IRENA
International Renewable Energy Agency

Deep-sea Mining Technology
Critical Materials for the Energy Transition

14 July 2022

Agenda

1

SCENE SETTING

Presented by IRENA

2

PRESENTATIONS

Presented by the Metals Company and the International Seabed Authority

3

DISCUSSION

The Metals Company, the International Seabed Authority, Republic of Nauru, and the Kingdom of Tonga

Poll

Familiarity with the topic

Areas of interest in the topic

Part I:
Scene Setting – Critical Materials in the Energy Transition

Scene setting – critical materials for the energy transition

Dolf Gielen
Director Innovation and Technology Centre
IRENA

IRENA work to date on critical materials

- IRENA Assembly January 2022 provided a mandate for Agency work on critical materials
- To date:
  - Scoping paper – together with ENEL Foundation – October 2021
  - Technical paper critical materials – November 2021
  - Deep dive lithium – February 2022
  - Launch of the **IRENA Collaborative Framework on Critical Materials for the Energy Transition** – March 2022
  - Deep dive rare earth elements – March 2022
  - Chapter 7 World Energy Transitions Outlook 2022 – March 2022
  - Nickel editorial
  - Editorials on critical materials in energy-post , smart-energy and mining review

- **Upcoming**:
  - Deep dive into **EVs battery manufacturing** process
  - Deep dive into **sustainable critical materials supply in Southern Africa** – with World Bank
  - Overview of **supply chain** of energy-related critical materials and minerals

Demand for critical materials is growing rapidly

Critical Materials in the Energy Transition

- Demand for critical materials is rapidly increasing as a result of mass **electrification**, deployment of **renewables**, and **electrification of the transportation system**.
- Enabling technologies require critical materials:
  - **Permanent magnets** for wind turbines and EVs require rare earth metals such as neodymium and dysprosium.
  - **Batteries** for electric vehicles and stationary battery systems typically use lithium.
  - **Solar energy technologies** use large amounts of copper and silver.

Actual (2021) and projected (2050) demand for copper, nickel, lithium and neodymium under IRENA's 1.5°C Scenario

Material		Demand in 2021 (Mt/year)	Demand in 2050 (Mt/year)	Source
Cu	Copper	30 Mt/yr	50-70 Mt/yr	Elshkaki *et al.* (2016); ICGS (2021); INSG (2021)
Ni	Nickel	2.77 Mt/yr	5-8 Mt/yr	Elshkaki *et al.* (2017)
Li	Lithium	0.3 Mt/yr	2-4 Mt/yr	Moore and Bullard (2021)
Nd	Neodymium	0.03 Mt/yr	0.2-0.5 Mt/yr	Barrera (2021); Joint Research Centre (2020, 2021); Deetman *et al.* (2021)

Deep-sea mining can help relieve supply bottlenecks

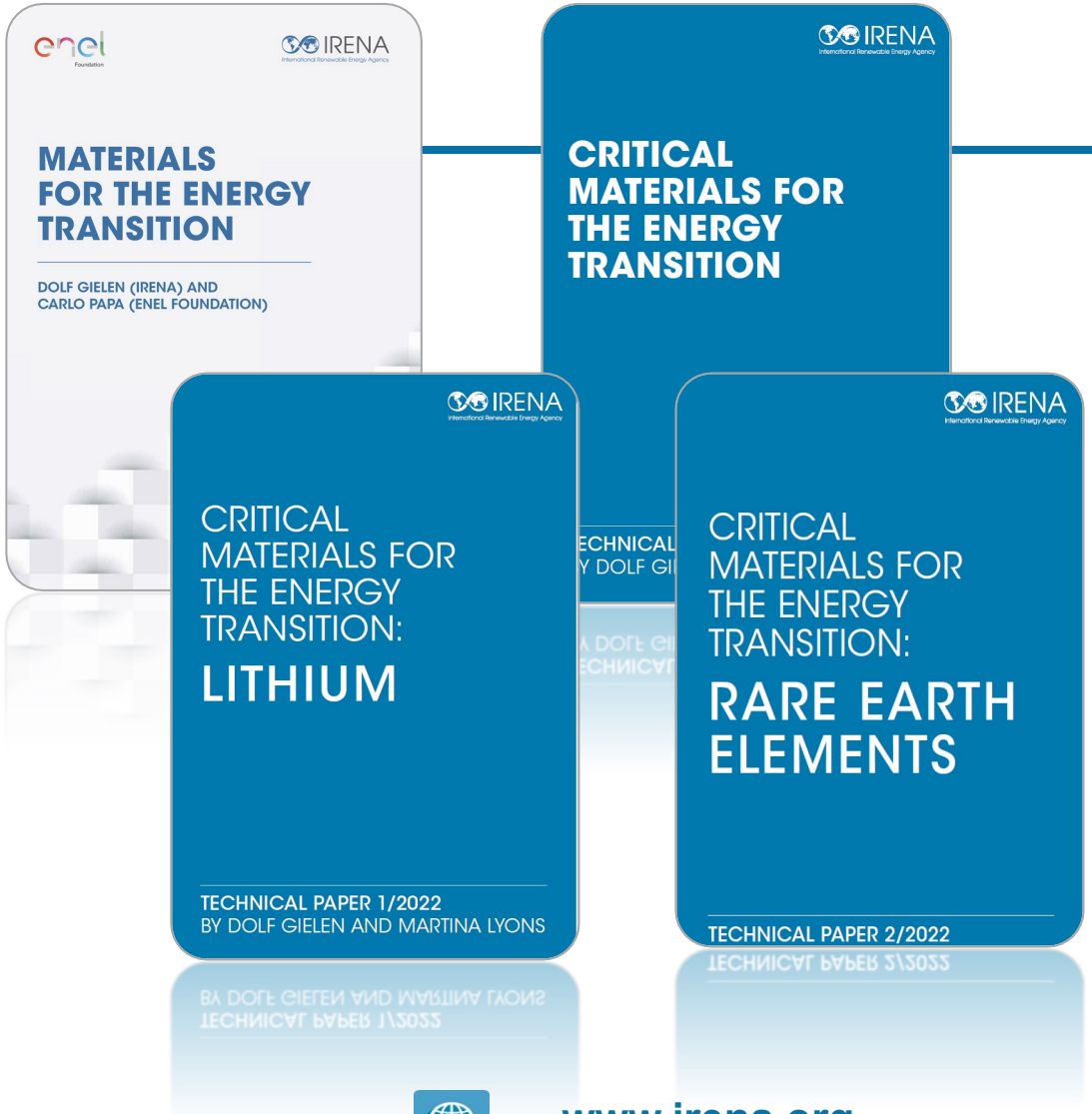
Supply and Developments in Mining Technology

- Some materials face immediate **supply deficits**; others are projected to experience **shortfalls** in the medium or long term.
- Key challenges include: **rapid demand growth** and the **ability to ramp-up** new mines fast enough.
- Improvements in mining technology could help relieve supply bottlenecks by opening the door to previously inaccessible resources. **One of the main developments is subsea mining.**

28
Ni
Nickel
58.693
2-8-16-2

Category	Value	Source
Current demand	2.45 Mt (2020)	Nornickel (2021)
Current supply	2.52 Mt (2020)	Nornickel (2021)
Projected demand in 2050	5 - 8 Mt	Elshkaki *et al.* (2016); ICGS (2021)
Current reserves	89 Mt	DERA (2021)
Resources	300 Mt (additional 290 Mt in subsea deposits)	Nickel Institute (2020)
Current recycling volumes	0.8 Mt	Nickel Institute (2020)
Top three producing countries	33% Indonesia; 12% Philippines; 11% Russian Federation	Gielen (2022)
Top three processing countries	35% China; 15% Indonesia; 8% Japan	Gielen (2022)

Nickel Supply at a Glance



Thank you for your attention!

CFMaterials@irena.org

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www.flickr.com/photos/irenaimages

www.youtube.com/user/irenaorg

Part II: Presentations

Presentations – The Metals Company

Jon Machin
Head of Offshore Development
The Metals Company

the metals company

Solving metal shortages with a high-grade, lower impact and abundant source from the seafloor

Prepared for IRENA Webinar
14 July 2022

Forward looking statements.

This presentation contains “forward-looking statements” within the meaning of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended, that relate to future events, TMC the metals company Inc.’s (the “Company”) future operations or financial performance, or the Company’s plans, strategies and prospects. These statements involve risks, uncertainties and assumptions and are based on the current estimates and assumptions of the management of the Company as of the date of this presentation and are subject to uncertainty and changes. Given these uncertainties, you should not place undue reliance on these forward-looking statements.

Important factors that could cause actual results to differ materially from those indicated by such forward-looking statements include, among others, those set forth under the heading “Risk Factors” contained in the enclosed Annual Report on Form 10-K for the year ended December 31, 2021, which was filed with the Securities and Exchange Commission on March 25, 2022, as well as any updates to those risk factors filed from time to time in our periodic and current reports. All information in this presentation is as of the date of this presentation, and the Company undertakes no duty to update this information unless required by law.

Unconventional resource:
Developing a new type of high-grade and abundant resource that requires no social displacement, no hard-rock mining and no fixed infrastructure.


Date: 30/05/2020
Time: 18:20:36 UTC
Dive No: 144
Easting : 482149.97m
Northing: 1147003.90m
HDG: 56.92
Depth: 4294.20m
Alt: 1.17m
Here is what
a polymetallic nodule
field looks like.

Resource definition: easy and effective to define.

