

# GSR | Update on the Patania II Trial and Monitoring Plans



MiningImpact 2 Open Discussion  
Virtual Meeting | 21 January 2021

Dr Samantha Smith | Head of Sustainability & External Relations



## MI2 Open Discussion

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# Introductions Who are we?

GSR Proprietary Information – Commercial in Confidence Treatment Requested

# Dredging, Environmental and Marine Engineering [DEME]

Turning challenges into opportunities



- 5,200 colleagues worldwide
- 100+ main vessels

- 77+ nationalities
- 140+ years of experience



# 2

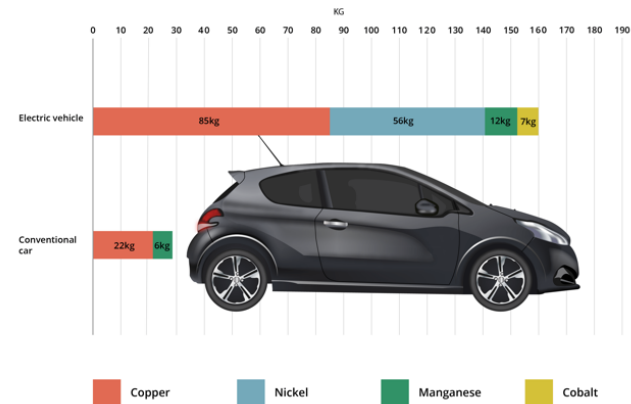
Why are we  
here?

# SUPPLY AND DEMAND OF CRITICAL MINERALS

## ECONOMIC DEVELOPMENT & CLEAN ENERGY TRANSITION

- ▶ Clean energy technologies are metal intensive
  - › Demand for cobalt four times greater than reserves by 2050, and will also exceed nickel reserves  
*Institute for Sustainable Futures, 2019 (1.5-degree scenario)*
- ▶ Urban infrastructure is metal intensive
- ▶ Recycling unable to bridge supply gap for many decades
- ▶ Sufficient terrestrial resources but seafloor may be a better option

Composition of electric vehicle versus conventional car



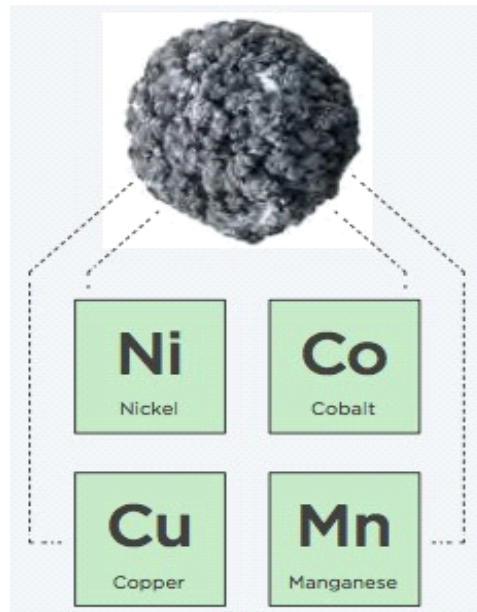
\* values represented are for an NMC811 battery and have been taken from "Lithium-Ion Battery Supply Chain Considerations: Analysis of Potential Bottlenecks in Critical Metals", Elsa A. Olivetti et al.



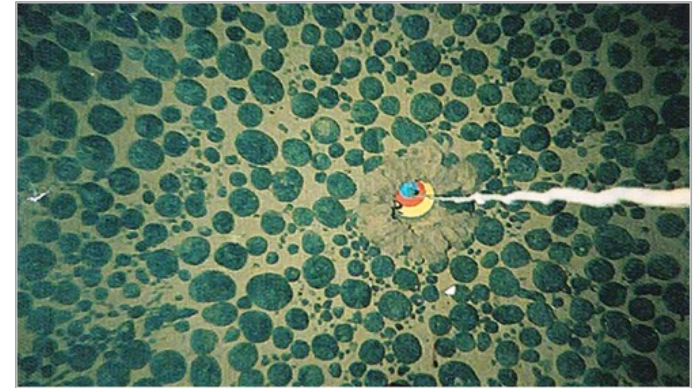
**New urban infrastructure to house a population of the size of New York required every eleven weeks between now and the end of the century**



- ▶ Rich in manganese, nickel, copper and cobalt
- ▶ Rare earths also present
- ▶ Potato-sized, hard
- ▶ Exist on the surface – not attached
- ▶ They cover extensive areas of the ocean's abyssal plains



