



Digitalization of the ocean space

Robotics and digital solutions for the Deep-Sea Mineral market

Argeo team present here today



Trond Figenschou Crantz
CEO / Founder

- 20+ years of leadership experience from Schlumberger and PGS
- Extensive technical, operational and commercial experience
- B.Sc. In Robotics and MBA



Thorbjørn Rekdal, PhD
CTO

- 20+ years of leadership experience from PGS
- Head of PGS Research and Commercialization
- Chair of PGS Technology Council
- Commercialized several large technology projects
- PhD in Geophysics and M.Sc. in Applied Mathematics



Odd Erik Rudshaug
CFO

- 35+ years experience from shipping and oil & gas
- Co-founder & CFO for RXT, experience from PGS and EMGS
- M.Sc. Business & Economics



Anna Lim, PhD
Discipline Leader

- 10 years of research experience from international projects and Oil&Gas industry
- Expert-coordinator of Deep-Sea Mining pilot at NTNU
- 3 successful Ultradeep-water Exploration Campaigns including simultaneous multi-AUV and multi-ROV surveys
- PhD in Geophysics from NTNU

Argeo's mission

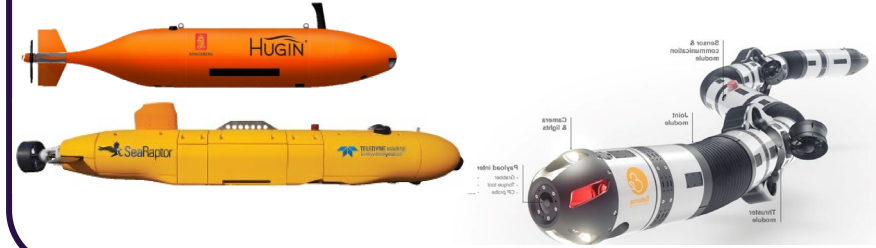
Transforming the ocean surveying and inspection industry

..by utilizing autonomous underwater and surface vehicles & unique sensor and imaging technology

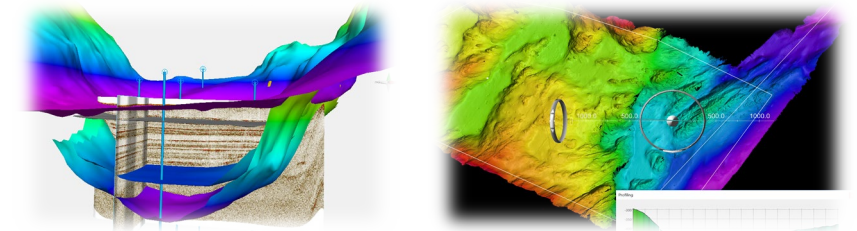
..to significantly increase efficiency and quality

..and to substantially reduce the CO2 footprint for the industry

High capability AUVs



Unique imaging and modelling technology



“Faster, better, greener and at a lower cost”

Robotics and Digital solutions for the ocean space

EPCI



- Data acquisition, imaging and underground modelling for large infrastructure projects
- High accuracy imaging reducing project risk and construction costs

Offshore wind



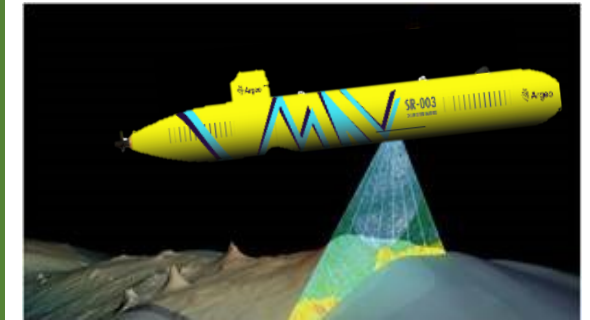
- Wind farm design of foundations, substations etc.
- Investigation of routes for power cable
- Inspection of existing infrastructure

O&G Survey & Inspection



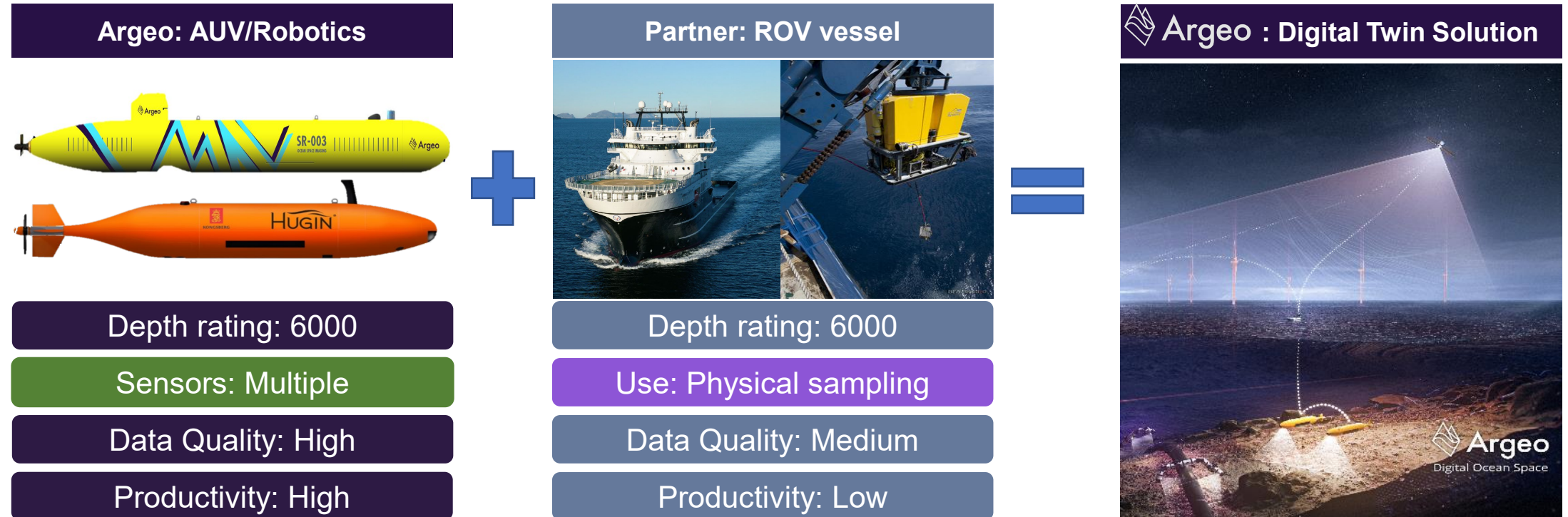
- Offshore field design, location of platform and subsea infrastructure
- Investigation of routes for pipelines
- Detection of damage and erosion on existing installations