BOX CORE SAMPLING[1]

250
box cores collected[2]

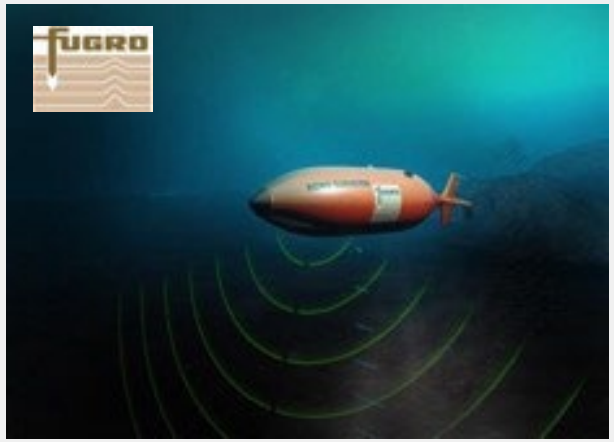
82,000
kg (wet) nodules collected[2]

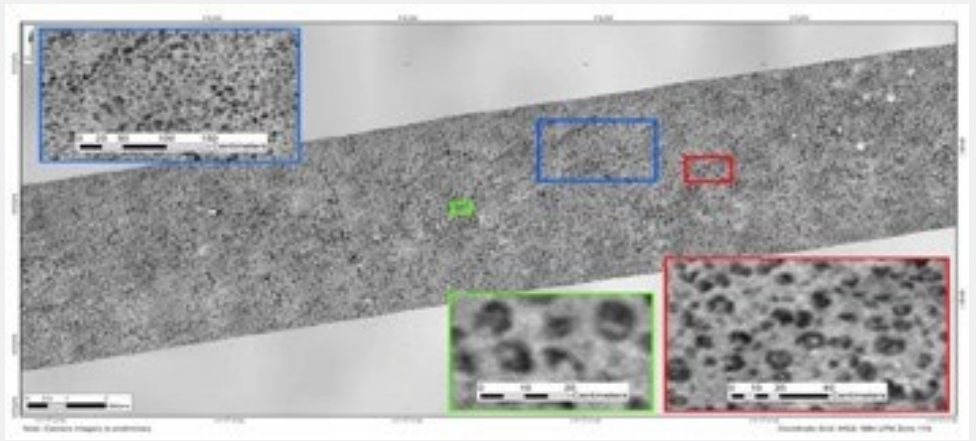
13,950
biological samples collected[2]

AUV CAMERA IMAGERY[1]

178,591
km^2 of high-res bathymetric survey[2]

5,439
km^2 detailed seafloor imagery[2]





[1] Images from DeepGreen's resource survey offshore campaigns in NORI contract area.
[2] Boxcores, nodules collected, high-res bathymetry, detailed bathymetry – compiled by DeepGreen from - Canadian NI 43-101 and SEC Regulation S-K (Subpart 1300) Compliant NORI Area D Clarion Clipperton Zone Mineral Resource Estimate and associated financial model, AMC, March 2021. Canadian NI 43-101 Compliant TOML Clarion Clipperton-Zone Project Mineral Resource Estimate, AMC, July 2016 and DeepOcean NORI – D Bulk Sampling Report, 2020. Erias Cruise 6a Biological and Physiochemical Co-Sampling Report NORI area D post cruise, 2019; Erias Cruise 6b Biological and Physiochemical Co-Sampling Report NORI area D post cruise report, 2019.

Proven technology.

1970's pilot testing in CCZ

Kennecott Copper Corp
British Petroleum, Rio Tinto-Zinc Corp
Consolidated Gold Fields
Noranda Mines, Mitsubishi Corp

Deepsea Ventures Inc.
US Steel, Sun Oil, Union Miniere

Ocean Management Inc.
International Nickel Company
Metallgesellschaft AG
Sumitomo, Sedco

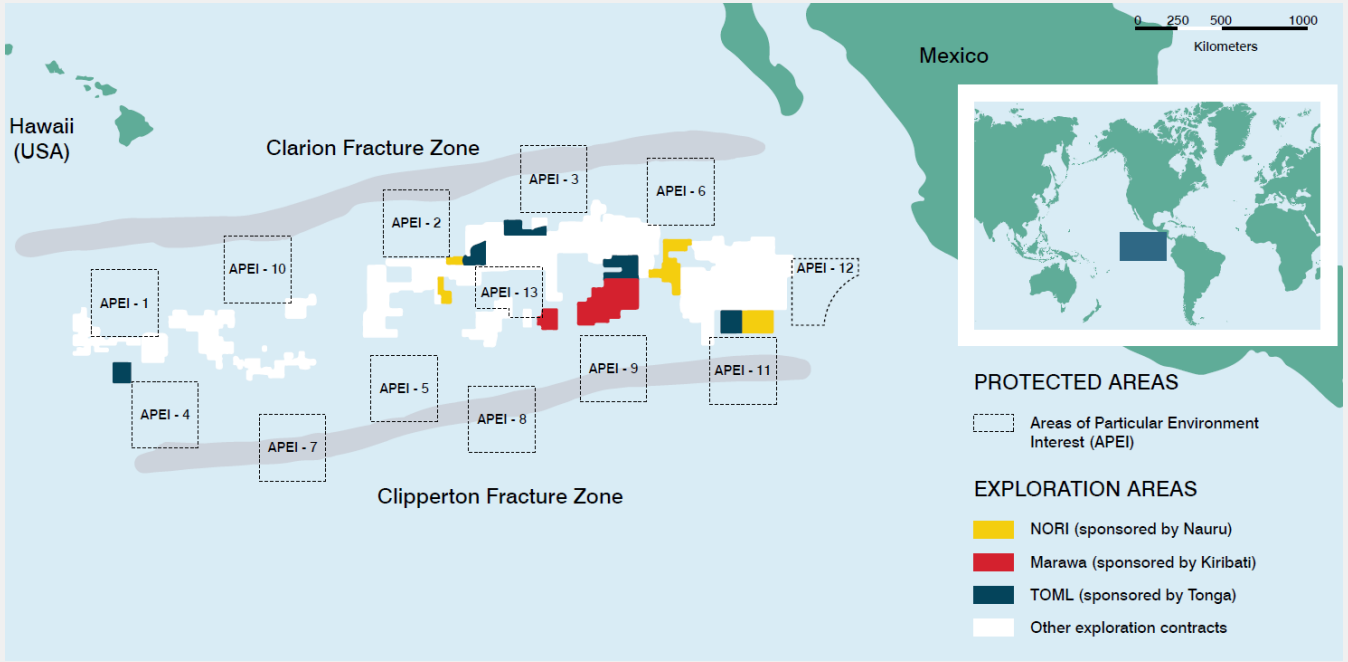
Lockheed
Amoco Minerals, Shell Petroleum

Present Day

Offshore Diamond Mining
De Beers, NAMCO, Samicor

Source: July 7,1977 The New York Times.

TMC technical resource statements issued on NORI + TOML, with an *in situ* estimated resource of Ni, Cu, Co and Mn sufficient to electrify the entire US passenger car fleet[1].



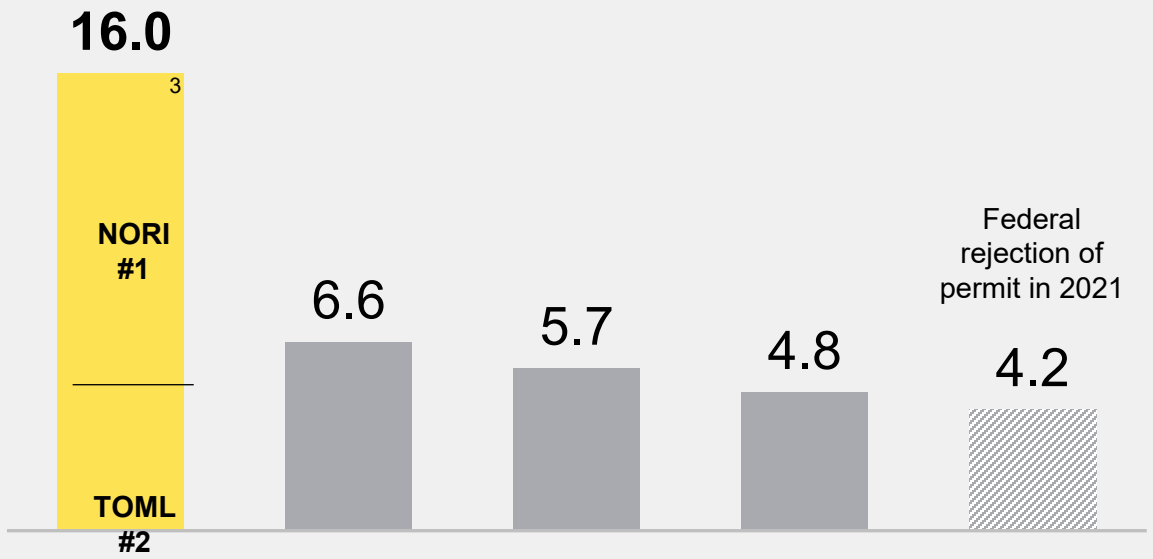
TMC exploration contract area	NORI[2]	TOML[3]	Marawa
Sponsoring State	Republic of Nauru	Kingdom of Tonga	Republic of Kiribati
Exploration area	74,830 km^2	74,713 km^2	74,990 km^2
Technical resource statement	Yes	Yes	Work in progress
Estimated nodule tonnage	866[4] million tonnes (wet)	768 million tonnes (wet)	
Manganese	29.5%	29.2%	
Nickel	1.3%	1.3%	
Copper	1.1%	1.1%	
Cobalt	0.2%	0.2%	

[1] Assuming 75kWh batteries with NMC811 chemistry and nodule resource grade and abundance, "Where Should Metals for the Green Transition Come From?", Paulikas et al, LCA white paper, April 2020. Calculation based on estimated contained value of nickel.
[2] SEC Regulation S-K (Subpart 1300) Compliant NORI Clarion Clipperton Zone Mineral Resource Estimate AMC, 17 March 2021. 521 Mt Inferred, 341 Mt, 4 Mt Measured.
[3] SEC Regulation S-K (Subpart 1300) Compliant TOML Clarion Clipperton Zone Project Mineral Resource Estimate, AMC, 26 March 2021. 696 Mt inferred, 70 Mt Indicated, 2.6 Mt Measured.
[4] SEC Regulation S-K (Subpart 1300) Compliant NORI Area D Clarion Clipperton Zone Mineral Resource Estimate and associated financial model, AMC, 17 March 2021. 11 Mt Inferred @ 1.4% Ni, 1.1% Cu, 0.1% Co and 31.0 % Mn and 15.6 Kg/m2 abundance, 341 Mt Indicated @ 1.4% Ni, 1.1% Cu, 0.1% Co and 31.2% Mn and abundance 17.1Kg/m2, 4 Mt Measured @1.4% Ni, 1.1% Cu, 0.1% Co and 32.2% Mn and 18.6 Kg/m^2.