## POLYMETALLIC NODULES

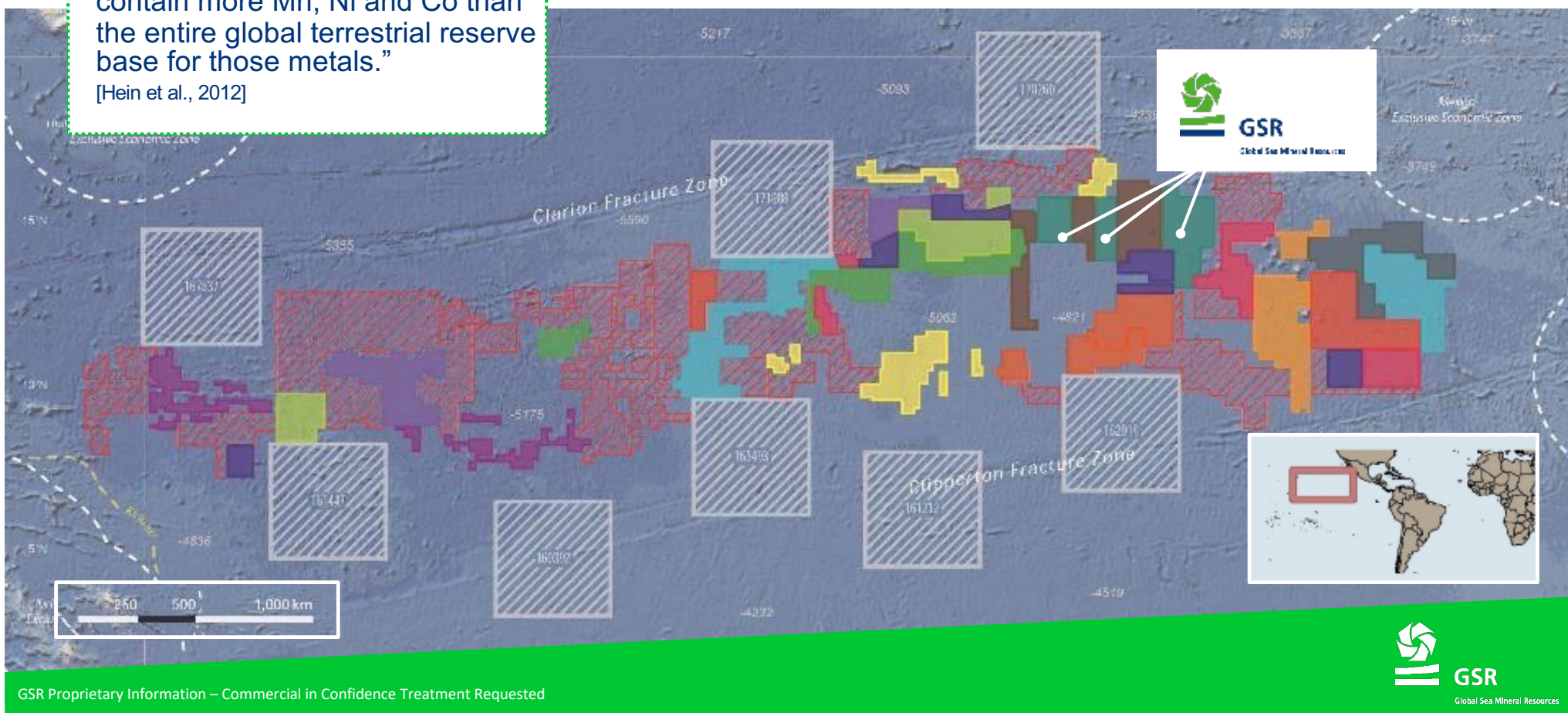


“Nodules in the Pacific Ocean contain more Mn, Ni and Co than the entire global terrestrial reserve base for those metals.”

[Hein et al., 2012]

## PROJECT DEVELOPMENT

EXPLORATION AREA IN THE CCZ



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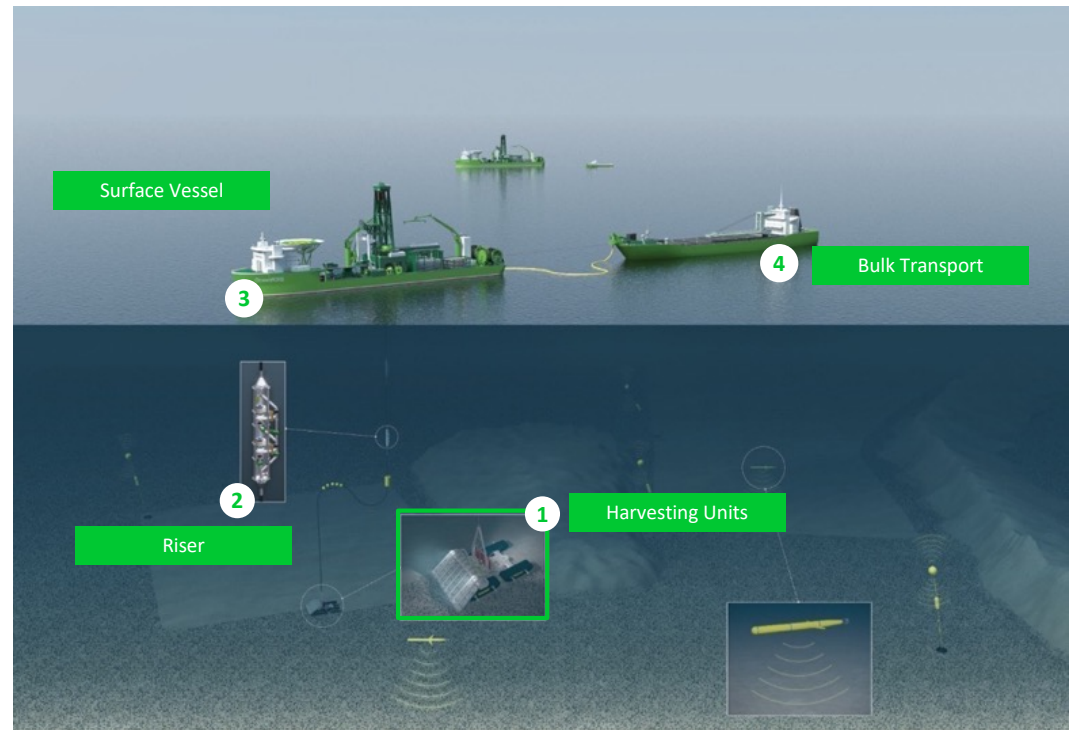
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## Project Development