Deep Sea Minerals



- Exploration for Deep-Sea Minerals (DSM)
- Wide use of sensors and in-house technology for mineral deposits characterization, a system under development by Argeo Robotics

Technology and methods in use for the Deep-Sea Mineral “industry” today



Robotics for every offshore service requirements

Ultra Deep-Water Survey



Ultra Deep-Water Survey



Inspection, Maintenance and Repair (IMR)



Key features

- Up to 50 hours battery capacity
- Depth rated to 6,000m
- Wide range of available sensor integrations
- Custom sensor integrations available

- Up to 50 hours battery capacity
- Depth rated to 6,000m
- Great maneuverability and stability
- Visual, bathymetric and sonar survey data

- Modular combination of joints, thrusters and payload modules
- Disruptive technology for subsea inspection, maintenance and repair (IMR)
- Engineered to live permanently under water

Benefits

- ✓ Container based (40") LARS integrated
- ✓ Multiple inhouse developed sensors
- ✓ Fully modularized design for easy transport
- ✓ Long endurance and autonomous navigation

- ✓ Container based (40") LARS integrated
- ✓ Multiple modularized sensor systems
- ✓ Long endurance and autonomous navigation

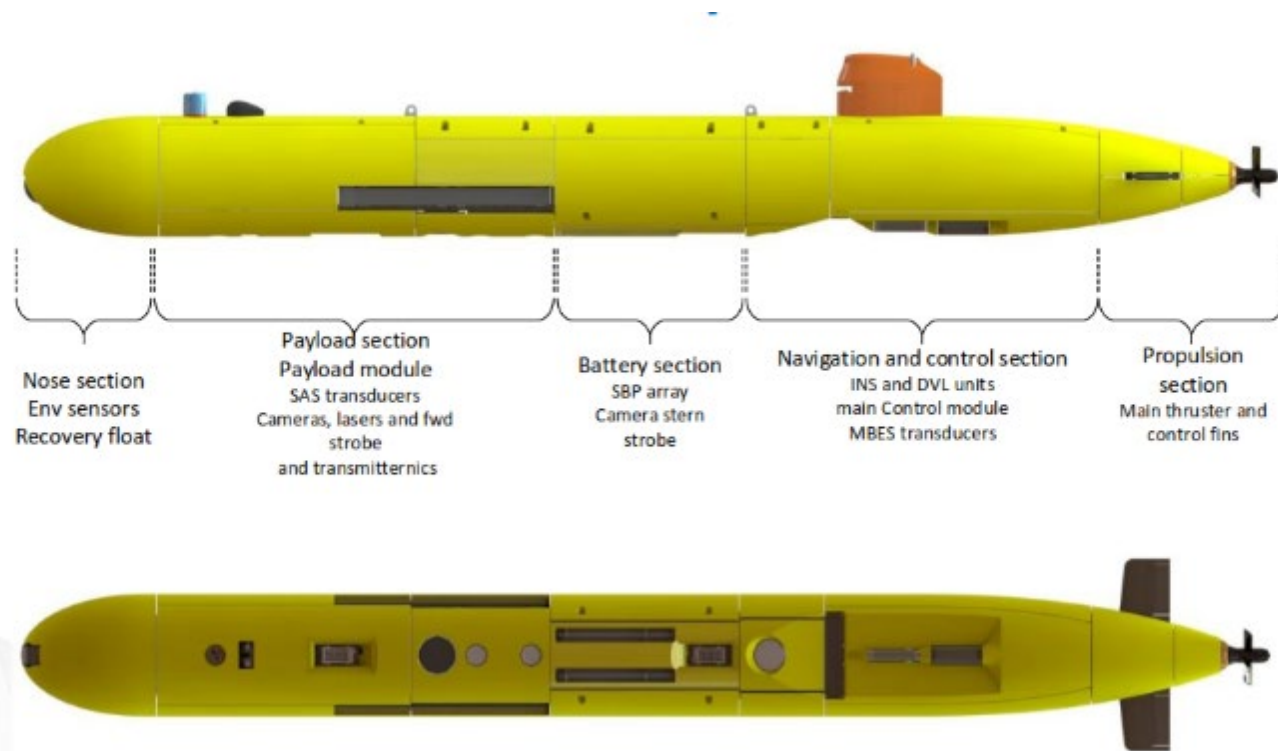
- ✓ Ultra-flexible and slender body that can operate in restricted areas subsea
- ✓ Modular system that can be tailor made for various operations
- ✓ Perfectly placed for DSM monitoring tasks

Exploring and mapping
the deep oceans



A closer look at our SeaRaptor 6000

Autonomous Underwater Vehicle (AUV)