TMC: #1 and #2 largest undeveloped nickel projects on the planet

World's largest nickel projects – 2022

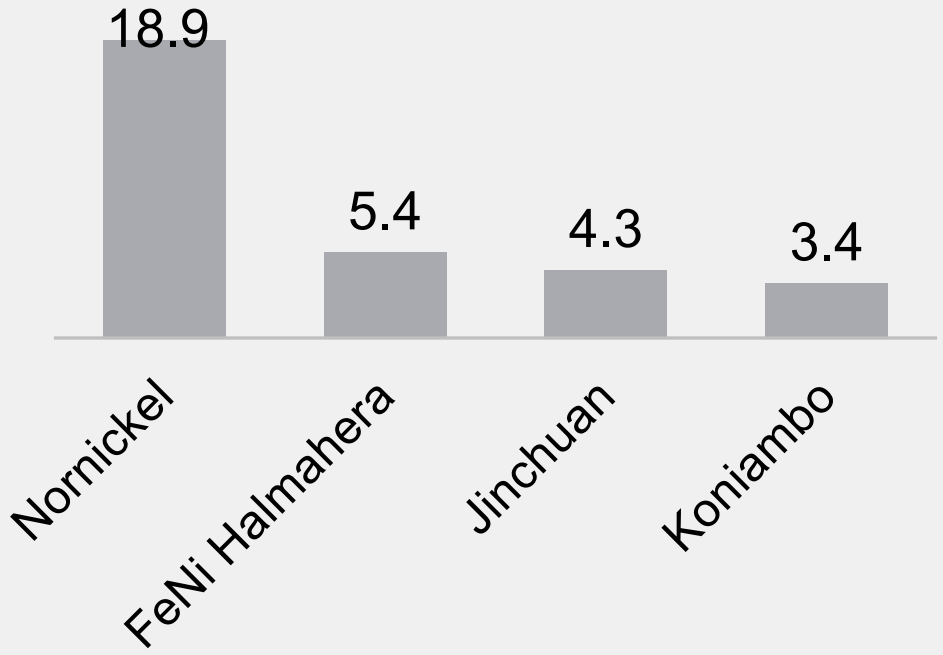
Total est. resources (inferred, indicated & measured), in Mt[1]



	TMC portfolio	Sangaji	Dumont	Turnagain	Twin Metals
Location	Clarion Clipperton Zone	Indonesia	Canada	Canada	USA
Nickel equivalent grades[4]	**3.2%**	1.8%	0.3%	0.2%	0.2%

World's largest nickel operations ranked by resource

Total resources (inferred, indicated & measured), in Mt[2]



Nornickel	FeNi Halmahera	Jinchuan	Koniambo
Russia	Indonesia	China	New Caledonia
2.3%	1.9%	1.3%	2.5%

[1] https://www.mining.com/featured-article/ranked-worlds-biggest-nickel-projects-2022/
[2] Global Nickel Industry Cost Summary, Wood Mackenzie, August 2020; inclusive of reserves. Asset Reports for FeNi Halmahera, Jinchuan and Koniambo.
[3] Canadian NI 43-101 Resource Statement for full field financial model (internal DeepGreen development scenario).
[4] Nickel equivalence calculation uses NORI-D Model price deck as stated in NORI Initial Assessment available at investors.metals.co.

For nickel, nearly all net supply growth on land is expected to come from Indonesia, most of which has guaranteed offtake by China.

Global terrestrial nickel production forecast
Kilotonnes per annum

Source: Steven Brown, *Responsible Mining & Metals* with data from Macquarie

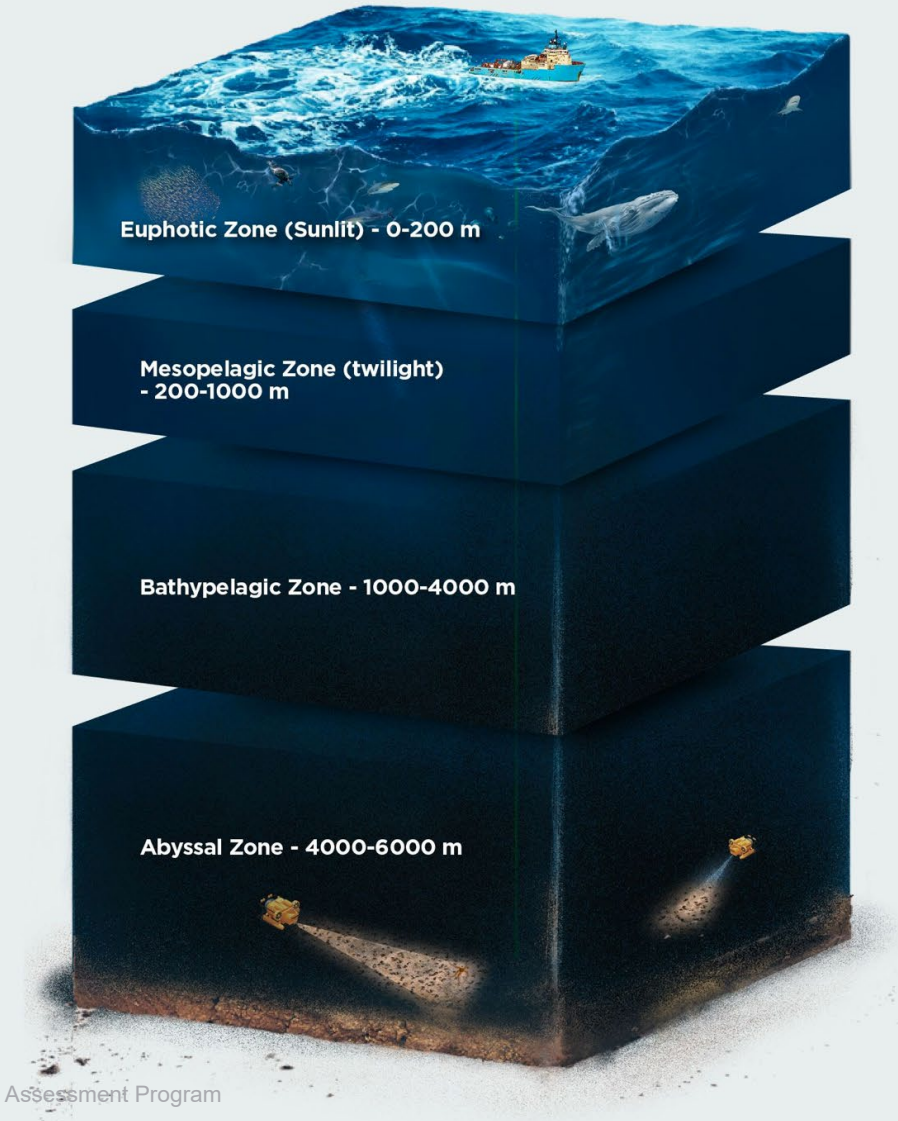
The alternative to nodules: deforestation, tailings, high emissions, and enormous waste.

NICKEL MINING IN RAINFORESTS

Investing heavily in science:
Funding the largest seafloor-to-surface research program in human history with lower ESG goals from the outset.

Offshore: investing in research program.

18 offshore campaigns
710 days at sea
100+ studies



Deep-sea ESIA program for NORI

Surface biology
Surface fauna logbook (PelagOS)
Remote Sensing, Hydrophone Acousitcs

Pelagic biology
Microbial Community Characterization
Phytoplankton Community Characterization
Zooplankton Community Characterization
Gelatinous Zooplankton Characterization
Micronekton Characterization
Trophic Analysis (Stable Isotopes)
Temporal Variability of Pelagic Communities
Trace Element Profiles In Water Column
Particulate Profiles in Water Column
Discharge Plume Characterization (Physical)
Discharge Plume Characterization (Biological)
Midwater Discharge (food webs particle composition)

Benthic biology
Megafauna Characterization (Photo transects)
Megafauna Characterization (Time Lapse)
Macro Fauna Characterization
Micro Fauna Characterization
Meso Fauna Characterization
Macro Fauna Characterization

Sediment analysis
Baited camera and traps
Benthic respiration and nutrient cycling
Seafloor metabolic activities
Bioturbation, sediment characteristics
Porewater sampling
Exposure toxicology studies
Metals determination by ICP analysis
Induction of gene transcripts (metals)

Collector impact studies
Met ocean studies
Bathymetry (seabed mapping)
Habitat mapping
Database development
Digital twin development
Collector test nearfield studies
Collector test far-field modeling
Plume modeling
Existing Resource Utilization Study
Noise & Light Study
Meteorology & Air Quality Study
Hazard & Risk Assessment
Emergency Response Planning
Cultural & Historical Resources
Waste Management
Cumulative Impacts

Pilot Collection System being tested this year before planned upgrade to Project Zero System.

