EXPERT SCOPING WORKSHOP

Charting future horizons: harnessing advanced
technologies for the protection and sustainable
use of the international seabed area

📅 3 - 5 April 2024   📍 Hybrid: Porto, Portugal + online

Expert scoping workshop on

Charting Future Horizons: Harnessing Advanced Technologies for the Protection and Sustainable Use of the International Seabed Area

3-5 April 2024 | Porto, Portugal (hybrid)

Annotated Provisional Agenda

Day 1 Wednesday 3 April

Time (Porto)	Meeting activities
9:00 – 9:30 am	*Agenda item 1: Opening of the workshop* • H.E. Mr. Michael W. Lodge, Secretary-General of the International Seabed Authority (ISA) • Ms. Maria Luís Mendes, Legal Advisor, Ministry of Foreign Offices of Portugal • Prof. José Manuel Mendonça, Chairman of the Institute for Systems and Computer Engineering, Technology and Science (INESC TEC) of Portugal. • Prof. Maria João Viamonte, President of Superior Institute of Engineering of Porto (ISEP), Porto Polytechnic Institute *Group Photo*
9:30 – 9:40 am	*Agenda item 2: Meeting background, scope and expected outputs addressing key technologies, technological needs, research and development activities* The expert scoping workshop covers key elements with respect to the status, trends and challenges of marine and deep-sea technologies, identifies current best industry practices and provides guidance for strategic partnerships to build and develop the capacities of members of ISA, especially developing States. • Ulrich Schwarz-Schampera (ISA secretariat)
9:40 – 11:00 am	*Agenda item 3: Ocean observation and communication*

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	Ocean observation is key to modern global understanding in terms of environmental protection, the development of national and international blue economies, the security and protection of food supply, early forecast mechanisms for and monitoring of natural hazards (earthquakes, sea-level rises, submarine avalanches, volcanic eruptions), geological and environmental baselines, and to scientific research. Activities include various technological approaches encompassing satellite data, ship-borne measurements, autonomous systems, moorings and lander systems, and submarine cable systems. Ocean observation includes a complex spectrum of data acquisition and advanced subsea communication and data transfer at larger distances through the water column to surface installations or from a specific site via cable systems for data analysis. This agenda item aims at the identification of state-of-the-art, available and advanced technologies in the field of ocean observation and communication, the definition of current best industry practices, and the identification of strategic partnerships to build and develop the capacities of ISA members, especially developing States. • François Charlet, GSR: COMPASS project: GSR's adaptive management system for the responsible commercial scale collection of PMN • Rolf B. Pedersen, UiB: Techniques in Ocean Observation • Berit Floor Lund, Kongsberg: Sensors and AUV technologies for seabed mapping, environmental monitoring and maritime surveillance *Discussion (20 min.)*
11:00 – 11:30 am	*Coffee Break*
11:30 am – 1:00 pm	*Agenda item 3: Ocean Observation and Communication (cont'd)* • Souha El Mousadik, MIT: Monitoring the properties of suspended sediment from deep seabed mining operations. • Garrett A. Mitchell, FUGRO: Potential for improved real-time environmental monitoring and adaptive management of sediment plumes with quantitative 3D turbidity and SPM multibeam backscatter imaging, in situ remote sensing, and digital twin technology • Lionel Camus, Akvaplan Niva: A low-CO_2 smart autonomous multiplatform system to monitor and forecast mineral plume and impact. *Discussion (20 min.)*
1:00 – 2:00 pm	*Lunch Break*
2:00 – 3:30 pm	*Agenda item 4: Monitoring* Monitoring intervenes at the local scale and includes the online, transparent, and reliable observation of all human activities in the oceans, from shipping to fishery and marine fish farming to seabed mineral exploration and environmental baseline surveys and future exploitation. Technological solutions include satellite data, ship-borne measurements, autonomous systems, moorings and lander systems, submarine cable systems, and data dashboards. This agenda item aims to identify state-of-the-art, available and advanced technologies in the field of ocean and seabed monitoring, the definition of current