Vehicle dimensions specifics

Length: 6.8 meters

Weight: 1.6 tons

Design: Modular

Operations: 40" container

Main payload sensors

Acquiring 2.5 km² per hr at 3-4 cm resolution, that's 60 km² 3D per day

CathX Hunter UHD Camera and laser system

Kraken minSAS sonar system

Teledyne Multibeam

Teledyne Sub-Bottom Profiler

A cluster of Environmental sensor systems

Multiple LED strobe lights

Magnetometer

In-house technology for mineral deposits characterization - Argeo Robotics

The Art of SAS



Kraken minSAS 120



No Motion Blur



High level of Detail



CX-OB-1916

-18.166730410221938

117.46582031250001

Speed: 4kn

Altitude: 4m



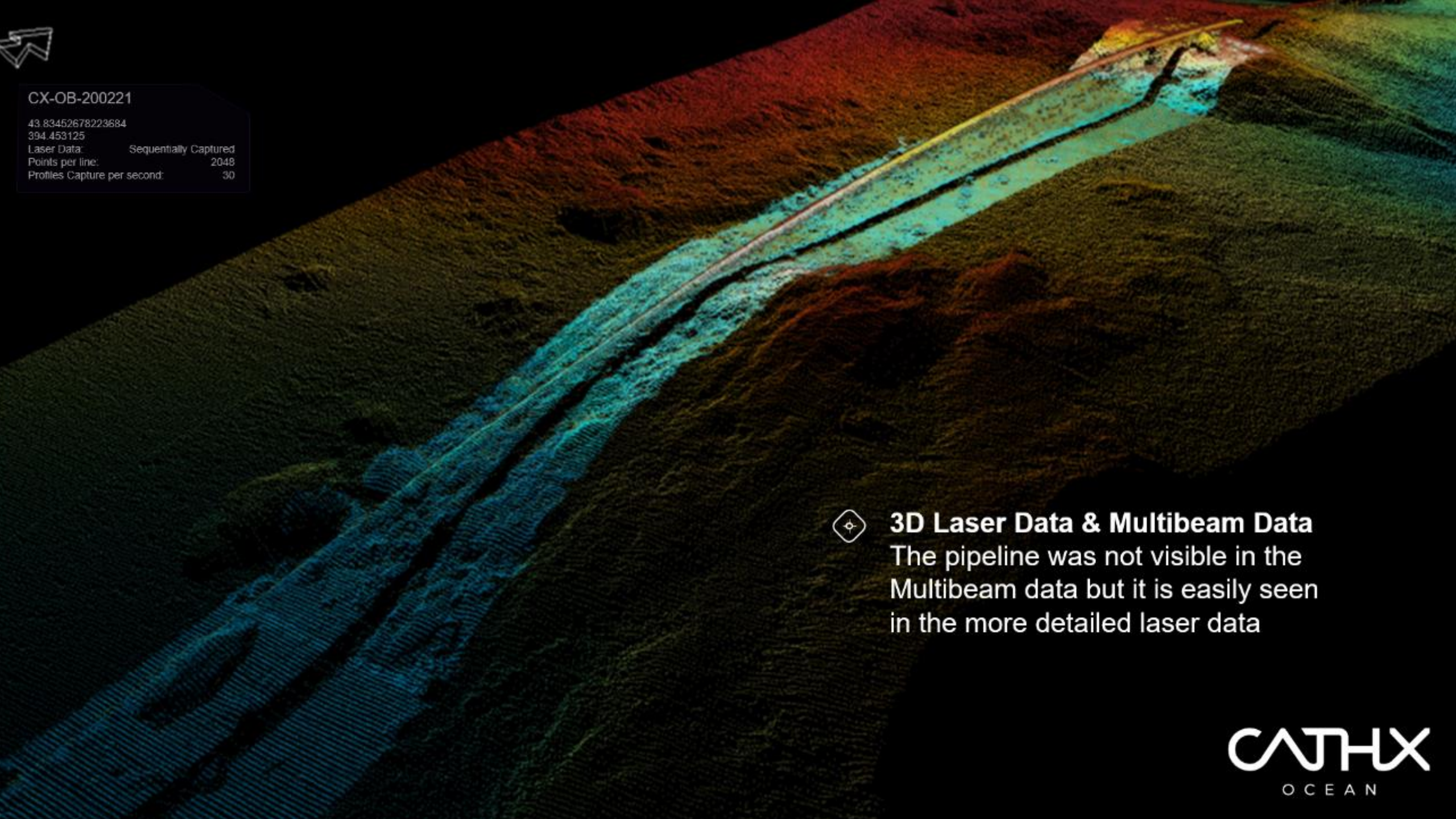
Coloured Image



Evenly lit scene

Small area seafloor detection (hair level)

CATHX
OCEAN



CX-OB-200221

43.83452678223684

394.453125

Laser Data: Sequentially Captured

Points per line: 2048

Profiles Capture per second: 30

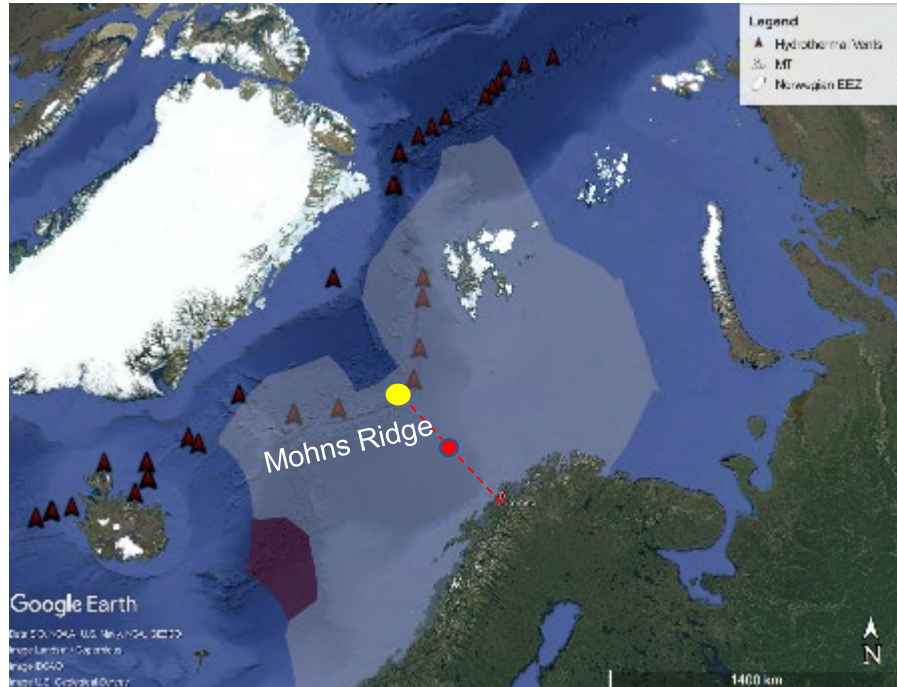


3D Laser Data & Multibeam Data

The pipeline was not visible in the Multibeam data but it is easily seen in the more detailed laser data

A look into the near future of Argeo operations

The Mohns (Annas) Treasure scenario



Distance from Tromsø = 510 km

Roundtrip = 1020 km

Argeo onshore Mission Controlled Operation



Mohns Ridge full length is ~ 500 km

Very Long Range AUV's:

Transit capacity: 52% (1020 km)

Remaining survey capacity: 980 line km

3D Survey duration 6.5 days ~ 400 KM²

No surface vessel needed, fully remote operation from Argeo Mission Control Center