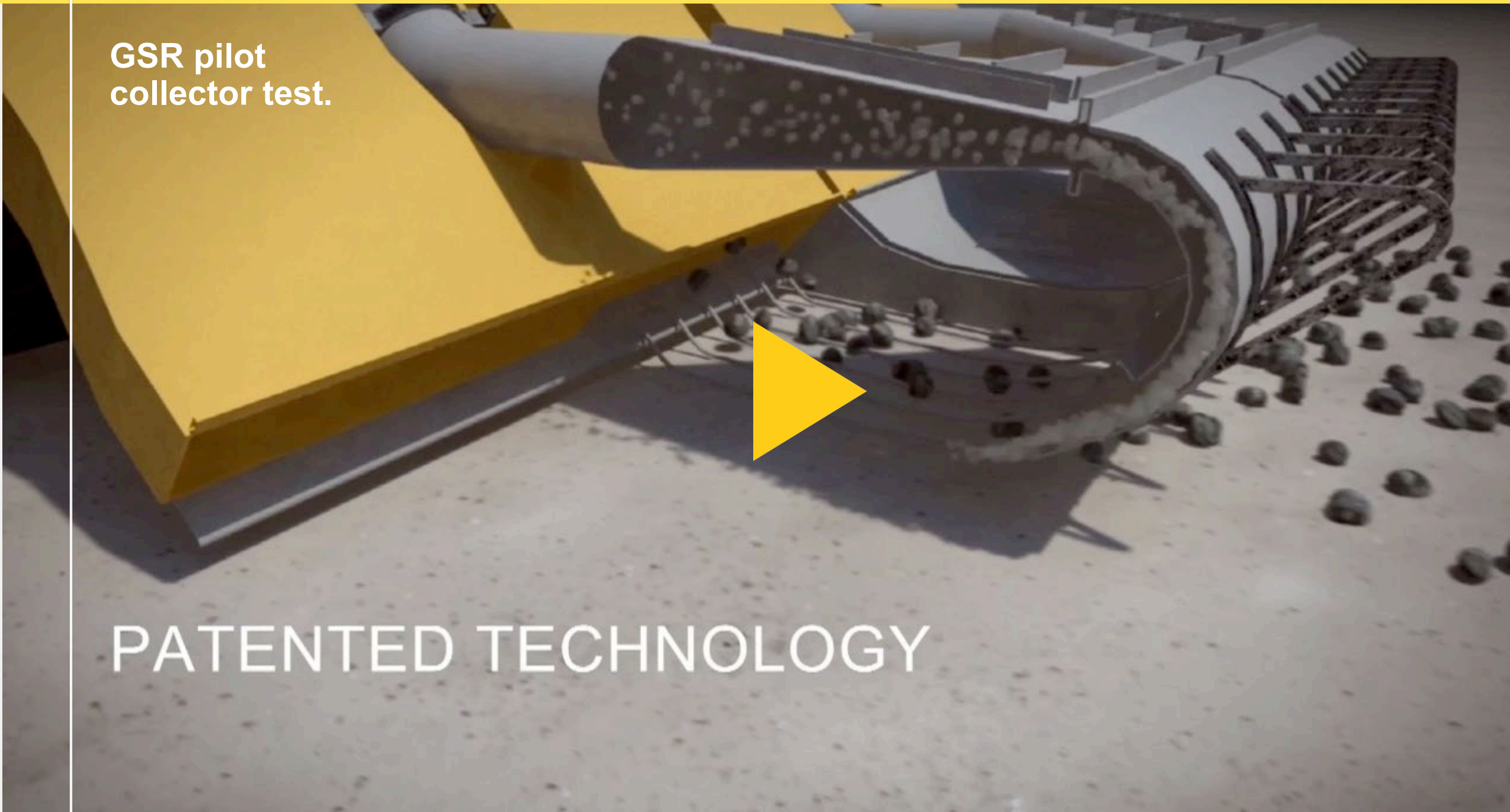
PILOT COLLECTOR SYSTEM TEST PROGRAM 2022

January	Riser acceptance test
February	Thruster re-lift, dockside vessel commissioning, review of nodule offloading & handling test program
Feb 7	LARS load test
Feb 28–Mar 3	Thruster installation
March 2–9	Collector wet function tests in outer harbor
March 12–17	Hidden Gem dynamic positioning trials
March 18–28	Collector drive test in the North Sea
April 6–11	Deep water test in the Atlantic
April / May	Riser deployment test
Aug–Sep	**Planned pilot trials in NORI-D** - Integrated collector test - Environmental impact monitoring - 3,600 wet tonnes expected to be collected

Completed

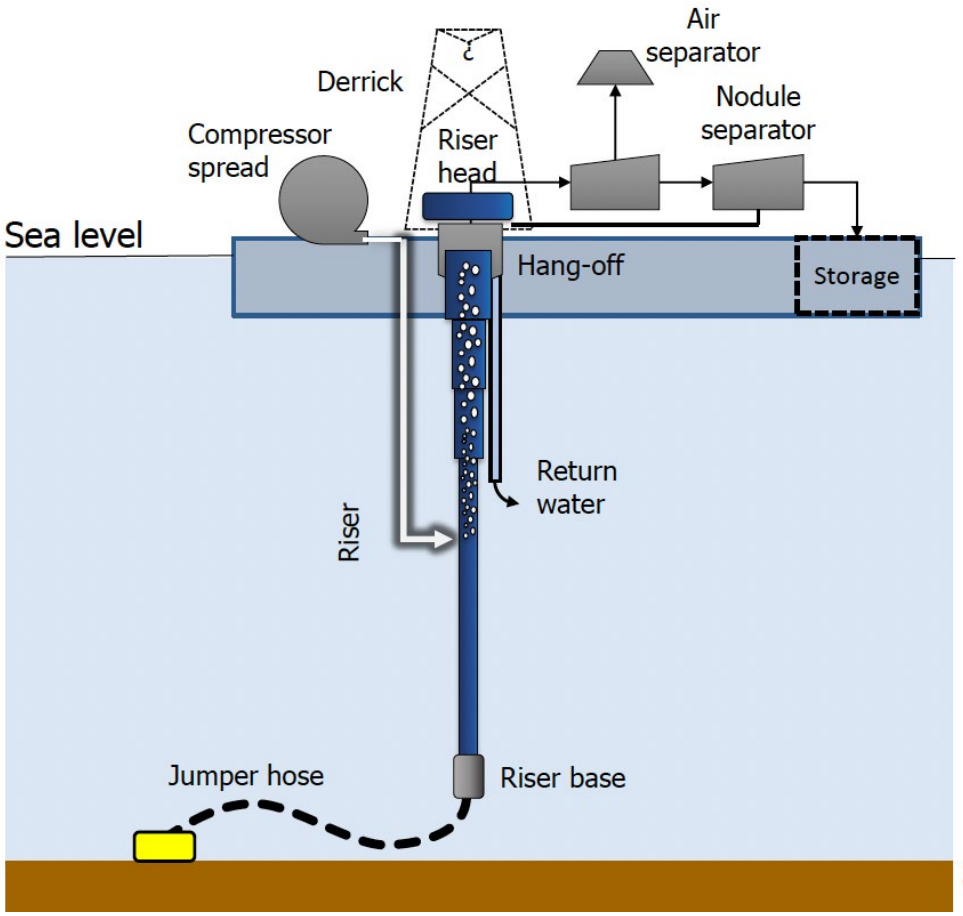
Ongoing/upcoming

GSR pilot collector test.



The Pilot Collection System will be put through several key trials.

- Deployment of riser pipe from the surface vessel to the seabed
- Coupling of the riser pipe and umbilical with the seabed collector vehicle
- Propulsion and manoeuvring of the vehicle on the seabed.
- Collection of nodules
- Transfer of nodules up the riser pipe to the surface vessel
- Separation and retention of nodules from entrained water and sediment on the surface vessel
- Release of entrained seawater and sediment through a return pipe at a depth of approximately 1,200m
- Recovery of riser pipe and vehicle to the surface vessel

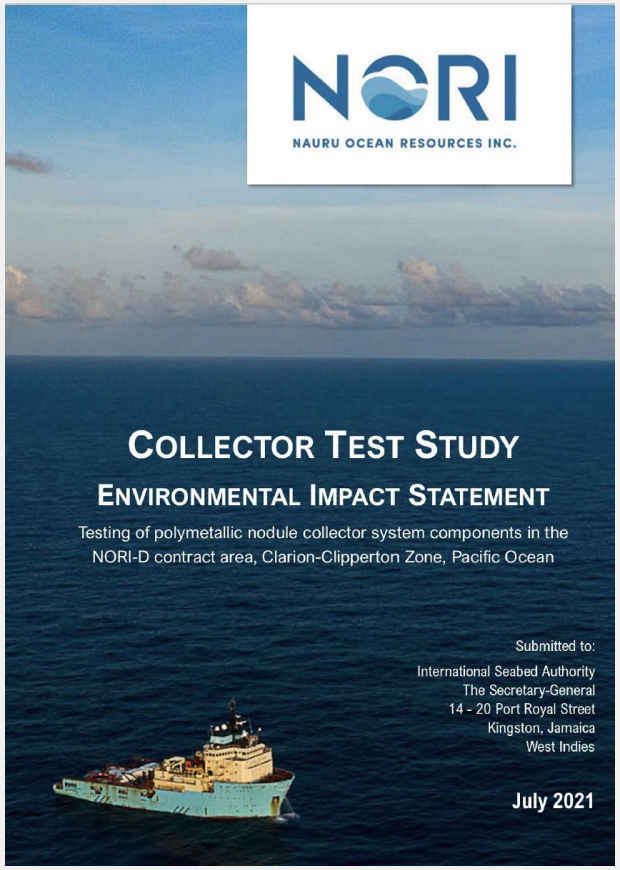


Courtesy of Allseas

Next big milestone: testing full nodule collection system in NORI-D area beginning this quarter.

Main objectives of full system test mining project:

1. Demonstrate technical feasibility of polymetallic nodule collector system.
2. Assess technical performance of prototype collection system, incorporate learnings into full-scale commercial system.
3. Assist in predicting potential environmental impacts of of full-scale operations.



NORI-D Collector Test EIS

12 week planned pilot trial at NORI-D in 2022
260 hours full system testing
3,600 wet tonnes of nodules to be collected
0.5 km^2 impacted directly by collector
6 km^2 impacted by sedimentation

NORI-D Collector Test EIS conclusion: The risk of the collector test resulting in ‘serious harm’ to marine environment at a regional scale is assessed to be **negligible**.

“Eyes on the seafloor”:
Building a digital twin to enable regulator and stakeholder access to subsea operations.

Sponsoring states:
Creating shared value with the Republic of Nauru and the Kingdom of Tonga.

Creating shared value with Nauru and Tonga.

