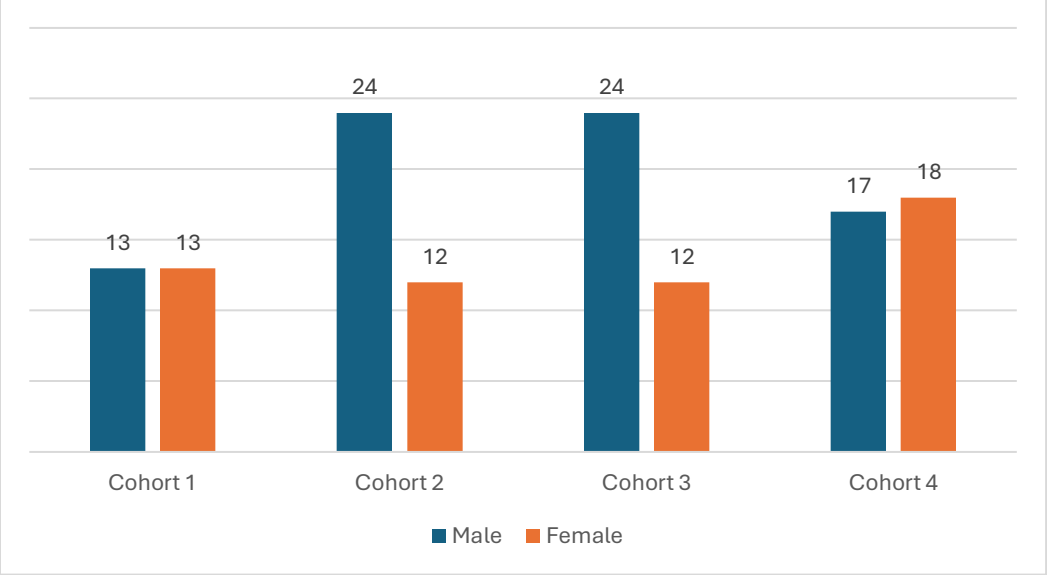


Figure 9. Individual gender representation in each Deep Dive Cohort

IV. Completion statistics

Divers are awarded a certificate upon completing all required lessons and electives in their Dive. Each lesson and elective include quizzes, culminating in a final quiz for the module, where participants must achieve a passing mark of 80 per cent or higher. To receive the certificate, Divers must achieve a passing mark of 80 per cent. The overall passing rate across cohorts is 80 per cent or 80 of 98 participants. Cohort 1 had the highest certification rate, with 80 per cent of Divers becoming certified. Cohorts 2 and 3 had slightly lower rates at 78 per cent and 89 per cent, respectively (Figure 10).

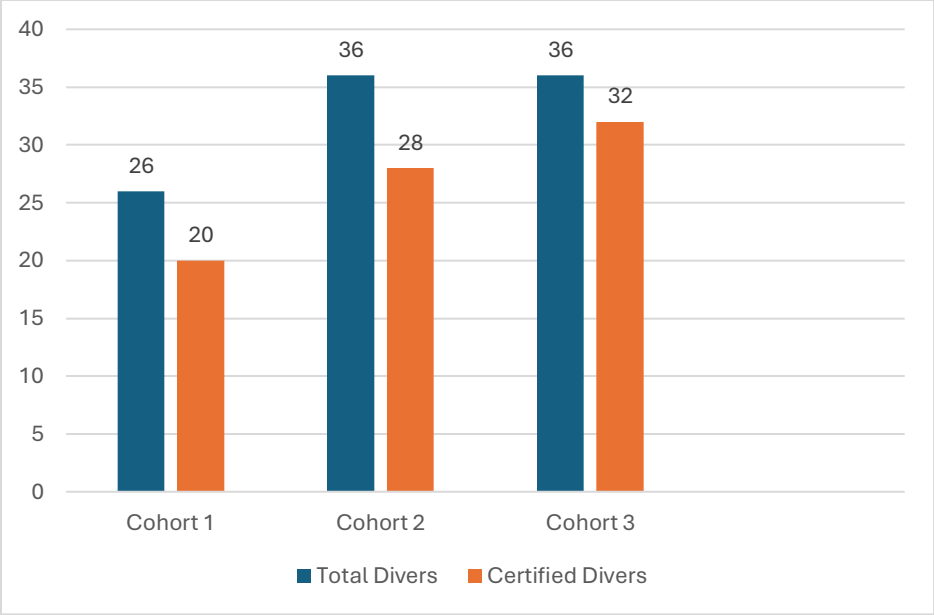


Figure 10. Certification rates in Deep Dive cohorts I-IV

V. Divers overall ratings of the programme

To gather feedback on the Deep Dive experience, Divers are required to complete a post-training survey at the end of their Dive. The survey included questions regarding the content, platform and their perceptions on recommending the programme. The certified Divers completed the final survey and responded to the questions relating to