Very Long Range AUV's

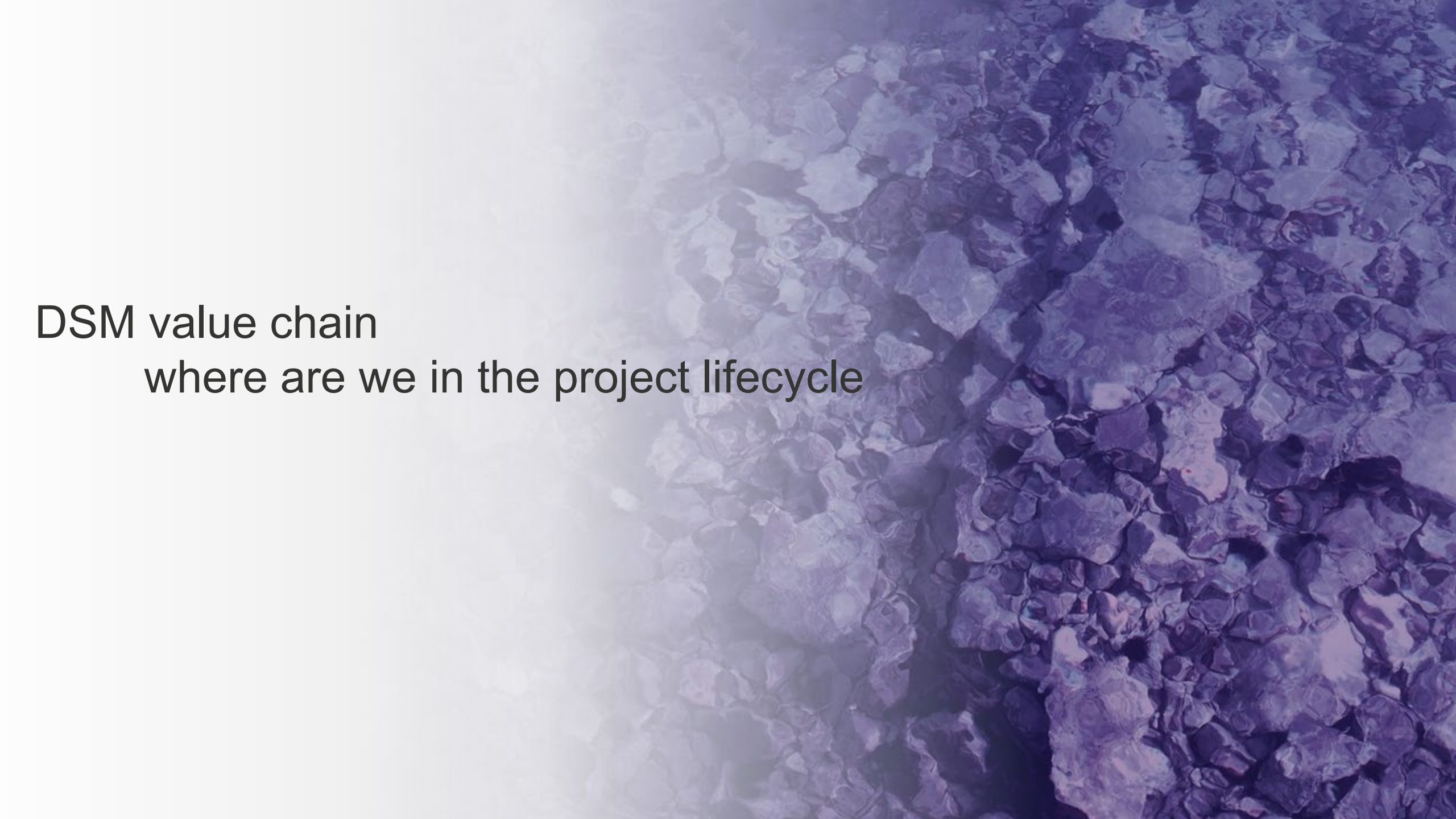


Resident IMR robots



Strategic asset rollout plan taking advantage of new technology

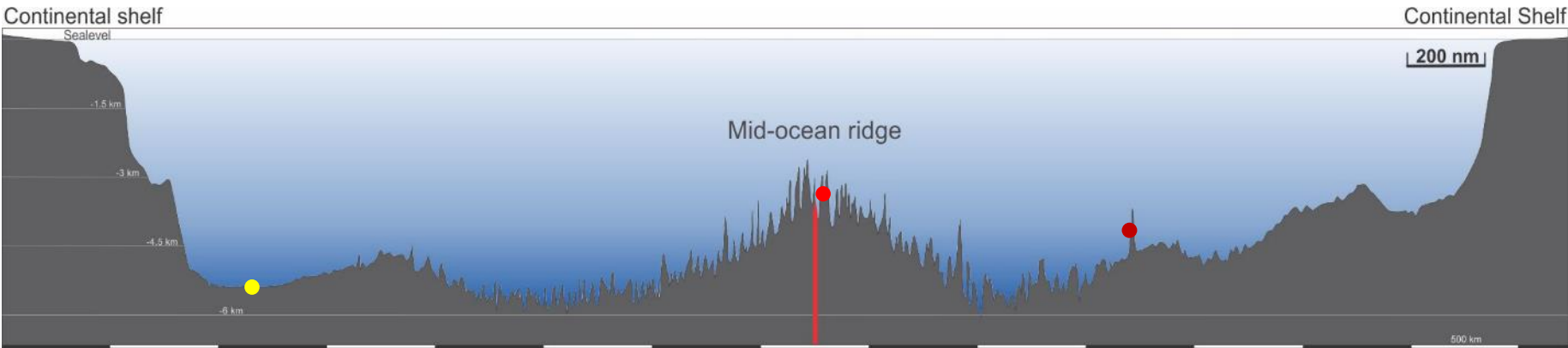
Manufacturer/Brand	Available	Key AUV specifications				Extended payload					
		Depth rating (m)	USV capable	Tracking	Endurance (Hr)	SAS	SBP	CTD	MAG	CAM/LASER	ADCP
	2020	1000	●	●	24	●	●	●	●	●	●
	Q4 2021	6000	●	●	50	●	●	●	●	●	●
	Q1 2022	6000	●	●	50	●	●	●	●	●	●
	ASV/USV Q1 2022	Surface		●	720	●	●	●	●	●	●
	Eelume Q1 2022	500	●	●	18			●	●	●	●
	Q2 2022	6000	●	●	50	●	●	●	●	●	●
	Q3 2022	6000	●	●	50	●	●	●	●	●	●
Next Gen.	2023	6000	●	●	15d	●	●	●	●	●	●