Financial Benefits

- TMC subsidiaries NORI and TOML pay the following to Nauru and Tonga: (1) annual administration fees to cover annual costs of administering the Sponsorship, and (2) nodule recovery fees once in production, a significant new revenue stream to diversify their economies

Community Benefits

- TMC formalized a grant program in Nauru and Tonga for community led initiatives focused on five themes: (1) ocean health & the environment, (2) women's empowerment, (3) youth, (4) sanitation and water, (5) healthy living and food security
- In 2021, supported 16 community projects in each Nauru and Tonga (see right panel)

Capacity Building

University of the South Pacific Scholarships

- Undergraduate and graduate scholarships (marine science, engineering, geology)
- Airfare, tuition, books, accommodations, monthly stipend
- In 2021, 2 students graduated with Bachelors of Science degrees through our scholarship program
- In 2022, we will support another 9 recipients (8 undergraduates and 1 master's student) from Tonga (4), Nauru (2), Fiji (1), Solomon Islands (1), and Somalia (1)
- Targeting12 students annually by 2024

Secondary School Scholarships & Technical Training

- Focuses on students pursuing science and provides tuition (minimum 50% women)
- In 2021, granted 4 secondary school scholarships in Tonga
- In 2022, granting 5 more
- Targeting12-15 supported annually by 2023
- Granted 4 technical scholarships at Tonga Maritime Polytechnic Institute

At-Sea Placements & Training Commitments

- Commitment to provide berths for Nauruan and Tongan nationals other early-career ocean scientists with focus on developing countries
- Minimum 10 training opportunities over a 5-year period (min. 50% women)
- In 2021, 4 at-sea placement opportunities

Women's center

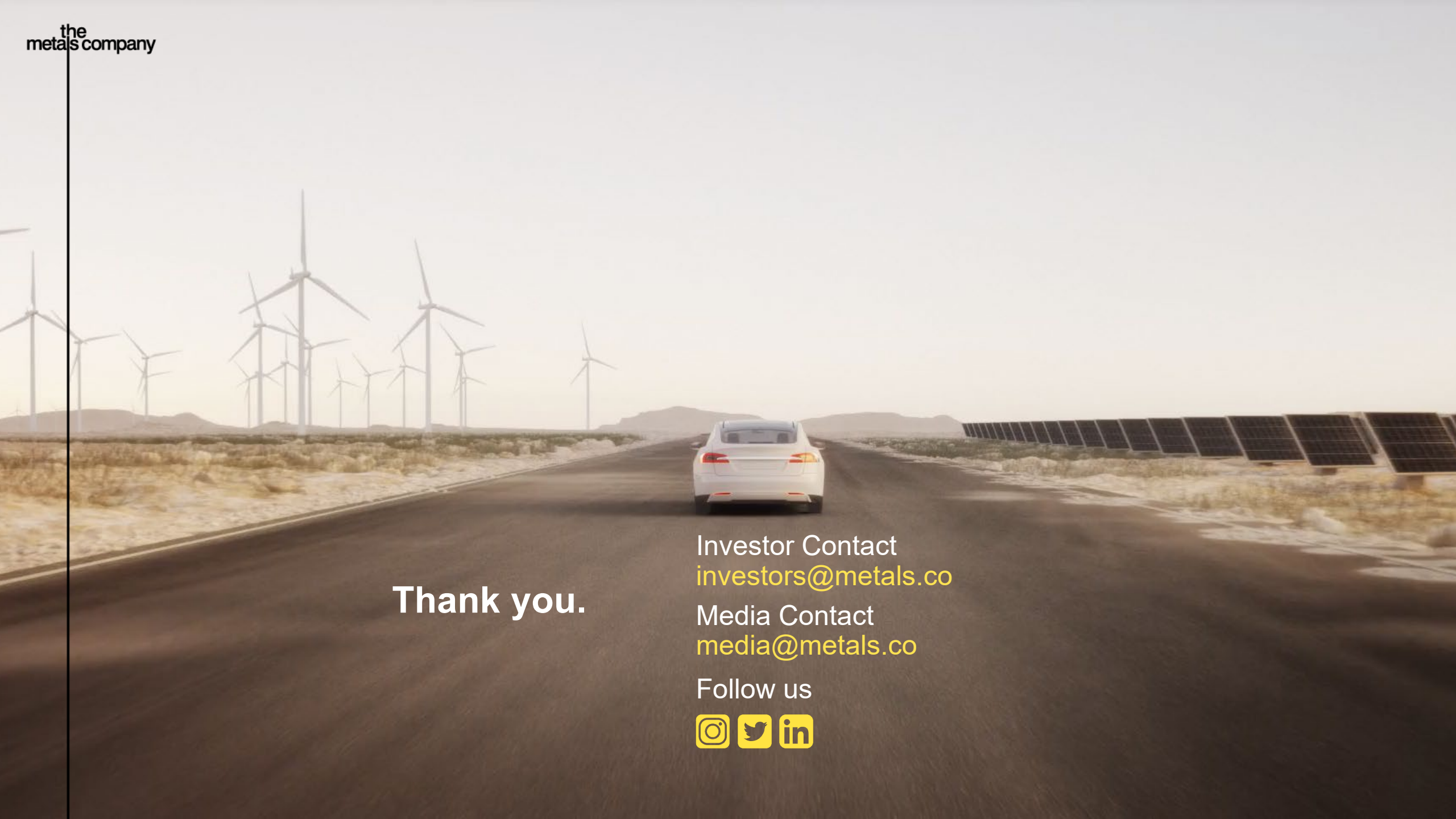

Mangrove planting

Water tanks


Collection bins


Powerlifting championship

the metals company



Thank you.

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Media Contact
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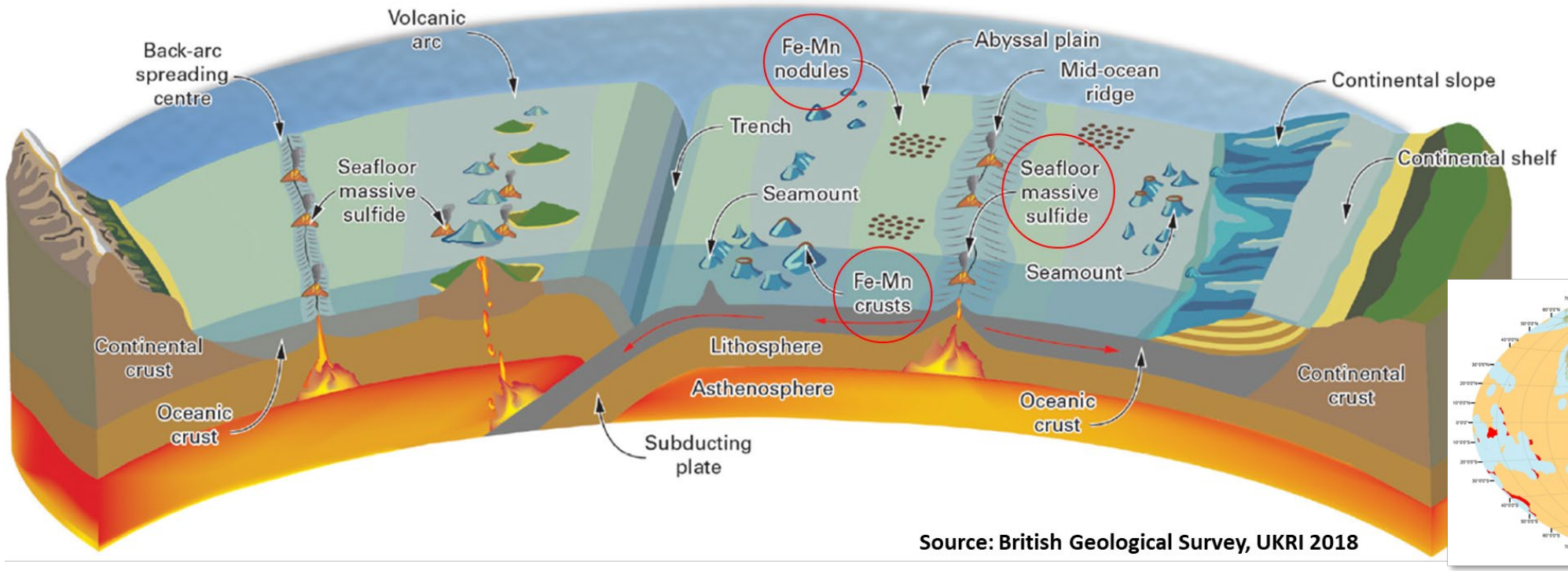
Follow us

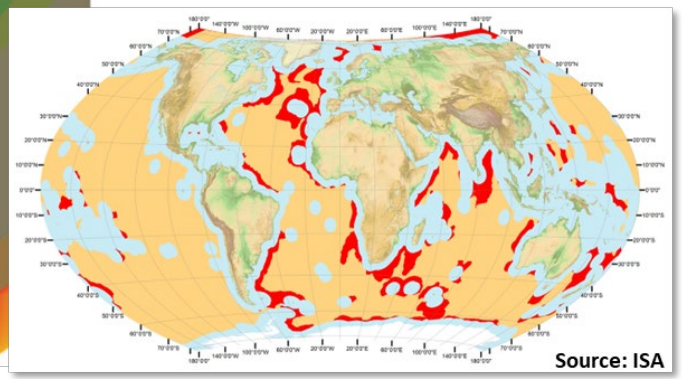
Presentation – The International Seabed Authority

Ulrich Schwarz-Schampera
Programme Management Officer (Mining Geology)
International Seabed Authority