a) the content meeting their knowledge level
b) the content meeting their interest
c) the knowledge from the training being easily applied to their personal or professional lives
d) if they would recommend the training to other people.

Divers reported positive feedback regarding the content, platform and overall quality of the Deep Dive. Applying the knowledge gained and willingness to recommend the programme to others were rated particularly high (Figures 11-14).

Figure 11 shows the percentage of certified Divers who reported that the content of the training met their level of knowledge. Cohort 3 had the highest rating at 83 per cent, followed by cohort 1 at 80 per cent and cohort 2 at 67 per cent.

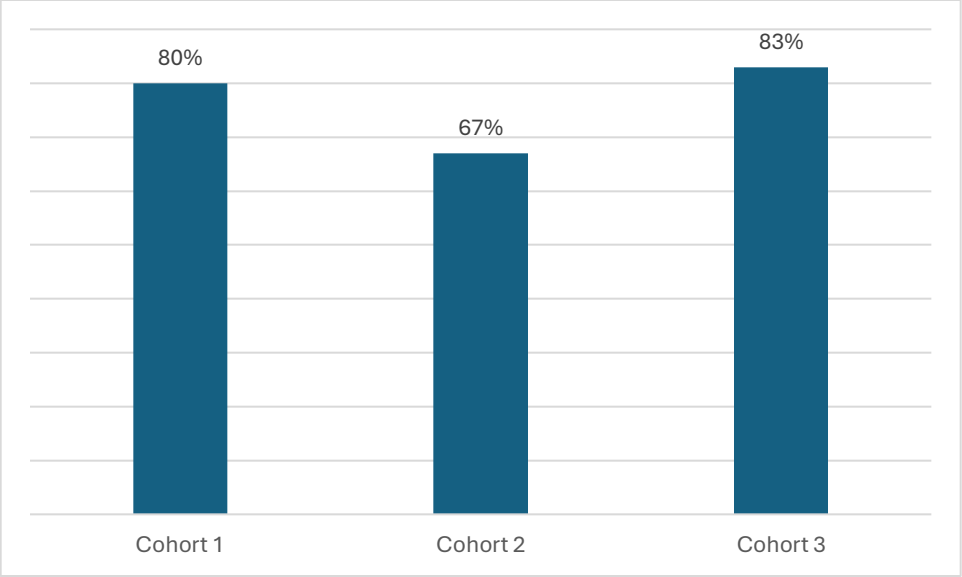


Figure 11. The contents of the lectures are easily accessible for my level of knowledge

Figure 12 shows the percentage of certified Divers who reported that the content of the training met their interests. Cohort 3 had the highest rating at 89 per cent, followed by cohort 1 at 75 per cent and cohort 2 at 67 per cent.