DSM value chain
where are we in the project lifecycle

Deep-Sea | Seabed | Seafloor | Marine Minerals

DEEP
REMOTE
DIVERSE
UNDEREXPLORED



Scale is important

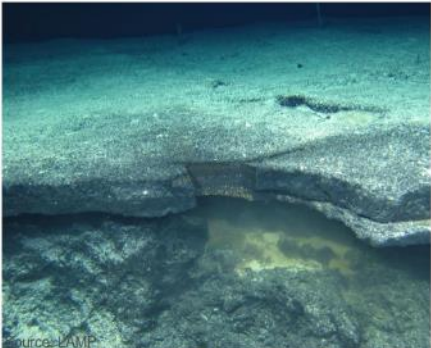
	Seafloor Massive Sulfides (SMS) ●	Polymetallic Nodules (PMN) ●	Cobalt-rich Ferromanganese Crusts (CFC) ●
Geological setting	In hydrothermally active areas Mid-ocean ridges, back-arc basins	In soft seabed Abyssal plains, oceanic plateaus	On surface of bare rocks Seamount flanks & summits
Average water depth	500 – 5000 m	4000 – 6000 m	800 – 4000 m
Main metals	Cu, Pb, Zn, Au, Ag	Fe, Mn, Ni, Co, Cu, REE	Mn, Co, Fe, Ni, Ti, Pt, REE
Sites in Norway	15 sites (active & inactive)	No discoveries	10 sites