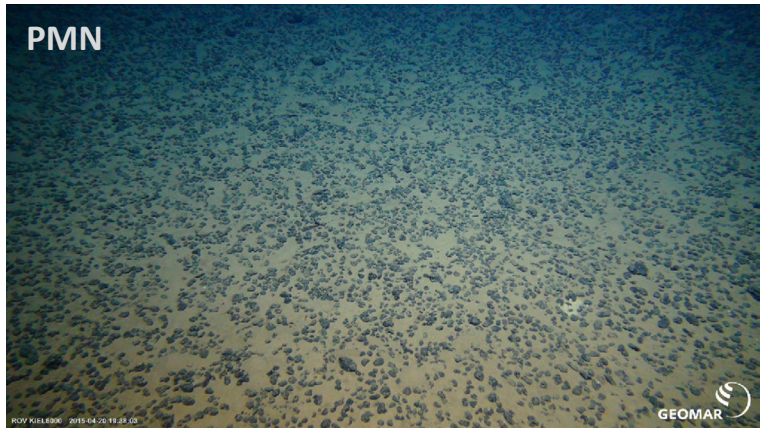
Resource Definition

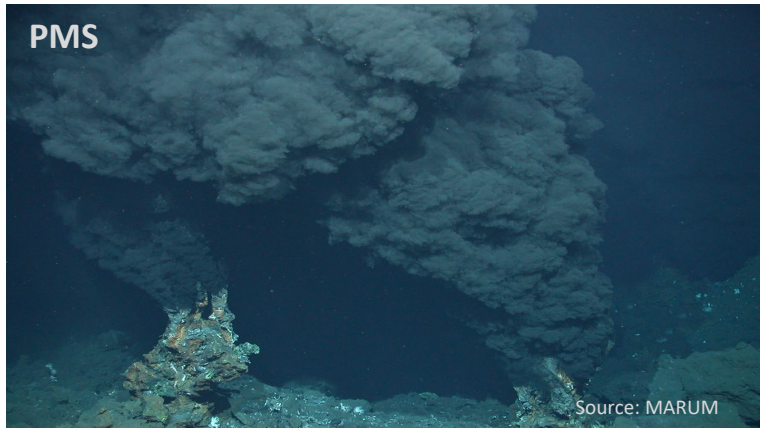


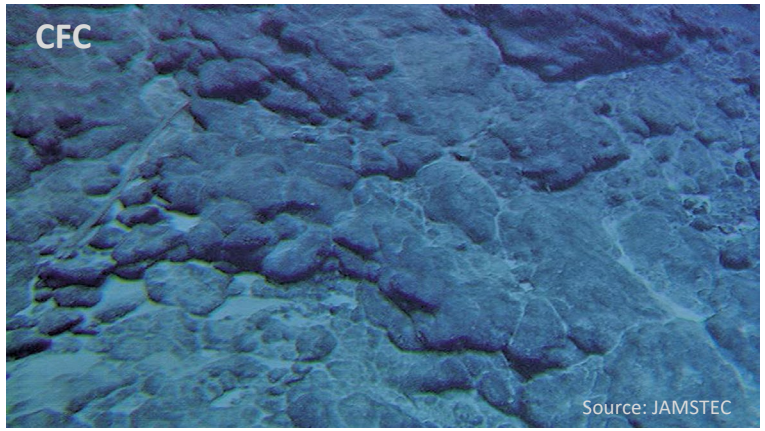
Source: British Geological Survey, UKRI 2018



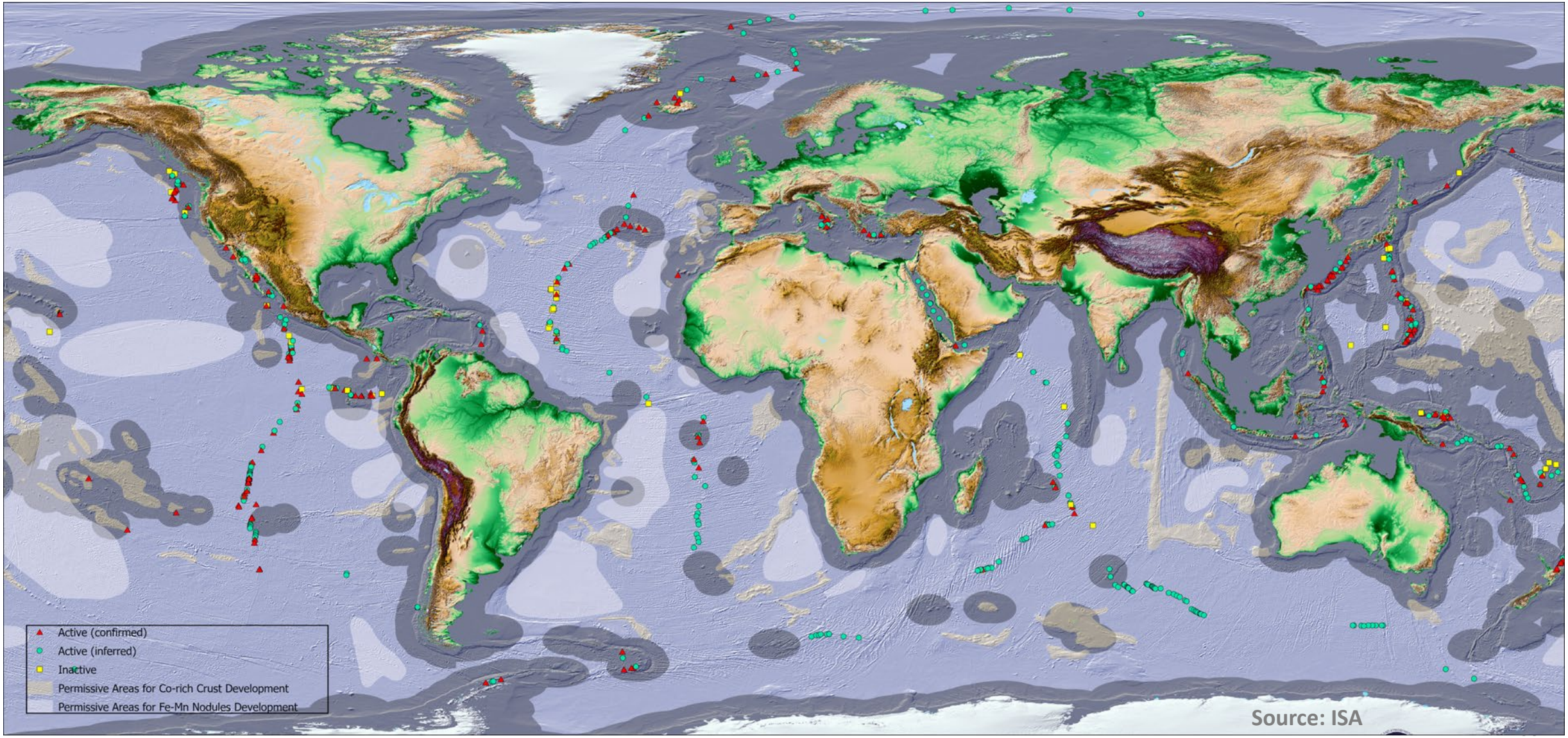
Source: ISA



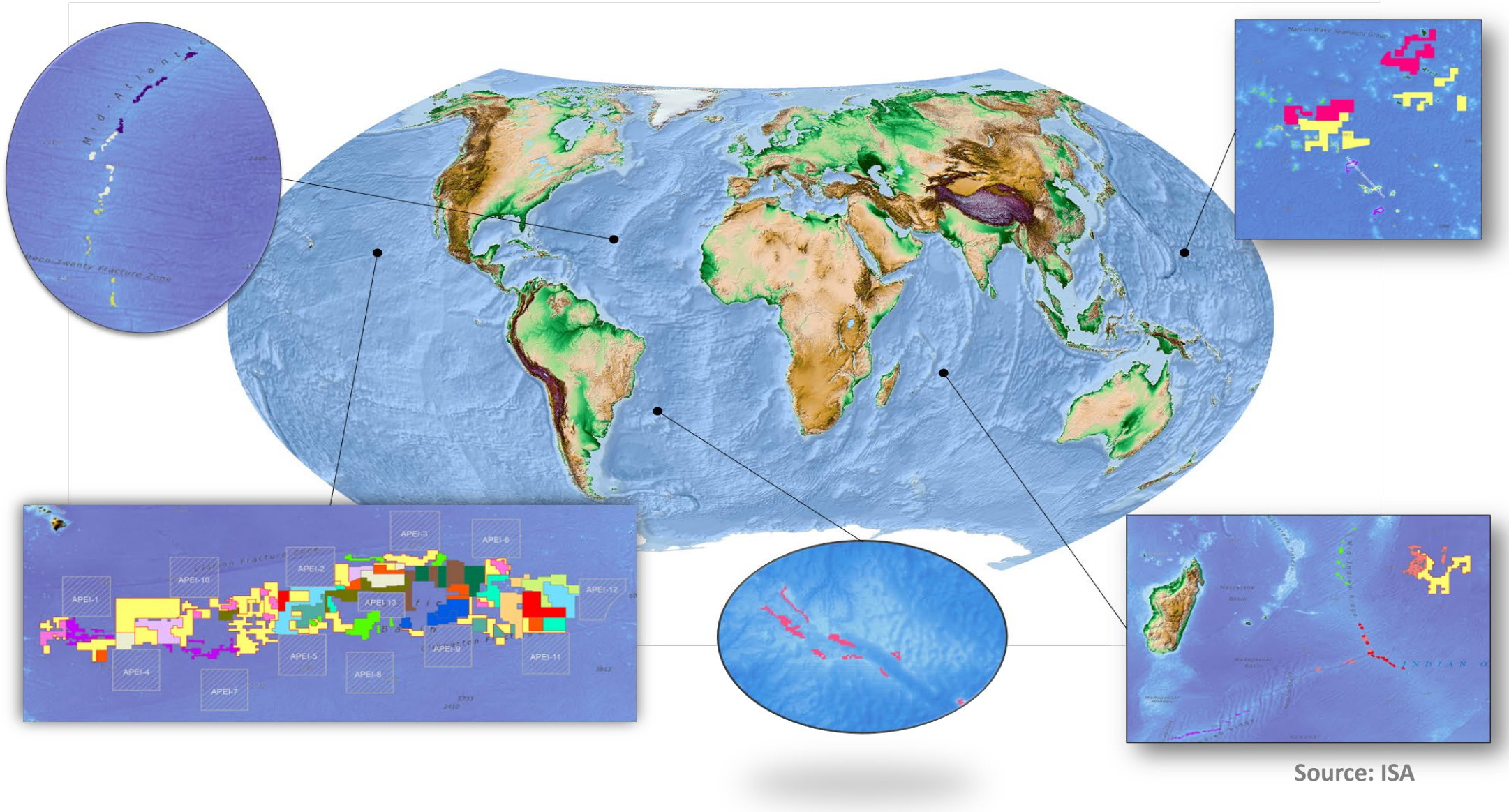




Resource Definition



Resource Definition, Exploration Contracts



Source: ISA

Technologies for Exploration and Environmental Baselines

IRENA
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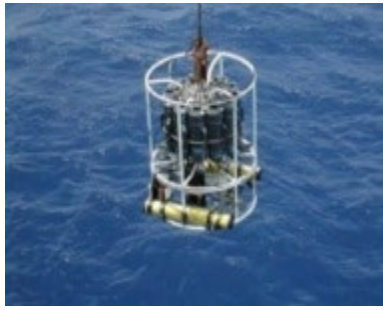
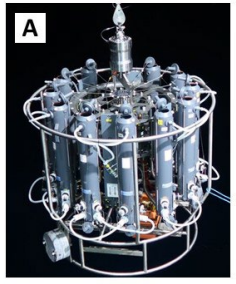
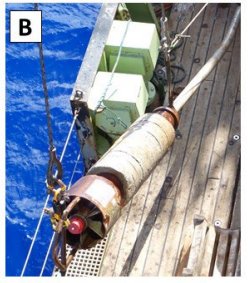
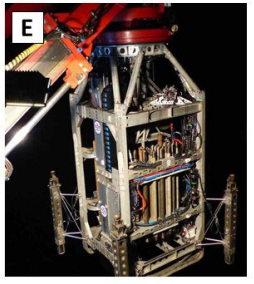
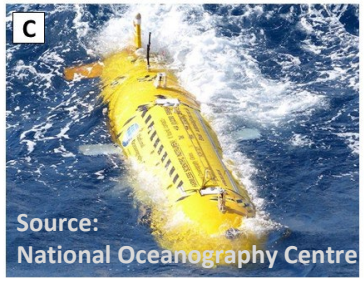