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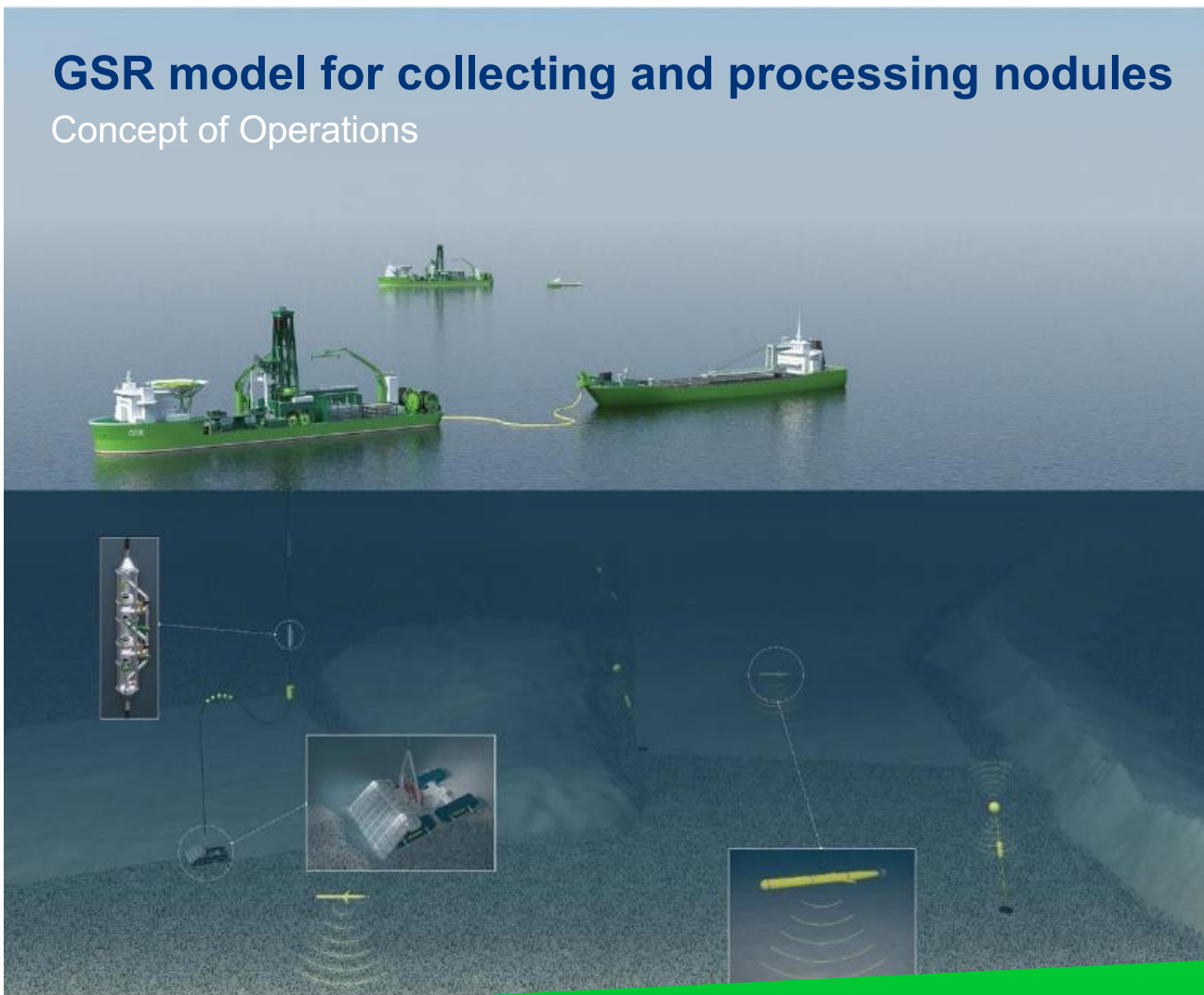
# GSR MINING SYSTEM OVERVIEW

- 1 ► **HARVESTING UNITS**
  - Hydraulic nodule collector, mounted on a tracked undercarriage
- 2 ► **VERTICAL TRANSPORT VIA RISER**
  - Collected nodules transported to the surface using a flexible riser, fitted with a series of single stage centrifugal pumps
- 3 ► **SURFACE VESSEL**
  - Surface vessels with the capability of handling nodules to be purpose built based upon current designs
- 4 ► **BULK TRANSPORT**
  - Transported on standard cargo vessels for shipment to land-based processing plant