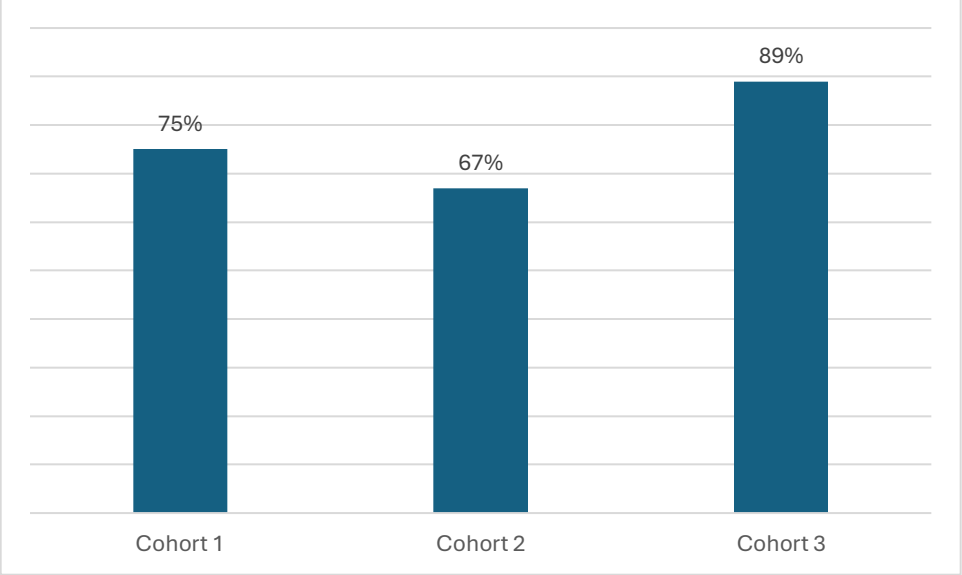


Figure 12. The choice of electives is broad, and they cover the topics I am interested in

Figure 13 shows the percentage of certified Divers who reported being able to apply the knowledge gained from the training to their personal or professional lives. Cohorts 1 and 3 had the highest application rates at 100 per cent, while cohort 2 reported a rate of 93 per cent.

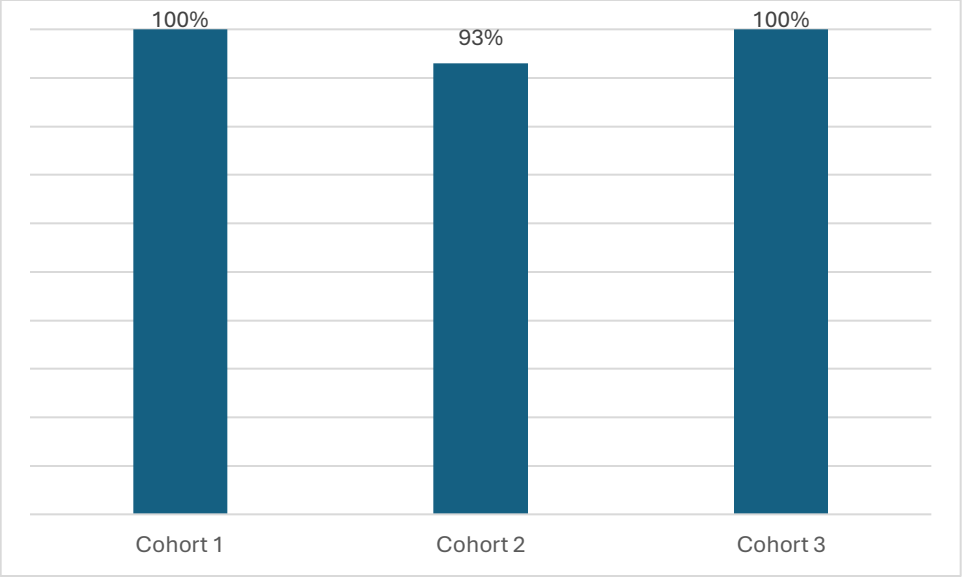


Figure 13. The information learned can be easily applied or used in my working/studying area

Figure 14 shows the percentage of certified Divers who would recommend the training to others. Cohorts 1 and 3 had the highest recommendation rates at 100 per cent, while cohort 2 reported a rate of 93 per cent.