~250 m x 250 m



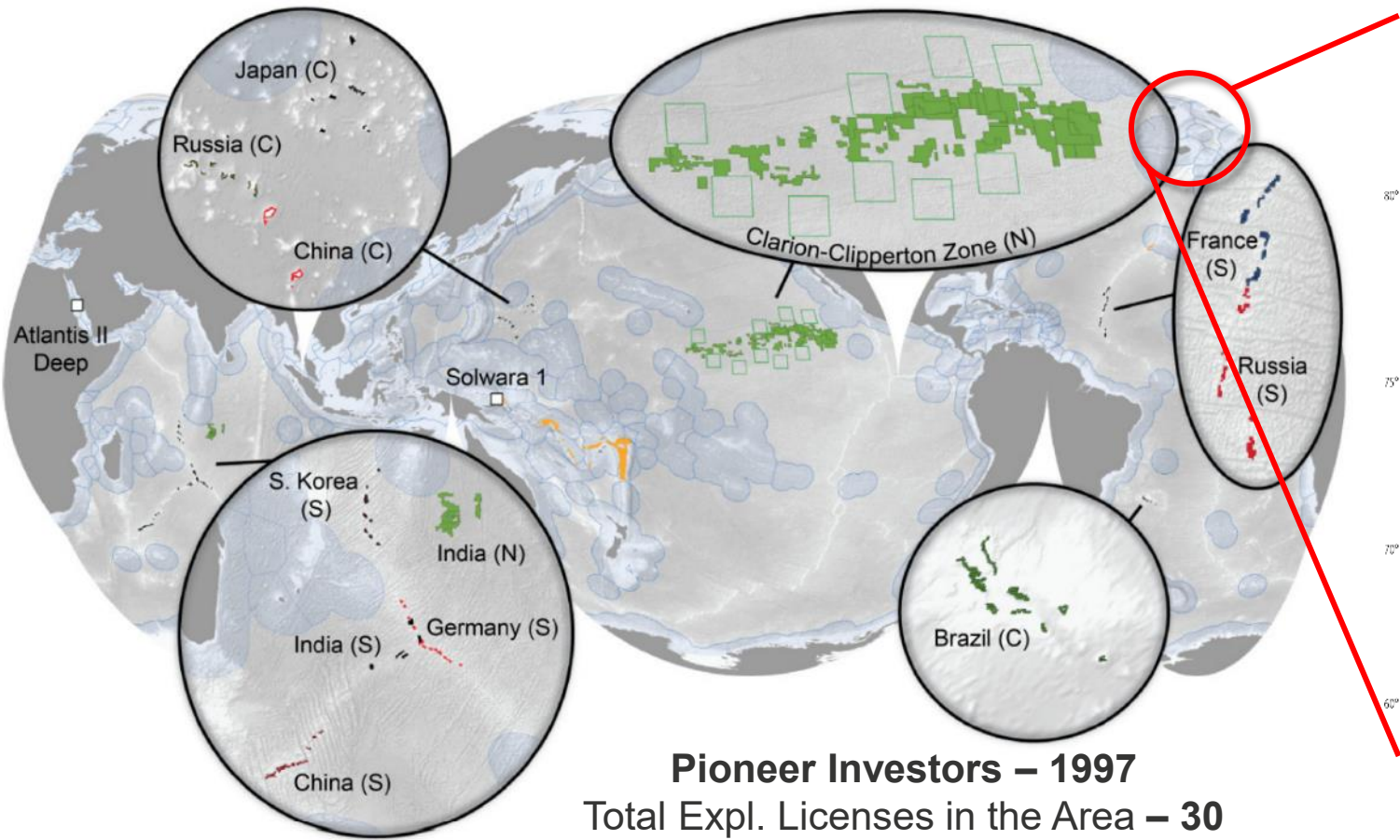
~0.15 m x 0.10 m



~ 500 m x 0.25 m

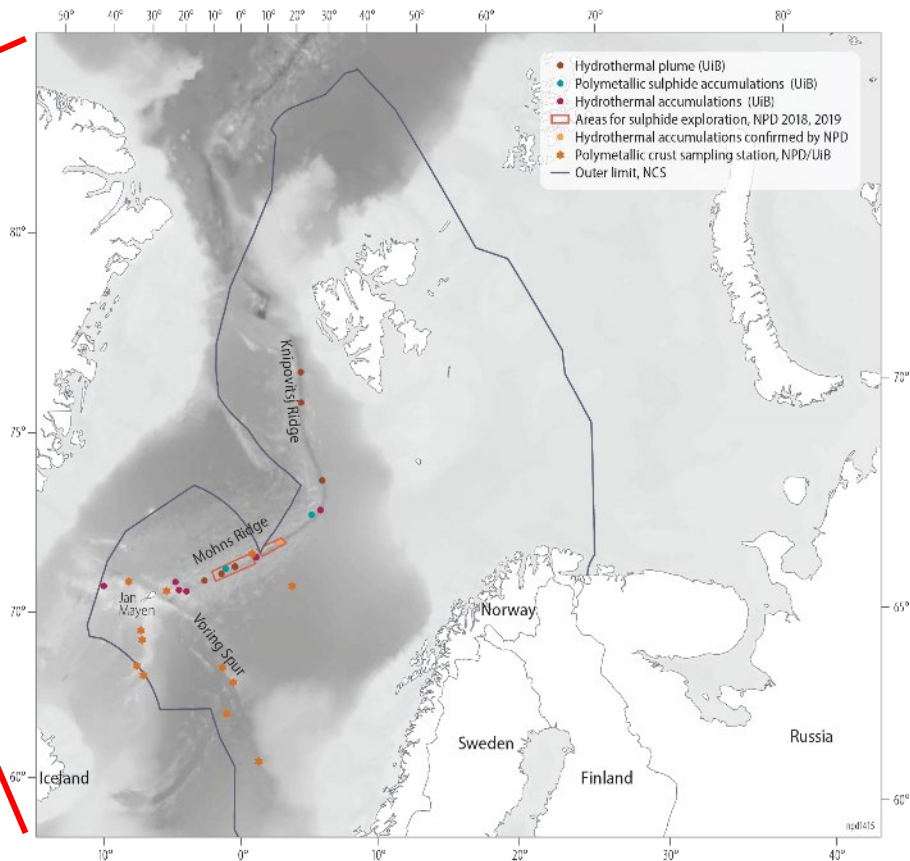
Global Exploration Licenses and Norwegian EEZ

Ferro-manganese nodules (N), Co-rich ferromanganese crusts (C) and Seafloor massive sulfides (S).
Source: Petersen et al. (2016)



Pioneer Investors – 1997
Total Expl. Licenses in the Area – 30
Extraction Licenses in the Area – 2023