# GSR model for collecting and processing nodules

## Concept of Operations





## STEP-BY-STEP APPROACH

### HARVESTING UNITS

**2017  
Patania I**



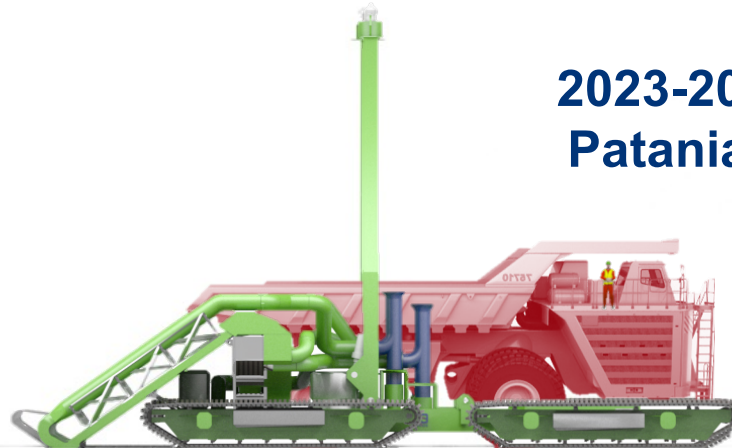
**Tracked Soil  
Testing Device**

**2020 - 2021  
Patania II**

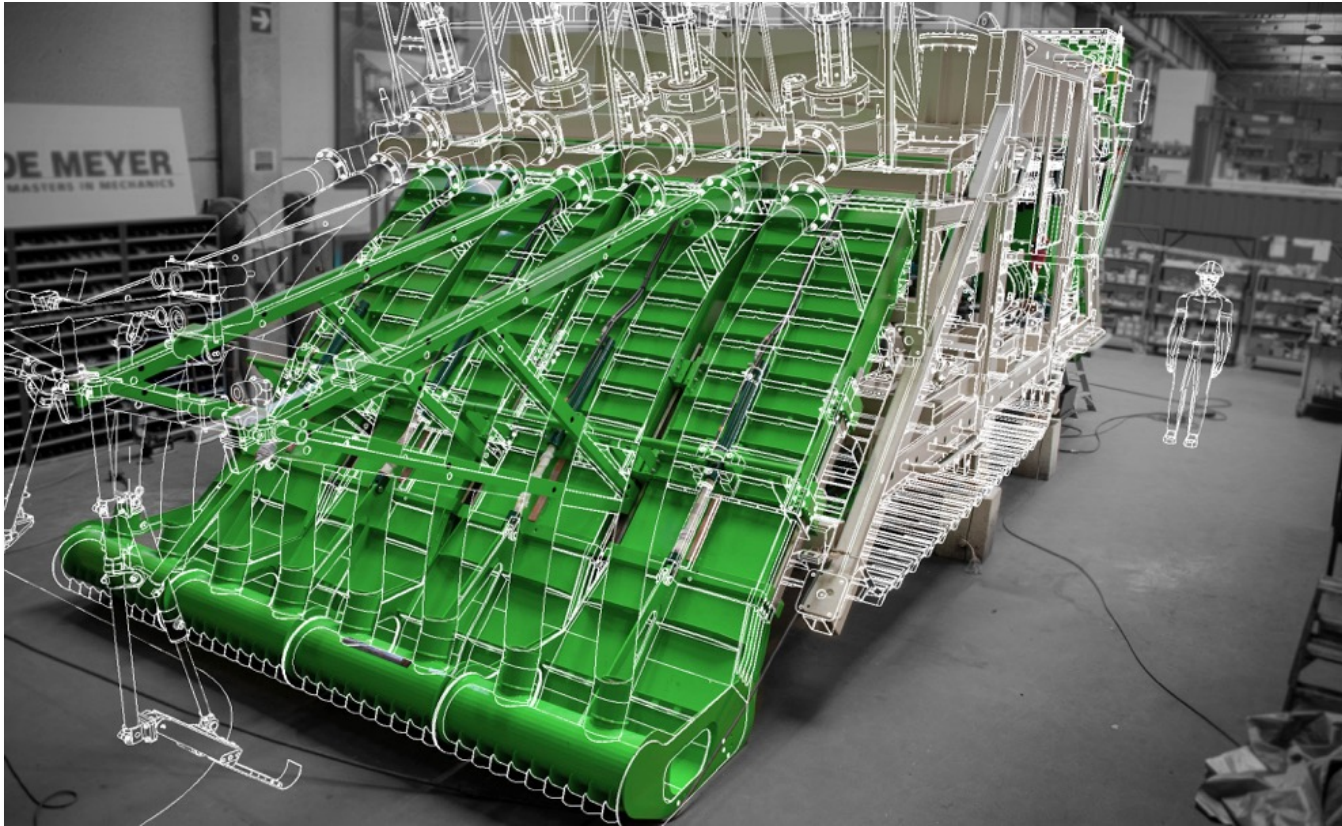


**Pre – Prototype  
Nodule Collector**

**2023-2024  
Patania III**



**Prototype  
Commercial Nodule Collector**



## Patania II

FROM DRAWING BOARD  
TO REALITY

Patania II - named after  
the fastest moving  
caterpillar on earth.

12m-long  
4m-wide  
4.5m-high  
25-ton  
nodule-collecting robot on  
caterpillar tracks

## STEP-BY-STEP APPROACH

### COLLECTOR ASSESSMENT ATLANTIC



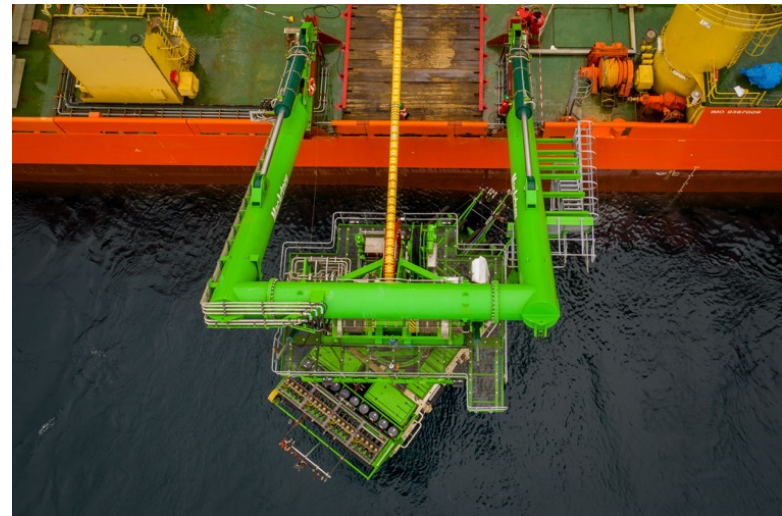
- ▶ Atlantic Expedition
  - ▶ 22 June – 19 July 2020
  - ▶ Validation of launch & recovery system and hyperbaric test of Patania II
  - ▶ Depth: 4500 m
  - ▶ No touch-down on seabed
- ▶ Trafficability assessment in Belgian EEZ
  - ▶ Depth: 28m



## STEP-BY-STEP APPROACH

### NEXT STEPS

- ▶ Prepare for Patania II trial in CCZ
- ▶ Period: February – May 2021
- ▶ Goal: In-situ validation of PII as per original EIS
- ▶ GSR Environmental Program complemented by independent vessel [GEOMAR – BGR]