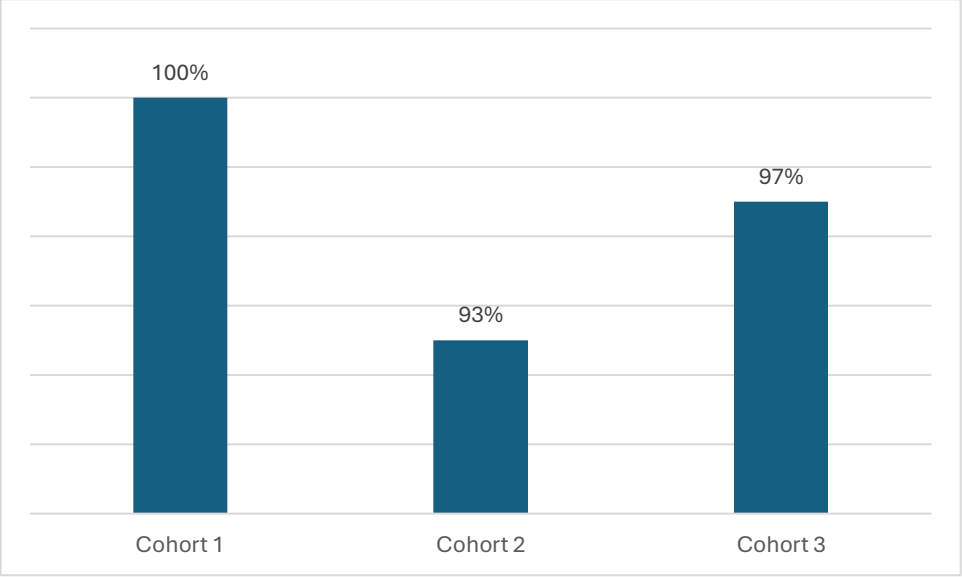


Figure 14. I would recommend Deep Dive to others

VI. Achievements to date

As ISA's only e-learning platform, Deep Dive is essential for training and capacity development as it provides flexible, accessible and scalable learning opportunities that can reach a global audience. It allows learners from diverse geographic locations to participate without the need for travel, reducing both time and financial barriers. As an e-learning platform, Deep Dive also supports a variety of learning styles through multimedia content, interactive modules and live or recorded sessions, making complex concepts more accessible. The online format also allows real-time updates to the materials to reflect the latest

industry standards and innovations, ensuring that participants gain relevant and current skills. This approach fosters a collaborative, inclusive learning environment that is crucial for building skills and expertise in a rapidly evolving world.

The Deep Dive programme has experienced notable success since its launch in July 2023, with a significant increase in interest and a growing number of applications from professionals eager to advance their skills in automation, control systems and related technologies. The Deep Dive programme has also seen a marked increase in the rate of certification attainment and successful course completions, reflecting the growing commitment and engagement of participants. To date, the Deep Dive programme has trained 133 Divers, including 28 women, representing 47 countries and has made a significant contribution to capacity development across 36 nations. Positive student feedback and testimonials have strengthened its reputation and allowed the Deep Dive to remain relevant. It has also enhanced the way that the programme feeds into other capacity development initiatives, as it supports the theoretical side of ISA's training offerings.

These accomplishments have been achieved within less than two years of operations, underscoring the sustainability and positive impact of Deep Dive (Figure 15).

DEEP DIVE

Timeline of achievements

1

July 2023 - Deep Dive launch

ISA launched the first ever online training programme exclusively devised to address all elements of the legal regime in Part XI of the UNCLOS and the 1994 Agreement, including technical and scientific aspects.

Oct 2023 - First Cohort

2

Deep Dive admitted the first cohort which included three enrolled from the CTP.

3

January 2024 -Modules expanded

Deep Dive includes modules 2 and 4 for January 2024 and modules 3 and 5 February 2024. The participants under the CTP are the first to take all three Dives.

New cohorts - new lessons

4

New experts joined modules 3 and 5 during the new modules.

5

July 2024 - Special Dives

Deep Dive expanded to include partnerships with the ISA-Egypt Joint Training and Research Centre and the International Relations Institute of Cameroon.

2024 - 2025 upcoming partnership

6

Stayed tuned for exciting new partnership, to deliver to deliver diplomatic courses for African diplomats in both English and French.

Figure 15. Deep Dive timeline

Deep Dive has made a valuable stride in partnering with research centres to expand the reach of the content and augment the content through more experts. Since launching Dive 1 in 2023 with just seven lessons and seven electives, Deep Dive has grown significantly, now offering a comprehensive five-module programme with a total of 30 lessons and 33 electives. Our network of experts is a key factor in this success, helping us expand our offerings and enhancing the relevance of Deep Dive.

The expansion of Deep Dive lectures marks a significant achievement, enhancing the overall educational experience for students. By increasing the number and diversity of available lectures, the Deep Dive can cater to a broader range of learning styles and preferences, ensuring that students have access to varied content that aligns with their interests and academic needs. This expansion not only enriches the curriculum but also fosters a more inclusive learning environment, allowing learners from different backgrounds and with different schedules to engage with the material at their own pace. This development reflects Deep Dive's commitment to continuous improvement and its dedication to delivering high-quality education in a flexible and accessible format.

In June 2023, the ISA Partnership Fund approved the development of a specialized training course on environmental impact assessment (EIA) for officials and scientists from ISA Member States involved in deep-sea activities. This course was part of ISA's efforts to fulfil its responsibilities under Article 145 of the UNCLOS to protect the marine environment from harmful impacts arising from activities in the Area. Deep Dive successfully tailored its lessons and electives to be seamlessly integrated into the EIA training course, showcasing Deep Dive's commitment to enhancing knowledge in this critical field.