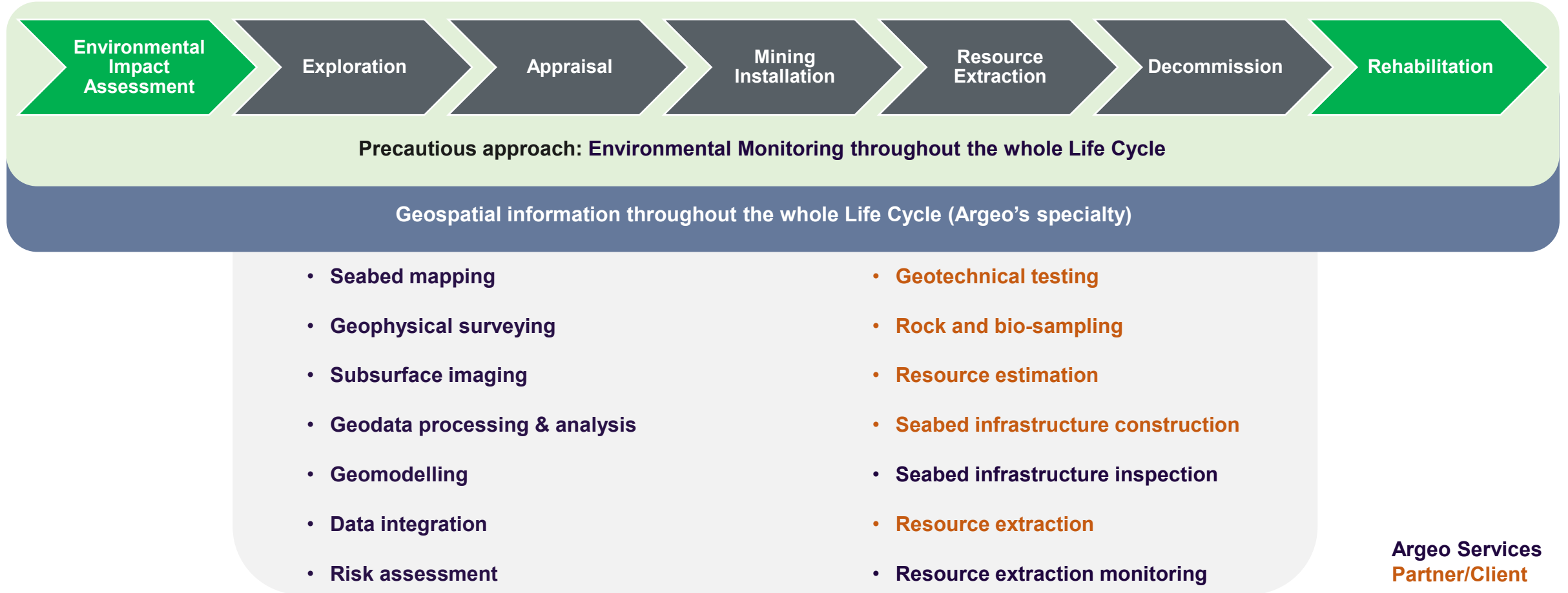
Argeo – East-Pacific Q1-2022



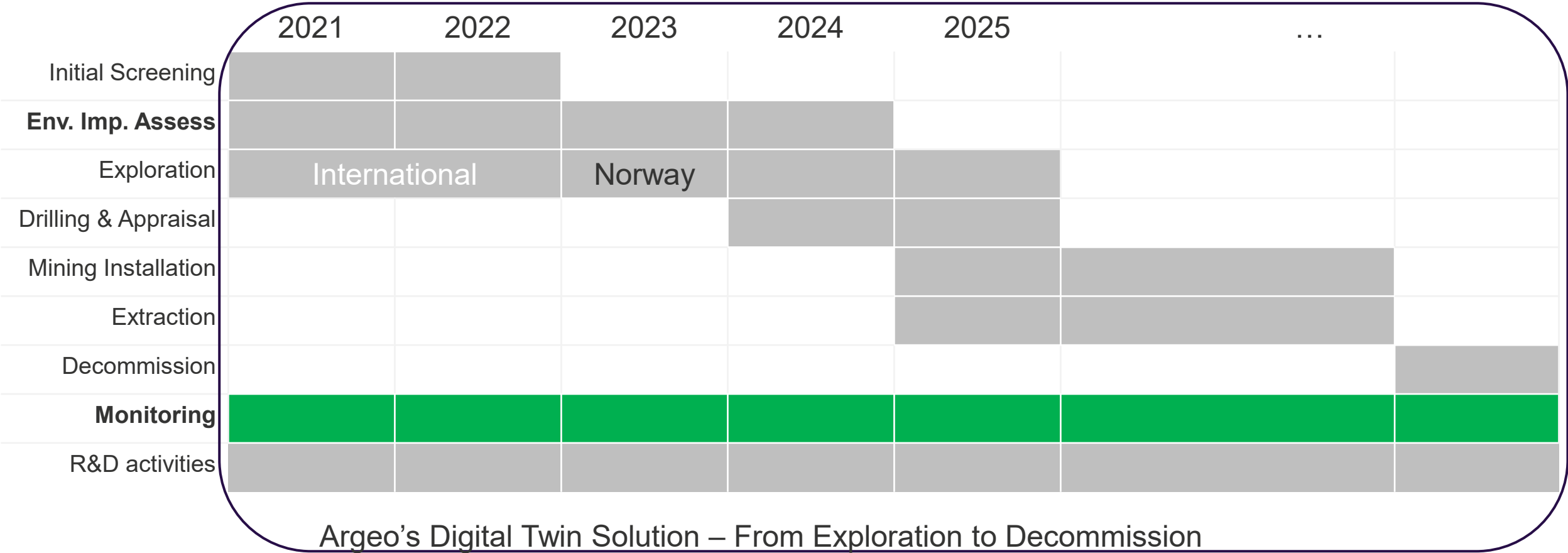
Pioneer Investors – 2020
Total licenses in the Area – 0
(decision is expected in 2023)