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	best industry practices, and the identification of strategic partnerships to build and develop the capacities of ISA members, especially developing States. • Jens Laugesen, DNV: Recent news in development of remote monitoring technologies for deep sea mining • Alfredo Martins, INESC TEC: Sensor systems for advanced marine monitoring • Jose Miguel Almeida, INESC TEC: Update on the consolidated concept of environmental monitoring (TRIDENT project) *Discussion (20 min.)*
3:30 – 4:00 pm	*Coffee Break*
4:00 – 5:30 pm	*Agenda item 4: Monitoring (cont'd)* • Al Rumson, DeepOcean & Alden Denny, Adepth: SimOps: Coring, geophysical sampling and environmental monitoring • Andrew Lipman, ABS: New technology qualification - the process and benefits *Discussion (20 min.)*
5:30 – 6:00 pm	*Agenda item 5: Compilation of thematic discussion for priorities in ocean observation and communication and monitoring* The thematic discussion covers key elements regarding the status, trends, and challenges of ocean observation, communication, and monitoring activities. It identifies current best industry practices and provides guidance for strategic partnerships to build and develop the capacities of developing States, members of ISA. • Ulrich Schwarz-Schampera (ISA) and Eduardo Silva (INESC TEC)
	Workshop Dinner

Day 2 Thursday 4 April

Time (Porto)	Meeting activities
9:00 – 9:10 am	*Summary of Day 1* • Ulrich Schwarz-Schampera (ISA)
9:10 – 10:40 am	*Agenda item 6: Autonomy - Automation – Robotics* State-of-the-art marine activities require autonomous, automated solutions, as do any activities in the deeper water column and on the seabed. Several ISA member countries invested in advanced autonomous systems (AUV) to better define their continental shelf. The developments largely depend on the innovation of sensor systems. Autonomous platforms inform the Seabed2030 initiative to map the seabed at high resolution by 2030. Automation and robotic systems are cost- and time-efficient and, therefore, critical for any activities in the deep sea. Spin-offs exist from the oil and gas industry and can be created for the land mining industry working in abandoned mining districts, drowned open pits, deep and drowned

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	underground mines as well as remote habitats or for catastrophic events by natural hazards.
	This agenda item aims to identify state-of-the-art, available and advanced technologies in the field of autonomy, automation and robotics, the definition of current best industry practices, and the identification of strategic partnerships to build and develop the capacities of ISA members, especially developing States. • Jon Machin, TMC: Strategic implementation of robotic machine automation in deep-sea mining • Alex Barnard, Bramley Murton, Andrew Ziegwied, Justin Manley, Marine Technology Society, NOC: Robotics and automation in deep-sea mining • Alasdair Cowie, Wael Bakr, MCS: Ocean Aurora - remote survey vessel for seabed exploration and exploitation *Discussion (20 min.)*
10:40 – 11:00 am	*Coffee Break*
11:00 am – 12:30 pm	*Agenda item 6: Autonomy - Automation – Robotics (cont'd)* • Anna Lim, Argeo: Strategic deployment of AUVs in seafloor massive sulfide exploration: Bridging scales and knowledge gaps • Carlos Almeida, INESC TEC: Robotics in seabed monitoring • Guido vd Bos, NOV Marine & Construction: Sustainable deep-sea mineral extraction: Harnessing the digital & technological developments to ensure safe, consistent & efficient operational workflow *Discussion (20 min.)*
12:30 – 1:30 pm	*Lunch Break*
1:30 – 3:00 pm	*Agenda item 7: Machine learning, artificial intelligence (AI)* Machine learning by artificial intelligence (AI) represents a new frontier in all ocean activities and aspects of the blue economy. It builds on data obtained by ocean observation and monitoring and the collection of key information on water column and seabed habitats, mineral occurrences, and potential natural hazards. AI has the potential to model and predict various aspects of oceanography, geology, mineral resources, biodiversity, and the environmental effects of all human activities. This agenda item aims to identify state-of-the-art, current, and advanced technologies in machine learning and artificial intelligence, define current best industry practices, and identify strategic partnerships to build and develop the capacities of ISA members, especially developing States. • Akira Tsune (DORD): A possible contribution of contractor for technical transfer regarding machine learning by artificial intelligence • Joao Carvalho, B. Ferreira, I. Tojeira (DeepFocus, EMEPC): Advancing deep-sea exploration through AI: Application to mineral resource and vulnerable habitat mapping • Thomas Peacock, atdepth: Integration of monitoring and simulations to tackle sediment plumes