Deep Dive has partnered with an African Academy for Deep Sea Diplomacy (ADSEA) in a memorandum of understanding signed in January 2024 between ISA and the International Relations Institute of Cameroon. This collaboration focuses on training activities related to UNCLOS and the 1994 Agreement, fostering cooperation with African States on ISA's mandate. ADSEA will provide blended training to diplomats from both English and French-speaking African countries, emphasizing the regime of the Area under Part XI of UNCLOS.

Deep Dive tailored its lessons and electives to develop an online course that will complement the face-to-face component of ADSEA. Similar to the EIA training, ADSEA participants will complete the e-learning segment of Deep Dive and then follow a two-week face-to-face segment in Cameroon. The training is set to commence soon, pending final arrangements.

Deep Dive has worked on improvements since cohort I to ensure that the Divers have a seamless transition through the modules. The coding improved and better transitioning is achieved with system updates, better data archiving and add-ons, which allow for better monitoring of Divers.

VII. Plans and next steps

Deep Dive is making progress towards accreditation. Accreditation will boost Deep Dive's credibility, ensuring quality and industry relevance. This would enhance employability for students and attract a diverse audience. It would also open access to funding and partnerships, supporting higher content quality and instructional resources, resulting in a more impactful learning experience.

Currently, the ISA Secretariat is working on additional lectures to enrich modules 1 and 4 on the contribution of ISA to the 2023 Agreement on the conservation of marine biological diversity of areas

beyond national jurisdiction, the interplay between future exploitation mining activities and fisheries and the relevance of the Kunming-Montreal global biodiversity framework for the activities in the Area.

Plans are also in place to improve the reporting evaluation of the programme's success. There will be tracer studies to improve the empirical reporting and find out how the knowledge gained from Deep Dive is being used.

VIII. Conclusion

The Deep Dive has achieved remarkable success since its inception, demonstrating its value as an educational platform and capacity development initiative. The steady increase in applications and certifications across all cohorts underscores the growing demand and the Deep Dive's ability to meet diverse educational needs. Deep Dive has trained 133 participants from 47 countries, contributing significantly to capacity development, especially in the fields of marine science and seabed resource management. Its impact is further highlighted by the successful engagement of special interest groups and women in marine science, with 28 women certified to date.

A key driver of Deep Dive's success is its student engagement model and constant monitoring and evaluation. This includes cohort-based interactions between Divers and experts. These interactions not only enhance learning but also provide valuable insights, making the content more applicable to real-world scenarios. The positive feedback and high levels of satisfaction of Divers, as well as the willingness to recommend the programme, further reflect its success.

The expansion of lectures and partnerships, such as those with the ISA-Egypt Joint Training and Research Centre and the International Relations Institute of Cameroon, has broadened the scope and reach of Deep Dive. These initiatives demonstrate its capacity to evolve and adapt, making it a sustainable and scalable model for future growth.

Technological improvements and the Deep Dive's progress towards accreditation indicate its readiness for the next phase of development. Deep Dive will further enhance its offerings, expand its reach and continue to make a significant impact in enhancing the knowledge of the Area and its resources as well as the ISA role and mandate.

Tables and figures

Annex I. Deep Dive experts and lecturers

H. E. Mr. Michael W. Lodge, International Seabed Authority

Dr. Marie Bourrel-McKinnon, International Seabed Authority

Lea Kolmos, International Seabed Authority

David Pusztai, International Seabed Authority

Eden Charles, International Seabed Authority

Dr. Luciana Genio, International Seabed Authority

Mariana Durney, International Seabed Authority

Dr. Ulrich Schwarz-Schampera, International Seabed Authority

Dr. Wanfei Qui, International Seabed Authority

Dr. Noémie Wouters, International Seabed Authority

Dr. Ann Vanreusel, Ghent University, Marine Biological Resources Core Facility

Prof. Aldo Chircop, Dalhousie University¸ Schulich School of Law

Prof. Atsuko Kanehara, Sophia University, Faculty of Law

Dr. Ellen Pape, Ghent University, Marine Biology

Dr. Kirsty McQuaid, University of Plymouth, School of Biological and Marine Sciences

Prof. Dale Squires, University of California San Diego, School of Global Policy and Strategy