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## RESPONSIBLE APPROACH



**GSR**

Global Sea Mineral Resources

## ENVIRONMENTAL MANAGEMENT

### GSR'S APPROACH

- ▶ Early, inclusive, transparent and ongoing engagement of key stakeholders
- ▶ Environmental Risk Assessment approach
- ▶ Step-by-step, precautionary
- ▶ Partnering with the scientific community
- ▶ **Demonstration that environmental effects can be adequately predicted and monitored**
- ▶ Demonstration that impacts and effects are acceptable





## OBJECTIVES

JPIO II

### ProCat Project | Patania II Phase

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In situ trials, in the operational environment of the CCZ, in order to:

- Confirm trafficability and maneuverability of soil specific- and purpose-built caterpillar tracks, decreasing energy consumption and direct seabed disturbance
- Optimize the in-situ operations of a hydraulic collector head to increasing pick-up efficiency and decrease energy consumption
- Validate nodule-sediment separation process of primary flow and subsequent nodule transport by secondary flow
- Verify reliability and the robustness of the technology to increase the state-of-the-art

### JPI-O MiningImpact 2 project – Assessing environmental effects

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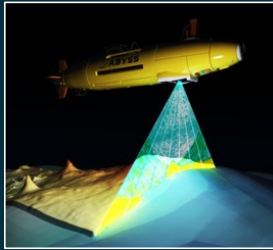


Independent scientific evaluation of the environmental impacts of the ProCat trials, in order to:

- Reduce existing knowledge gaps and uncertainties about environmental impacts
- Gather data about operational impacts
- Design of fit-for-purpose environmental monitoring programs
- Make recommendations of a precautionary approach for ISA's exploitation mining code



Boxcore



AUV

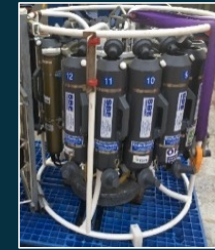


ROV



SyPRID

Deep sea  
Mooring



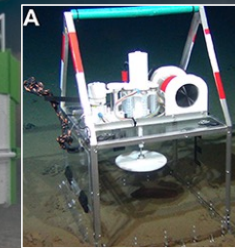
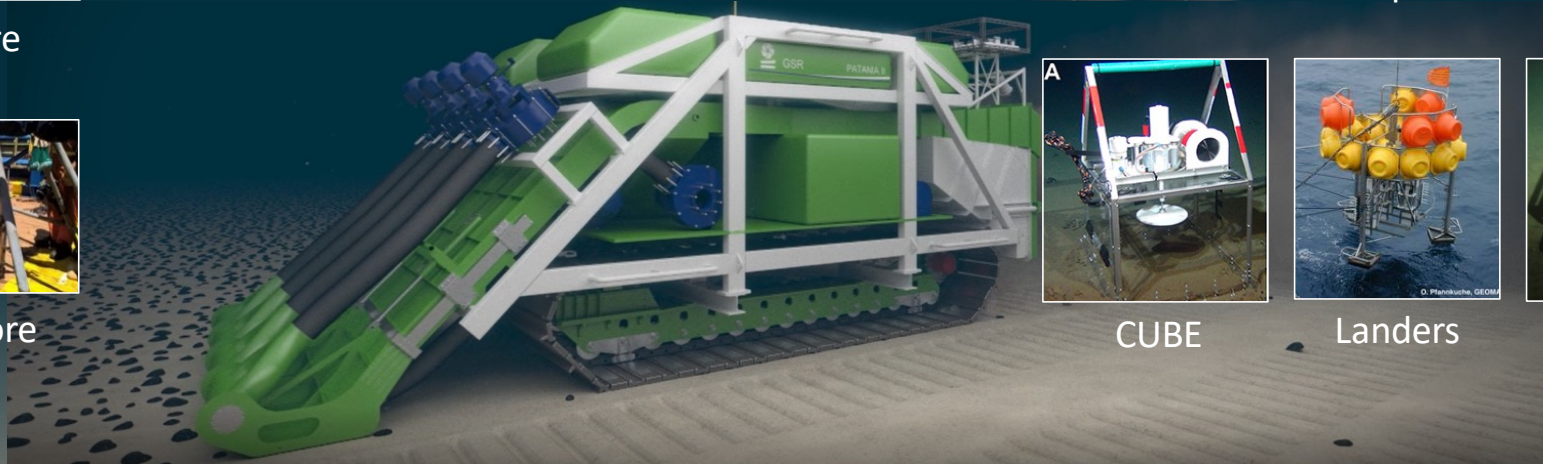
Water  
samplers



Pushcores



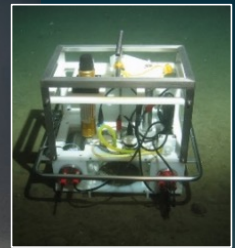
Multicore



CUBE



Landers



Benthic  
chamber





## ENVIRONMENTAL IMPACT ASSESSMENT FOR A SCIENTIFIC TEST [PRIOR-EIS]

- **Environmental Impact Statement**
  - › Introduction
  - › Policy, legal and administrative context
  - › Project description
  - › Description of the existing environment
  - › Assessment of impacts and proposed mitigation
  - › Accidental events and natural hazards
  - › Environmental management, monitoring and reporting
  - › Abbreviations
  - › Study team
  - › Expert review
  - › References

Ref: Following ISBA/23/LTC/CRP.3\* Download:

<https://www.deme-group.com/gsr/news/gsr-publishes-its-prior-environmental-impact-statement-relating-2019-patania-ii-disturbance>