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	Discussion (20 min.)
3:00 – 3:30 pm	*Coffee Break*
3:30 – 4:30 pm	*Agenda item 7: Machine learning, artificial intelligence (AI) (cont'd)* • Takehisa Yamakita, JAMSTEC: Examples and challenges of detection of species at the deepsea using deep learning and application of species distribution models to map their habitats • NN, Kobe U.: Machine learning and artificial intelligence in marine sciences *Discussion (20 min.)*
4:30 – 5:00 pm	*Agenda item 8: Compilation of thematic discussion for priorities autonomy - automation – robotics and machine learning, artificial intelligence* The thematic discussion covers key elements with respect to the status, trends and challenges of autonomy - automation – robotics technologies and machine learning, artificial intelligence, identifies current best industry practices and provides guidance for strategic partnerships to build and develop the capacities of ISA members, especially developing States. • Ulrich Schwarz-Schampera (ISA) and Eduardo Silva (INESC TEC)
	Optional Visit of a Porto Winery

Day 3 Friday 5 April

Time (Porto)	Meeting activities
9:00 – 9:10 am	*Summary of Day 2* • Ulrich Schwarz-Schampera (ISA)
9:10 – 10:40 am	*Agenda item 9: Mining – Energy - Metal Processing* Marine resources include seabed minerals and wind, wave and geothermal energy. ISA's contractors and pioneer investors developed technological concepts and tested innovative and advanced prototypes. Technological innovation is required for mining technologies to include state-of-the-art sensors, locomotion, automation, autonomy and robotics for best industrial and environmental practice offering a wide field of technical, low impact and cost-effective future improvements. Carbon-free transportation is of key importance. Cost-effective and environmental innovation is also required for the mineral treatment and processing after recovery. Solutions are needed for zero-waste approaches and carbon-free processes. Preliminary concepts exist for harvesting energy resources, including offshore wind, tides, oceanographic heat and wave and seabed geothermal. None of these resource options have been tested at an industry-like scale, and various technological innovations are required for their development. This agenda item aims to identify state-of-the-art, available and advanced technologies in the field of mining, energy and metal processing, the definition of

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	current best industry practices, and the identification of strategic partnerships to build and develop the capacities of ISA members, especially developing States. • Stefan Wegerer, Bauer Maschinen: Deep-eea sampling – technology development for minimal impact seabed mining • Oystein Larsen, LokeCCZ: A prospective business case: An integrated manganese nodule exploitation system based on minimum environmental impact technology • Jason Gillham, Oliver Gunasekara, Impossible Metals: A prospective business case - An overview of Impossible Metals' technology for selective harvesting polymetallic nodules while minimizing the environmental impact *Discussion (20 min.)*
10:40 – 11:00 am	*Coffee Break*
11:00 am – 12:30 pm	*Agenda item 9: Mining – Energy - Metal Processing cont'd* • Matt Boulby, NORI/TMC: Advances in the processing of PMN • Rebecca Bolton et al., CGG: The importance of imaging below the seabed for effective development of offshore geothermal resources *Discussion (20 min.)*
12:30 – 2:00 pm	*Lunch Break*
2:00 – 4:00 pm	*Agenda item 10: Plenary session: Open discussion and consolidation of future steps* Based on the results of the discussions for each of the five priorities identified, participants are invited to consolidate their input, in preparation for updating the mapping exercised carried out in preparation of the workshop. Participants will also discuss key considerations for a strategy to facilitate technological advancements for the sustainable development of seabed minerals in the context of ISA. This includes a collaborative approach to advancing smart and environmentally sound technology and possible modalities and topics for capacity-building activities. • Co-Chairs Ulrich Schwarz-Schampera (ISA) and Eduardo Silva (INESC TEC)
4:00 – 5:00 pm	*Agenda item 11: Closure of the workshop*
5:00 pm	*Visit of INESC TEC Laboratories*