Prof. Pedro Madureira, University of Évora, Portugal

Prof. Rüdiger Wolfrum, Heidelberg University, Germany

Prof. Saleem Ali, University of Delaware, Blue and Gold Distinguished Professor of Energy and the Environment

Prof. Warwick Gullett, University of Wollongong, School of Law, Australia

Akira Usui, Japan Organization for Metals and Energy Security

Alden Denny, ADEPTH Minerals

Anna Lim, Agreo

Annemiek Vink, German Federal Institute for Geosciences and Natural Resources

Berit Floor Lund, Kongsberg Digital As

Birte Timm, HF Offshore

Carsten Rühlemann, German Federal Institute for Geosciences and Natural Resources

Daniel Jones, National Oceanography Centre, United Kingdom

Elie Jarmache, French Research Institute for Exploitation of the Sea

Georgy Cherkashov, The All-Russia Scientific Research Institute for Geology and Mineral Resources of the Ocean

Gianni Scherl, Fincantieri

Harald Brekke, German Federal Institute for Geosciences and Natural Resources

Johan Heiler, Global Sea Mineral Resources

John Parianos, Cook Islands Seabed Minerals Authority

Joshua T. Tuhumwire, Gondwana Geoscience Consulting Ltd.

Katsunori Fujikura, Japan Agency for Marine-Earth Science and Technology

Kira Mizell, United States Geological Survey, Pacific Coastal and Marine Science Center

Kris De Bruyne, Global Sea Mineral Resources, Belgium

Leonhard Weixler, BAUER Group

Malcolm Clark, National Institute of Water and Atmospheric Research, New Zealand

Martin Sobczyk, Technische Universität Bergakademie, Germany

Sir Michael Wood, Twenty Essex, United Kingdom

Michelle Walker, Ministry of Foreign Affairs, Jamaica

Nobuyuki Okamoto, Japan Oil, Gas and Metals National Corporation

Samuel Popoola, Nigerian Institute for Oceanography and Marine Research

Sven Petersen, GEOMAR Helmholtz Centre for Ocean Research, Germany

Dr. Tara Davenport, National University of Singapore, Asia-Pacific Centre for Environmental Law

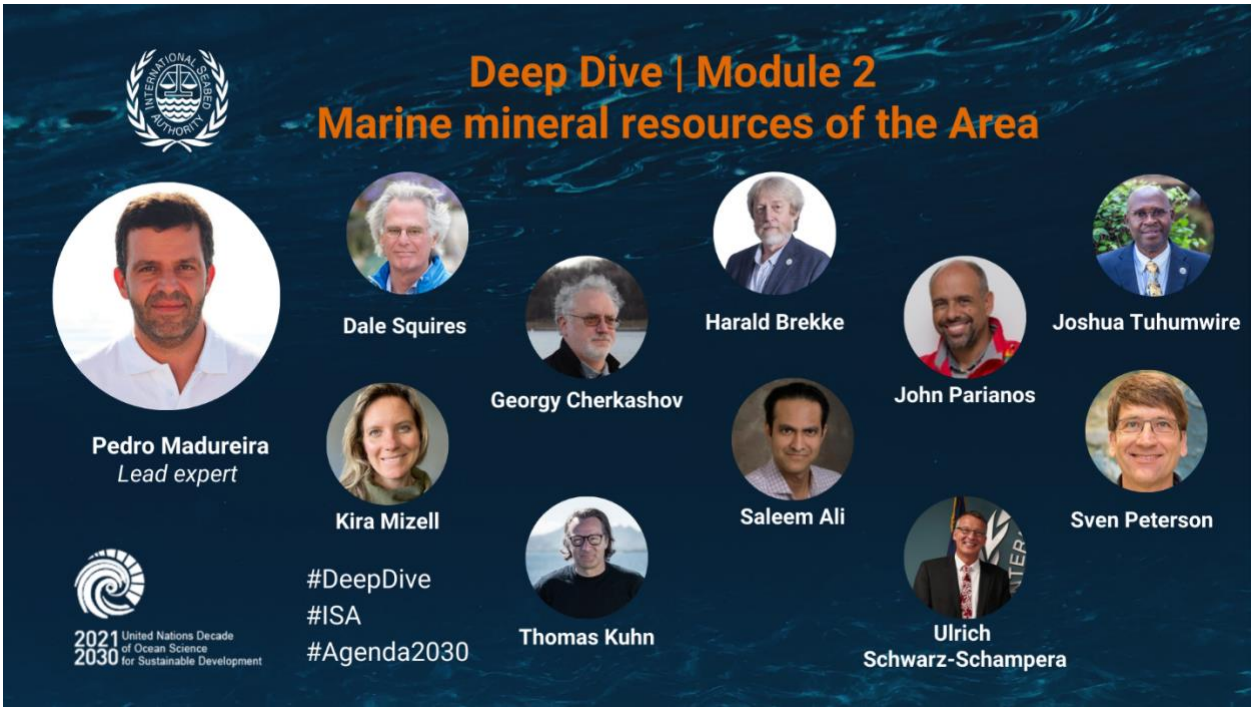
Thomas Kuhn, Federal Institute for Geosciences and Natural Resources