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## PATANIA II MONITORING

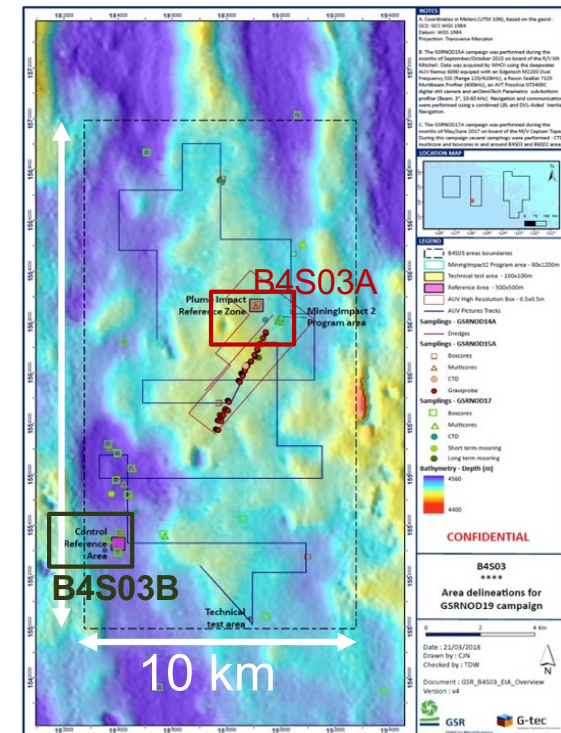


**GSR**

Global Sea Mineral Resources

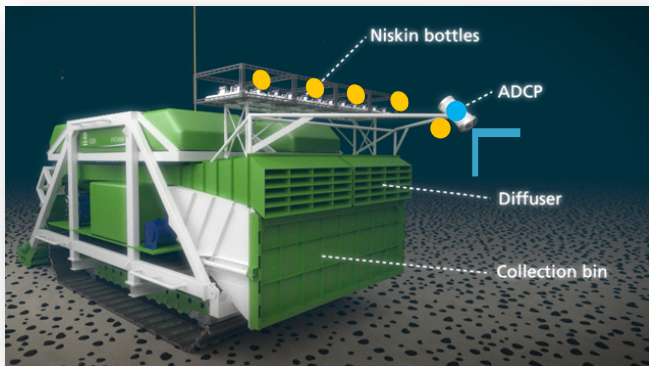
# MININGIMPACT2 LOCATIONS

- ▶ **MiningImpact2** | Before, After, Control, Impact (BACI)
- ▶ **Environmental Monitoring** | Same conditions as presented in the prior-EIS
- ▶ **B4S03A** : Area for the JPI-O MiningImpact 2 sites
  - › 'Mined' Area → Known
  - › Sediment plume → To be confirmed/determined
  - › During 2019: *Before* sampling, in-survey
  - › Long mooring since 2017 for background current, background turbidity levels & background Vertical fluxes, sedimentation
- ▶ **B4S03B** : Reference Site



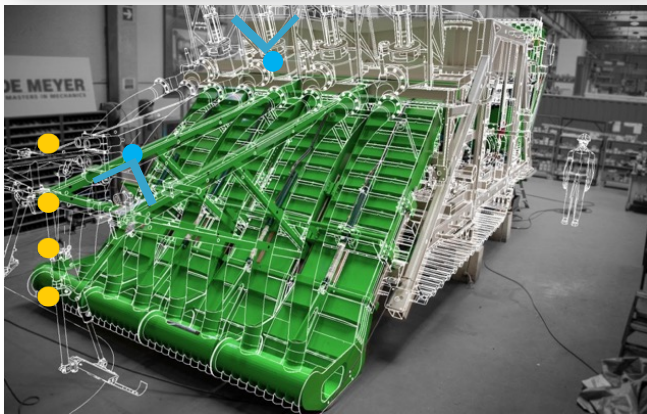
## PATANIA II MONITORING

### SENSORS AND EQUIPMENT



#### ► Sediment cloud behavior & design optimization – Near Field

- Densitometer / Flowmeter : sediment load and flow
- Multibeam / Altimeter: Depth of removal of sediment
- ADCP: 3D sediment plume dispersion & current
- Turbidity sensors : concentration in the plume
- HD camera (visual observations)
- Niskin bottles (water samplers)