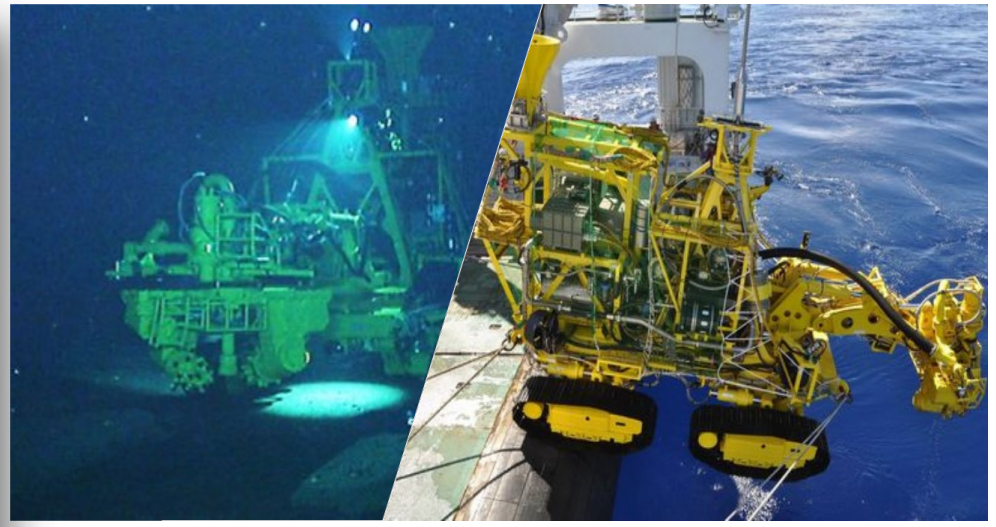


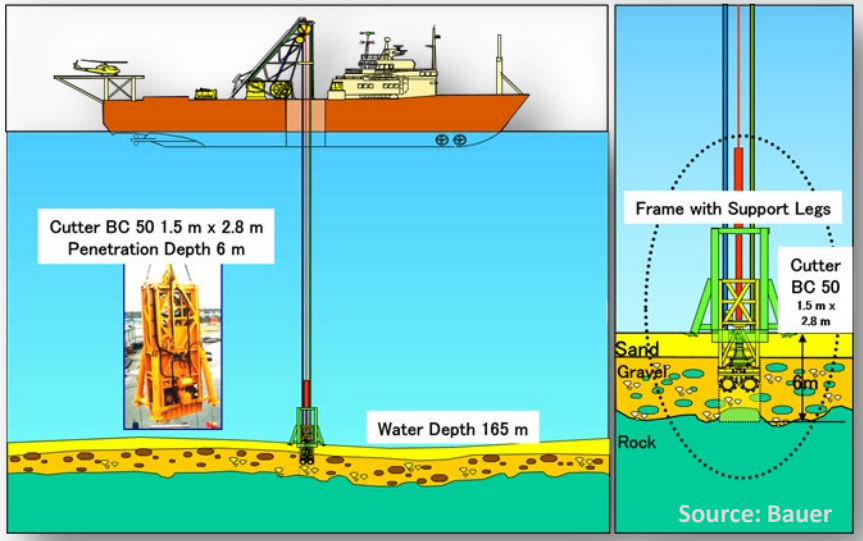


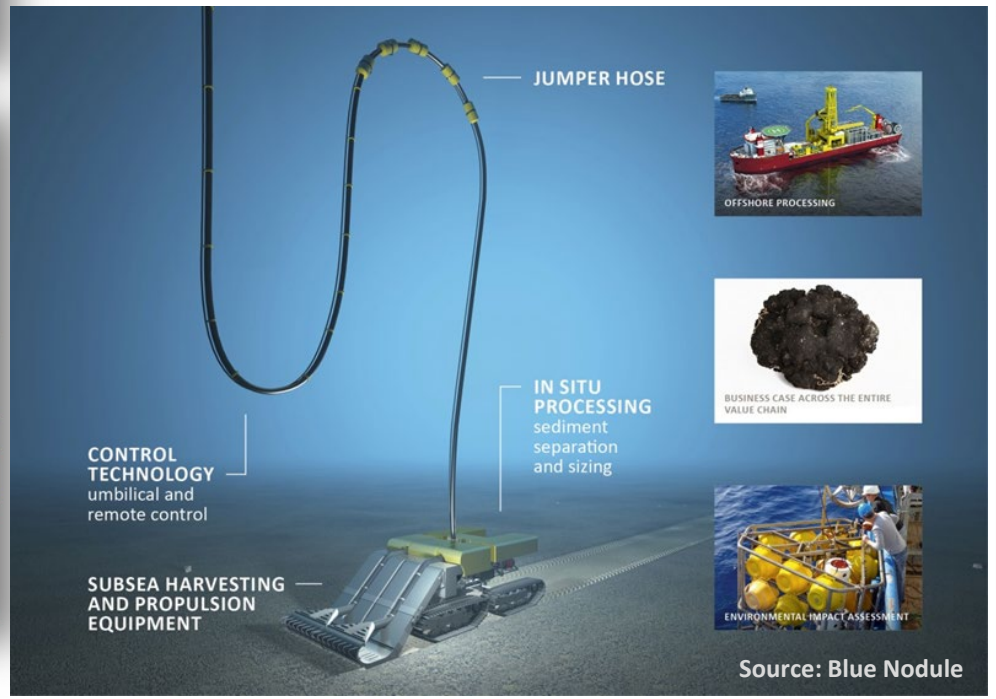




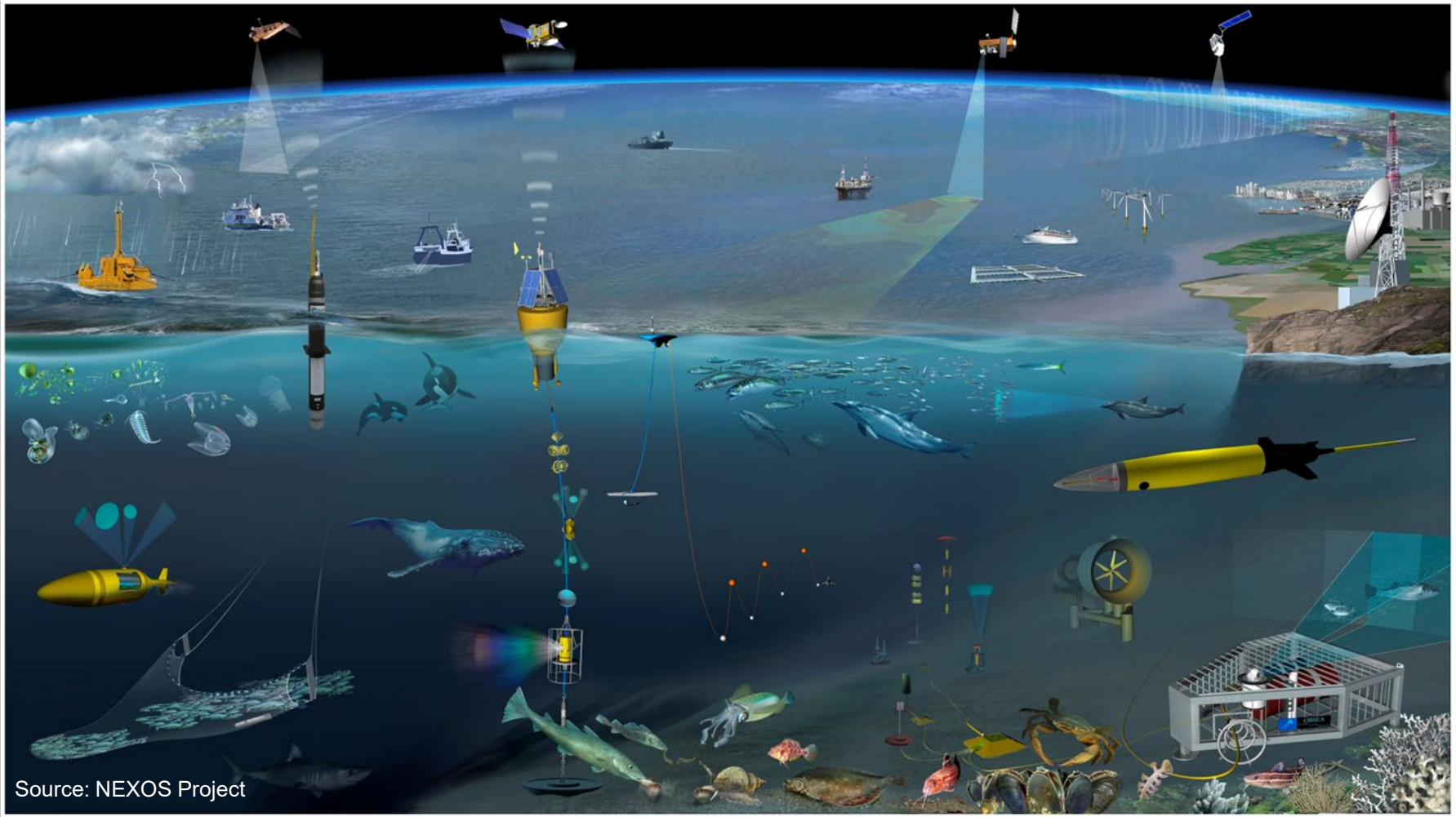
Technologies for Potential Exploitation

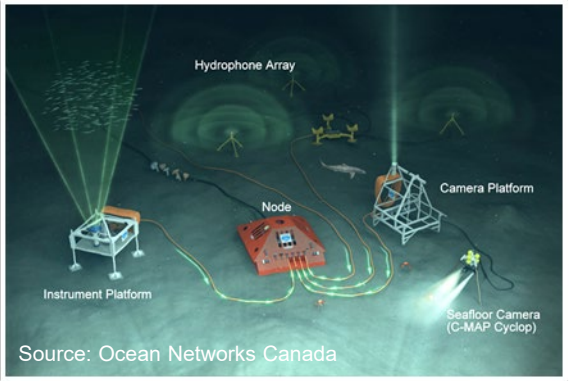


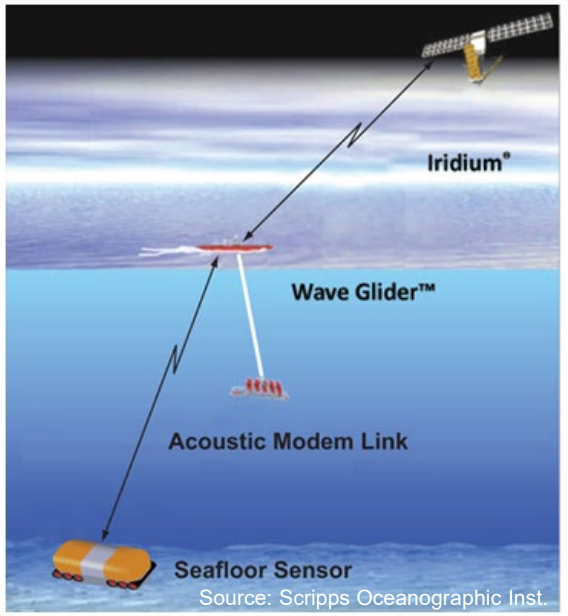




Exploration / Exploitation and Monitoring





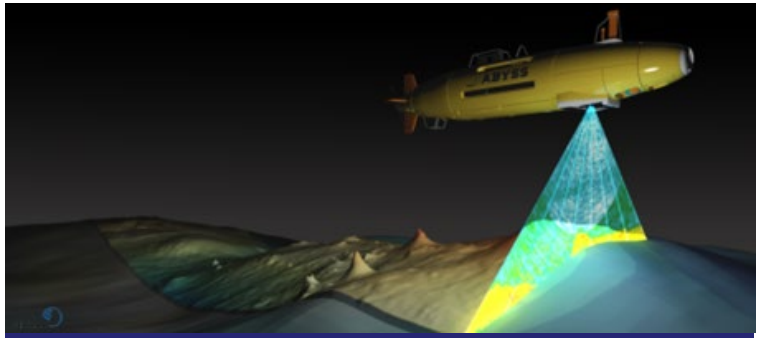


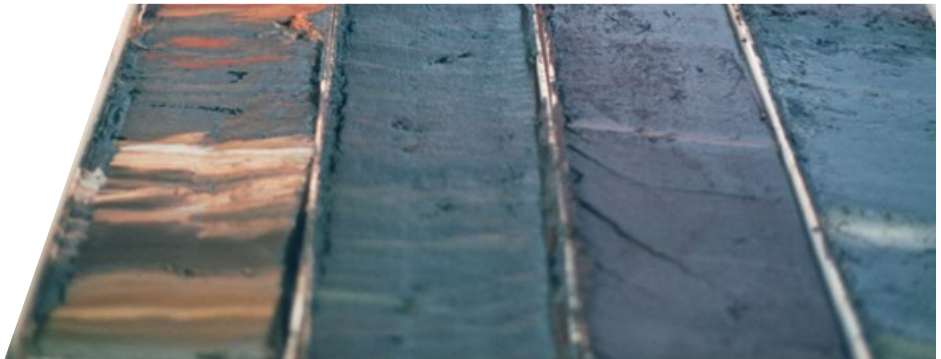
Marine Scientific Research

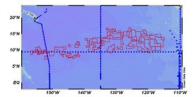
IRENA
International Renewable Energy Agency

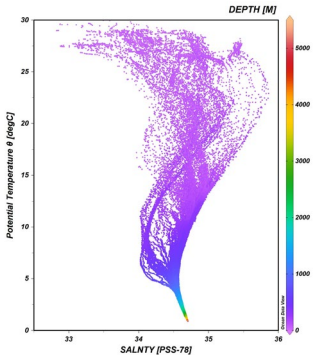
- AREA2030 initiative in cooperation with IHO
- Support to UN Ocean Decade 2030
- ISA's 'DeepData' data base from contractors' work for environmental baselines, available for researchers and scientific stakeholders
- Capacity Building with experts from developing countries (ADSR)