Tomohiko Fukushima, Japan Agency for Marine-Earth Sciences and Technology

Annex II. Deep Dive lectures and electives

Module 1: UNCLOS and the governance of the Area		
Lesson 1	Introduction to Part XI of UNCLOS and the 1994 Agreement	H.E. Mr. Michael W Lodge
Lesson 2	The Area: legal and scientific perspectives	H.E. Mr. Michael W. Lodge Dr. Ulrich Schwarz-Schampera
Lesson 3	ISA: role, functions and structure	Sir Michael Wood
Lesson 4	The Mining Code	Ms. Michelle Walker
Lesson 5	Responsibilities and obligations of sponsoring States	Prof. Rüdiger Wolfrum
Lesson 6	The Enterprise	Mr. Eden Charles
Lesson 7	Equitable sharing of benefits from activities in the Area	H.E. Mr. Michael W. Lodge
Electives		

Elective 1	Landlocked developing countries, least developed countries and Big Ocean States and UNCLOS and the sustainable development of ocean-based economies	Dr. Marie Bourrel-McKinnon
Elective 2	Deep-seabed mining and submarine cables	Dr. Tara Davenport
Elective 3	Implementation of Article 82 of UNCLOS: challenges and opportunities	Prof. Aldo Chircop
Elective 4	The common heritage of humankind: a historical concept for the development of Part XI and the 1994 Agreement	Mr. Elie Jarmache
Elective 5	Process for making an application for a plan of work for exploration	Dr. Ulrich Schwarz-Schampera
Elective 6	Settlement of disputes under Part XI	Ms. Mariana Durney
Elective 7	Due regard	Prof. Warwick Gullett
Elective 8	Equity as a conceptual basis for the development of benefit-sharing criteria	Prof. Dale Squires



Module 2: Marine mineral resources of the Area		
Lesson 1	Minerals, metals, mineral resources and reserves: basic definitions	Prof. Pedro Madureira
Lesson 2	Marine mineral resources: scientific aspects	Dr. Sven Petersen
Lesson 3	Marine mineral resources: economic and social perspectives	Prof. Saleem Ali
Lesson 4	The current status of exploration for marine mineral resources in the Area	Mr. Joshua Tuhumwire
Lesson 5	From exploration to exploitation: the mineral resource assessment	Dr. John Parianos
Lesson 6	The need for minerals in the current world	Prof. Pedro Madureira
Electives		
Elective 1	The geology of polymetallic nodules	Dr. Thomas Kuhn
Elective 2	The geology of polymetallic sulphides	Prof. Georgy Cherkashov
Elective 3	The geology of cobalt-rich ferromanganese crusts	Dr. Kira Mizell
Elective 4	Marine mineral resources: technological perspectives	Dr. Ulrich Schwarz-Schampera
Elective 5	Potential revenues from the exploitation of minerals in the Area	Prof. Dale Squires
Elective 6	Marine mineral resources of the continental shelf: links with Article 82 of UNCLOS	Mr. Harald Brekke

Module 3: Marine scientific research		
Lesson 1	Biology of polymetallic nodules	Dr. Ellen Pape
Lesson 2	Biology of polymetallic sulphides	Dr. Samuel Popoola
Lesson 3	Biology of cobalt-rich ferromanganese crusts	Prof. Tomohiko Fukushima
Lesson 4	MSR technologies and techniques (offshore and lab-based)	Dr. Annemiek Vink
Electives		
Elective 1	ISA MSR Action Plan in support of the United Nations Decade of Ocean Science for Sustainable Development	Dr. Noémie Wouters
Elective 2	Bathymetry: detailed mapping for exploration	Dr. Ing. Berit Floor Lund