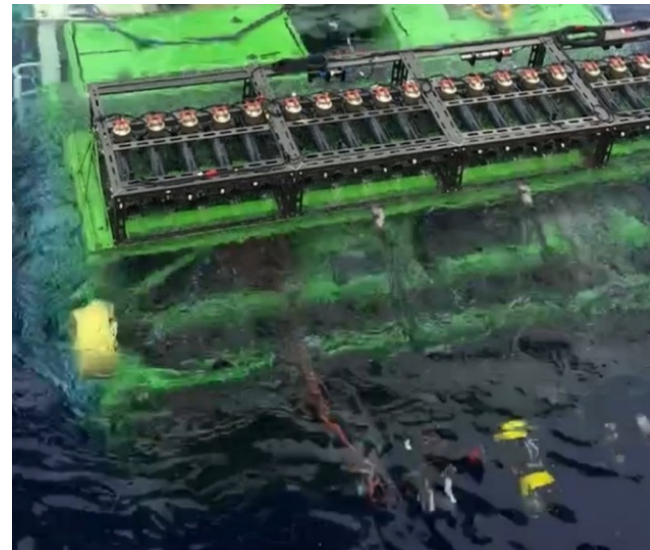


## PATANIA II MONITORING

### SENSORS AND EQUIPMENT



Plankton Pump



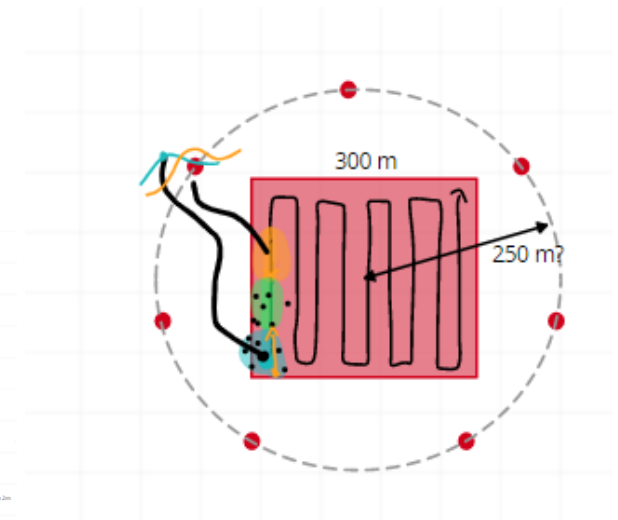
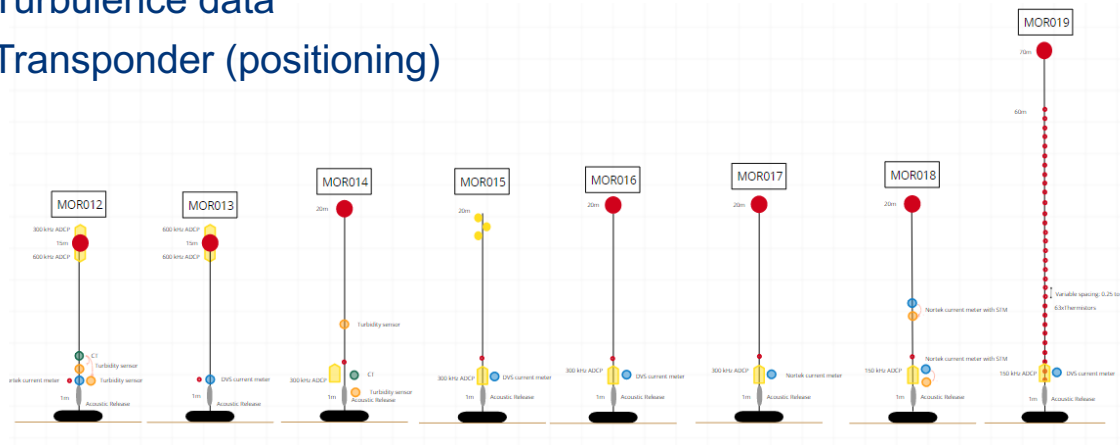
Remote-sampling Niskin bottle array for water sampling

# PATANIA II MONITORING

## SENSORS AND EQUIPMENT

### Mooring Placement

- › Turbidity data
- › ADCP data
- › Hydrophone
- › Turbulence data
- › Transponder (positioning)



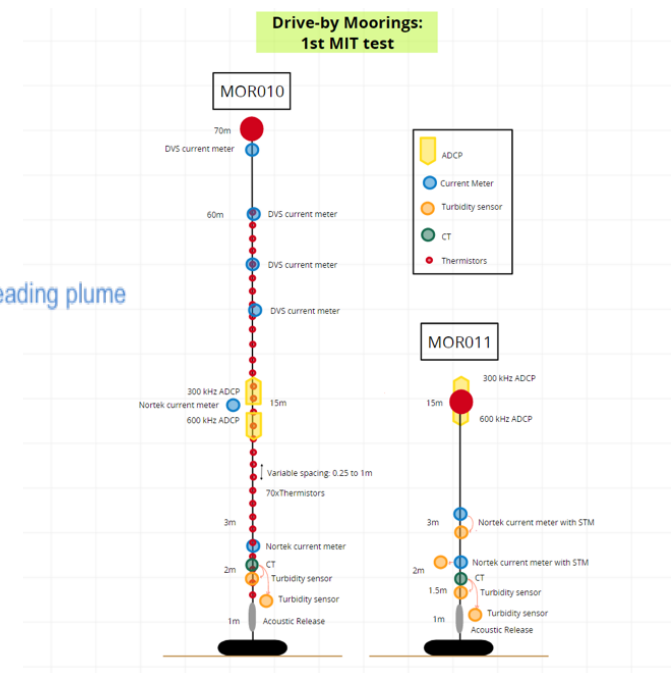
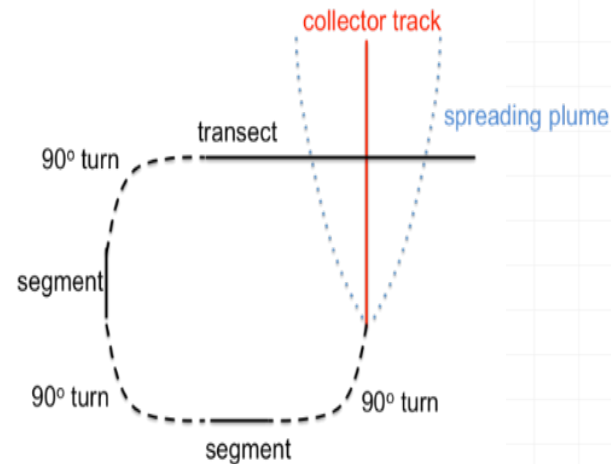
## ► Sediment cloud behavior & design optimization – Near Field

### ► Operations : Use Patania II as a monitoring tool to test multiple scenarios

- › number of suction heads,
- › flow rate,
- › speed of collection,
- › height of collection above seabed

### ► Objective :

- › Validate sediment plume model
- › Sediment remaining in suspension
- › Sediment characterization
- › Sediment layer removed