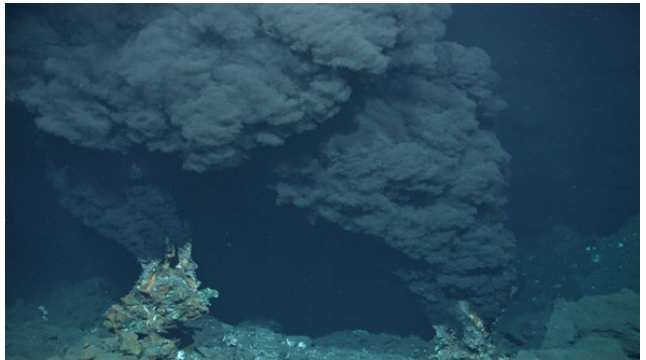
- Regional station and data compilation CCZ
- Sediment data analyses for prospecting and site identification
- Global water mass analyses
- Global geothermal potential of hydrothermal vent fields
- Metallurgical review for the processing of marine minerals











International Seabed Authority

Thank you for your attention!

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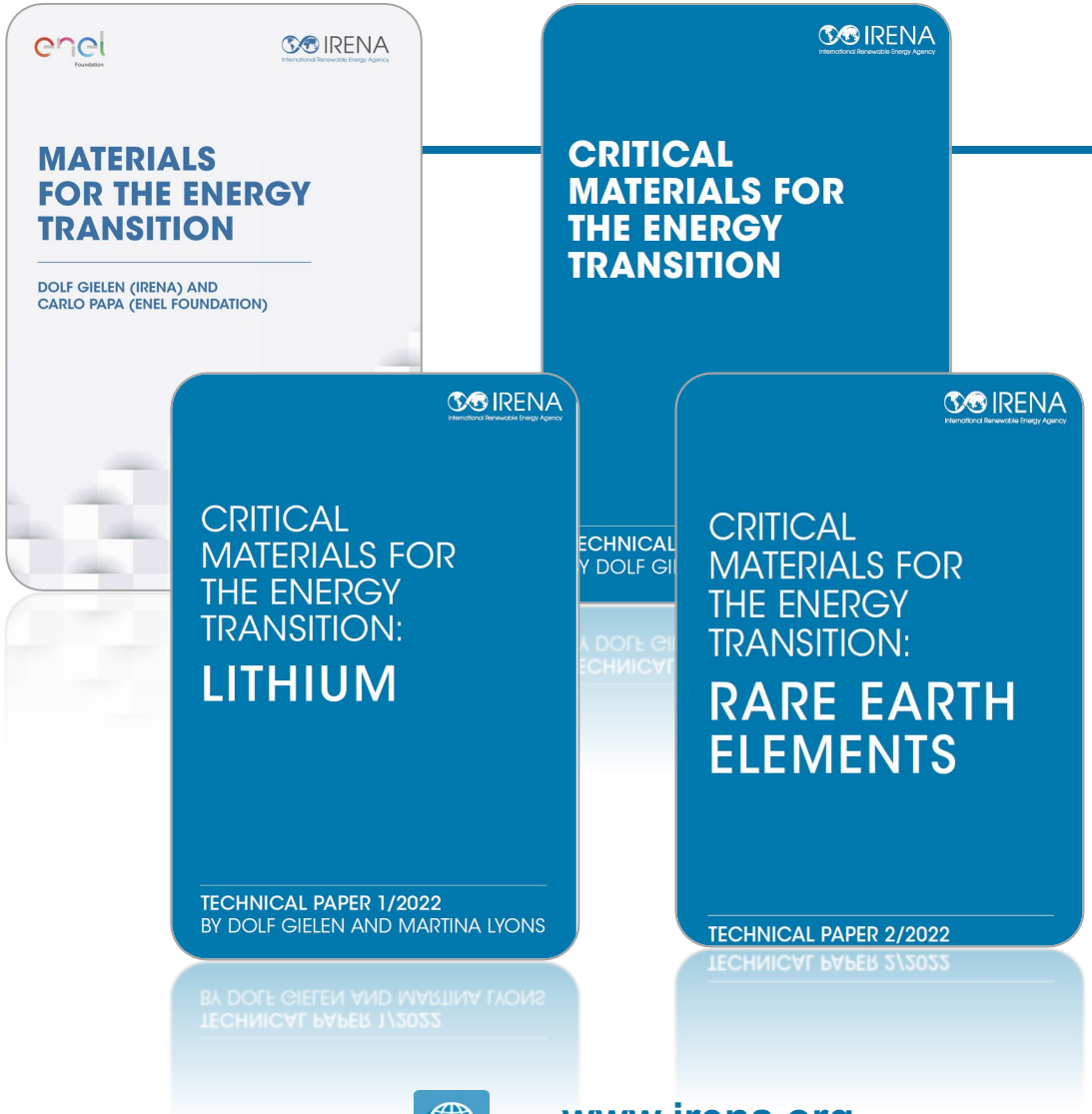
Part III: Discussion

Panel Discussion

Jon Machin
Head of Offshore Development
The Metals Company

Ambassador Margo Deiye
Ambassador, Permanent Representative to the ISA
Republic of Nauru

Ulrich Schwarz-Schampera
Programme Management Officer (Mining Geology)
International Seabed Authority



Thank you for your attention!

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