Elective 3	Logistics/transport before and after exploitation	Dr. Birte Timm
Lesson 4	Technologies for prospection for mineral resources in the Area	Dr. Anna Lim

Module 4: Protection of the marine environment from activities carried out in the Area		
Lesson 1	Legal obligations to protect the marine environment and the precautionary approach	Prof. Atsuko Kanehara
Lesson 2	Overview of environmental obligations in the ISA regime	Dr. Marie Bourrel-McKinnon
Lesson 3	Environment and ecosystems associated with each deposit type	Dr. Kirsty McQuaid
Lesson 4	Overview of baseline studies: importance and ISA expectations	Dr. Luciana Genio
Lesson 5	Environmental risk and impact assessment in the context of deep-sea mining	Dr. Malcolm Clark

Lesson 6	Development and implementation of regional environmental management plans in the Area	Dr. Wanfei Qui
Electives		
Elective 1	Environmental management plan and monitoring: a technical perspective	Prof. Tomohiko Fukushima
Elective 2	Deep-sea meiofauna of the Clarion-Clipperton Zone	Dr. Ann Vanreusel
Elective 3	Deep-sea megafauna of the Clarion-Clipperton Zone	Prof. Daniel Jones
Elective 4	Environmental management plan and monitoring: a legal perspective	Mrs. Lea Kolmos-Weis
Elective 5	Simplified monitoring of deep-sea ecosystems: focus on deep-sea marine protected areas in Japan	Dr. Katsunori Fujikura

Module 5: Technology development and innovation for the sustainable development of mineral resources in the Area		
Lesson 1	Technologies for prospection for mineral resources in the Area	Dr. Anna Lim
Lesson 2	Methods and tools for exploration for polymetallic nodules in the Area	Dr. Carsten Rühlemann Lund
Lesson 3	Technologies for extraction of polymetallic nodules in the Area	Mr. Johan Heiler
Lesson 4	Methods and tools for exploration for polymetallic sulphides in the Area	Mr. Alden Denny
Lesson 5	Technologies for extraction of polymetallic sulphides in the Area	Mr. Leonhard Weixler
Lesson 6	Scopes, methods and tools for exploration of cobalt-rich ferromanganese crusts	Prof. Akira Usui
Lesson 7	Development of mining technology for polymetallic sulphides and cobalt-rich ferromanganese crusts	Dr. Nobuyuki Okamoto
Electives		
Elective 1	Monitoring for exploration and exploitation activities	Prof. Georgy Cherkashov
Elective 2	Logistics/transport before and after exploitation	Dr. Birte Timm
Elective 3	Vessel and fleet management	Mr. Gianni Scherl
Elective 4	Testing of mining components during exploration: a legal and regulatory framework	Dr. David Pusztai
Elective 5	Testing of mining components during exploration: technological approach	Mr. Kris De Bruyne
Elective 6	Bathymetry: detailed mapping for exploration	Dr. Ing. Berit Floor Lund
Elective 7	Area 2030: facilitating the high-resolution mapping of the Area by 2030	Dr. Ulrich Schwarz-Shampera

Annex III. Deep Dive partners

ADEPTH Minerals

Agreo

Cook Islands Seabed Minerals Authority

Dalhousie University

German Federal Institute for Geosciences and Natural Resources

Fincantieri

French Research Institute for Exploitation of the Sea

GEOMAR Helmholtz Centre for Ocean Research

German Federal Institute for Geosciences and Natural Resources

Ghent University

Global Sea Mineral Resources

Gondwana Geoscience Consulting Ltd.

Heidelberg University

HF Offshore

Japan Agency for Marine-Earth Science and Technology

Japan Oil, Gas and Metals National Corporation

Japan Organization for Metals and Energy Security

Kongsberg Digital As

Ministry of Foreign Affairs, Jamaica

National Institute of Water and Atmospheric Research, New Zealand

National Oceanography Centre, United Kingdom

National University of Singapore

Nigerian Institute for Oceanography and Marine Research

Sophia University, Japan

The All-Russia Scientific Research Institute for Geology and Mineral Resources of the Ocean

Twenty Essex

University of California San Diego, School of Global Policy and Strategy

University of Delaware

University of Évora

University of Plymouth

University of Wollongong

United States Geological Survey, Pacific Coastal and Marine Science Center