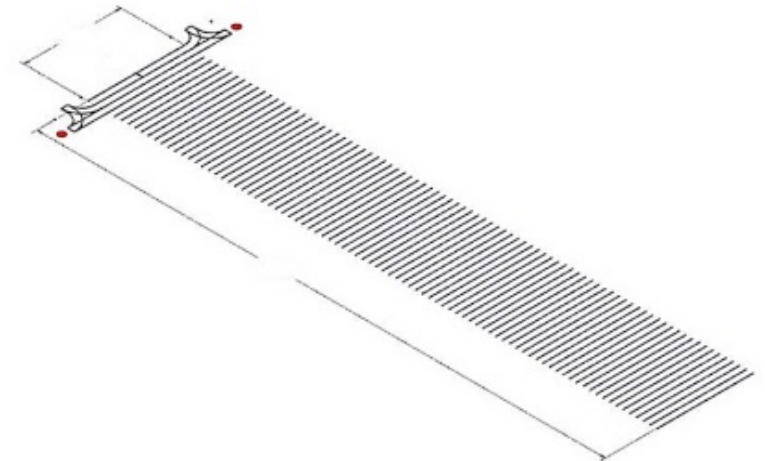


## JPIO II UPDATE

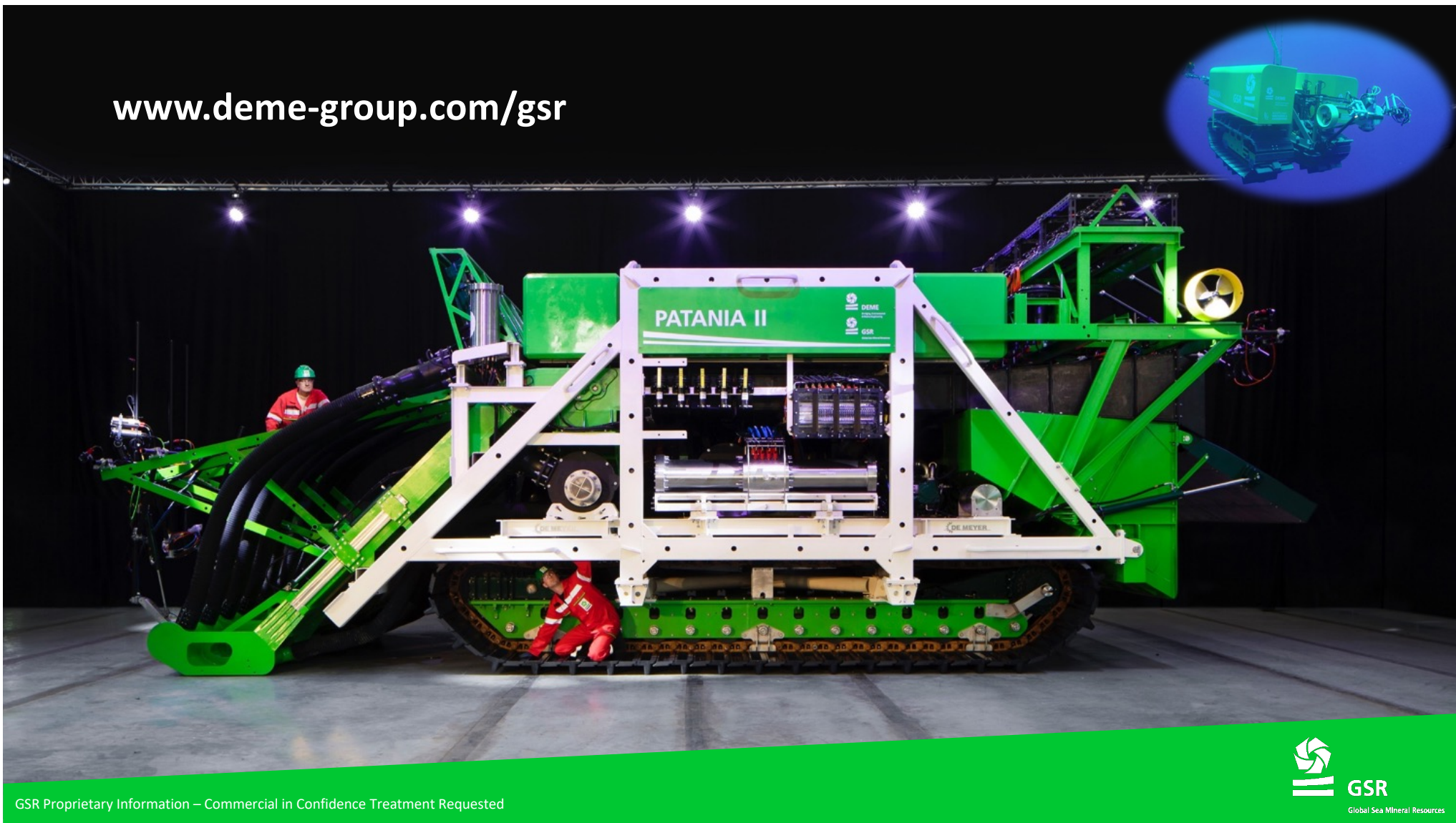
### ► Environmental Monitoring | Independent third-party:

- › In line with its commitment to an open, transparent, and scientifically rigorous testing program, the Patania II trial will be independently monitored by the MiningImpact 2 consortium.
- › Another contractor, the Federal Institute for Geosciences and Natural Resources (**BGR**) has offered the use of its regular baseline charter for a monitoring campaign dedicated to achieving the objectives of the MiningImpact 2 project.
- › Impact of the Patania II trial has not changed.
- › MiningImpact 2 researchers remain involved.
- › Monitoring objectives will be met.
- › Study represents an important collaboration.

### ► Aim: remove nodules from part of the seafloor to mimic conditions of an actual mining operation and monitor impacts



[www.deme-group.com/gsr](http://www.deme-group.com/gsr)



GSR Proprietary Information – Commercial in Confidence Treatment Requested