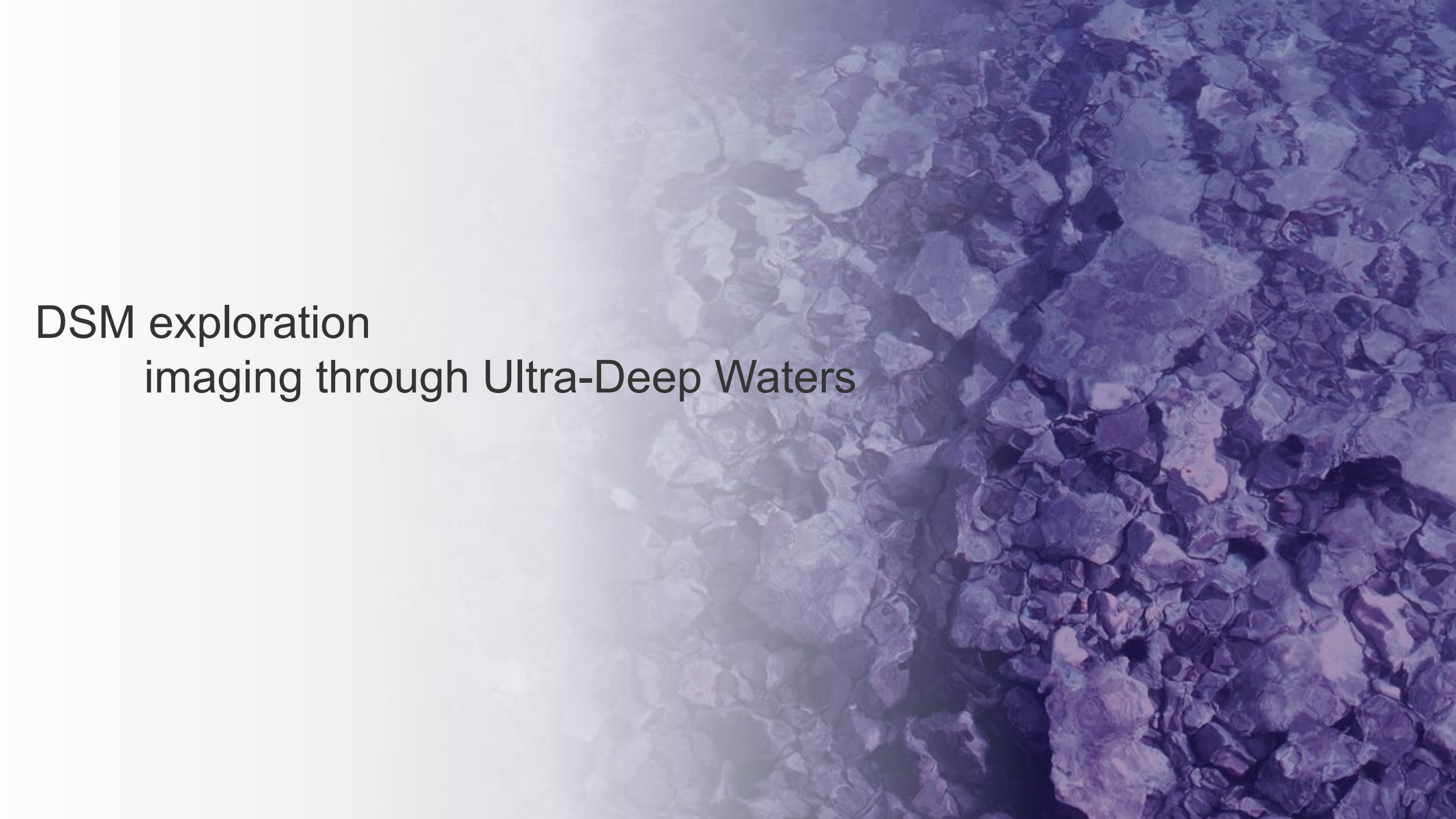
Value Chain for Deep-Sea Minerals

Norway: 2023
Globally: 1997



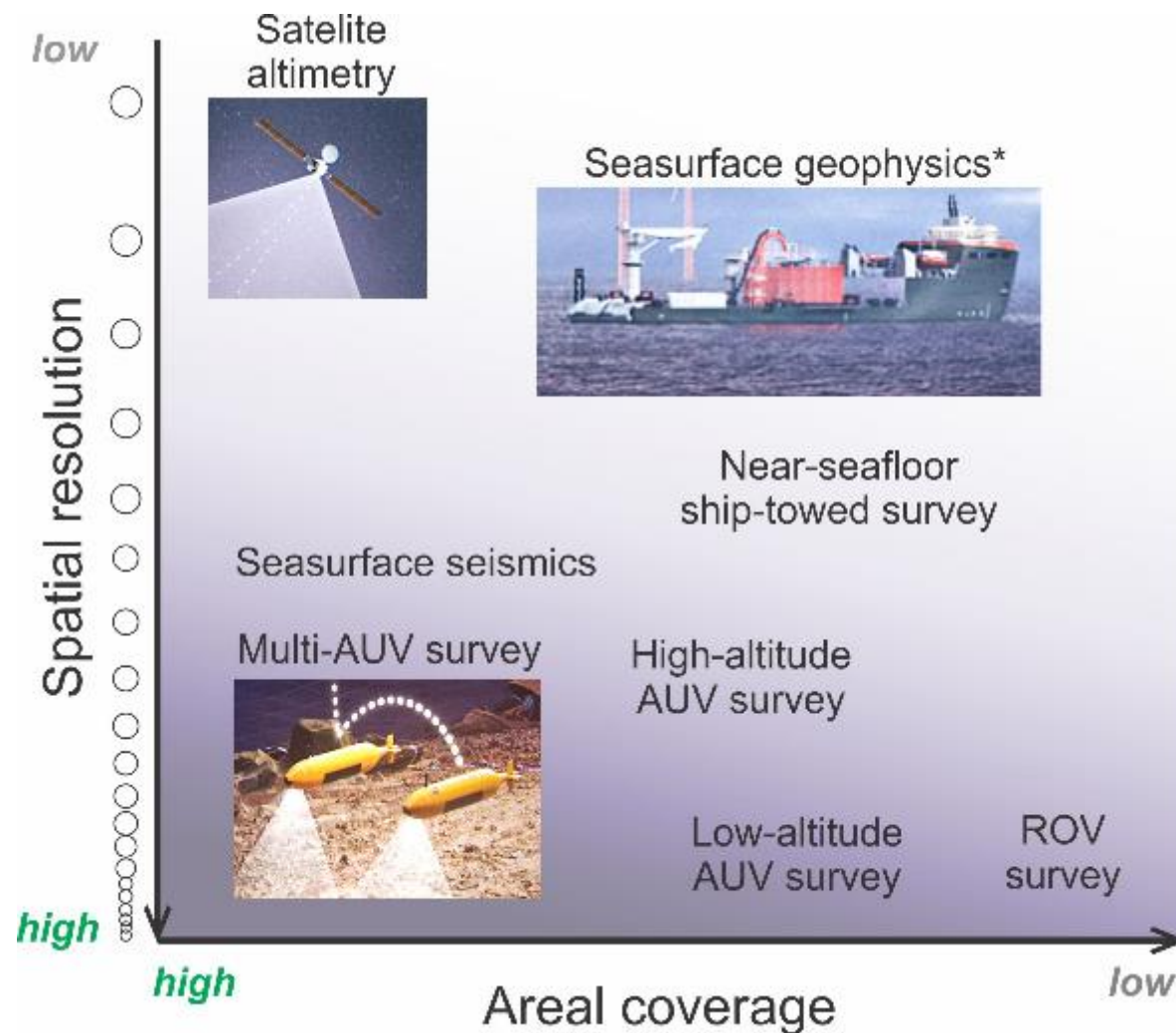
Deep-Sea Minerals Project Lifecycle example



The background of the slide features a detailed, high-resolution image of a rocky seabed. The rocks are dark, jagged, and covered in intricate patterns, possibly representing coral or other marine life. A soft, light-colored gradient is applied to the left side of the image, fading into the white background where the text is located.

DSM exploration imaging through Ultra-Deep Waters

Autonomous Underwater Vehicles are **THE** tools to resolve the deposits



AUV/Robotics



Day rate: Low

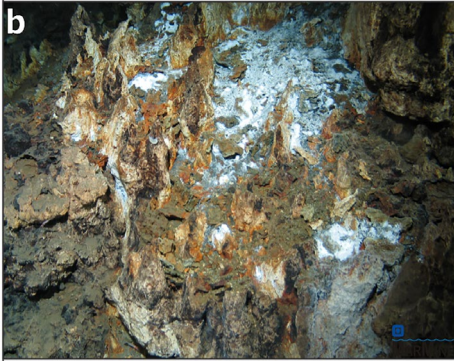
CO2-emission: Low

Data Quality: High

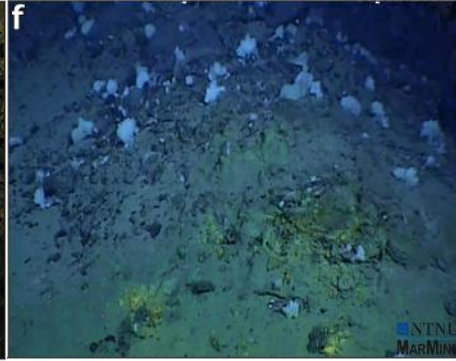
Productivity: High

Is there a silver bullet?

Data Integration and Multi-Physical Approach



Will not be mined
- active venting



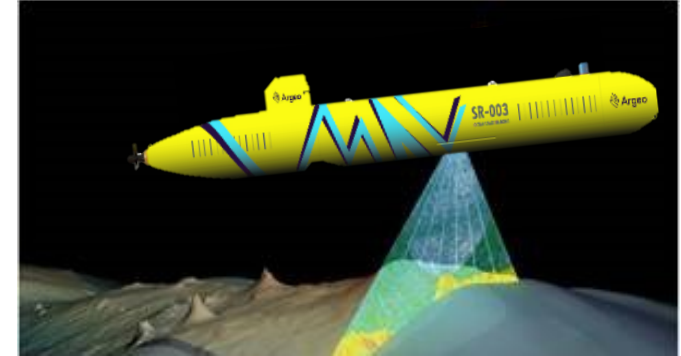
Can be mined



No mineral deposit
- typical seafloor

~~Only visual inspection~~
~~Only seabed mapping~~
~~Only seismic~~
~~Only magnetics~~
~~Only sampling~~
~~Seasurface vessel-based survey~~
...

Combination of various sensors that are
sensitive to different physical properties
mounted on **Underwater Vehicles**



- High-Resolution Multibeam Sonar
- Side-Scan Sonar; MinSAS/HiSAS
- Sub-Bottom Profiler
- Magnetometer
- Laser & Camera; Hyperspectral imagers
- IIoT sensors
- in-house technology for mineral deposits characterization developed by Argeo Robotics

A digital “time-machine” of information from complex data

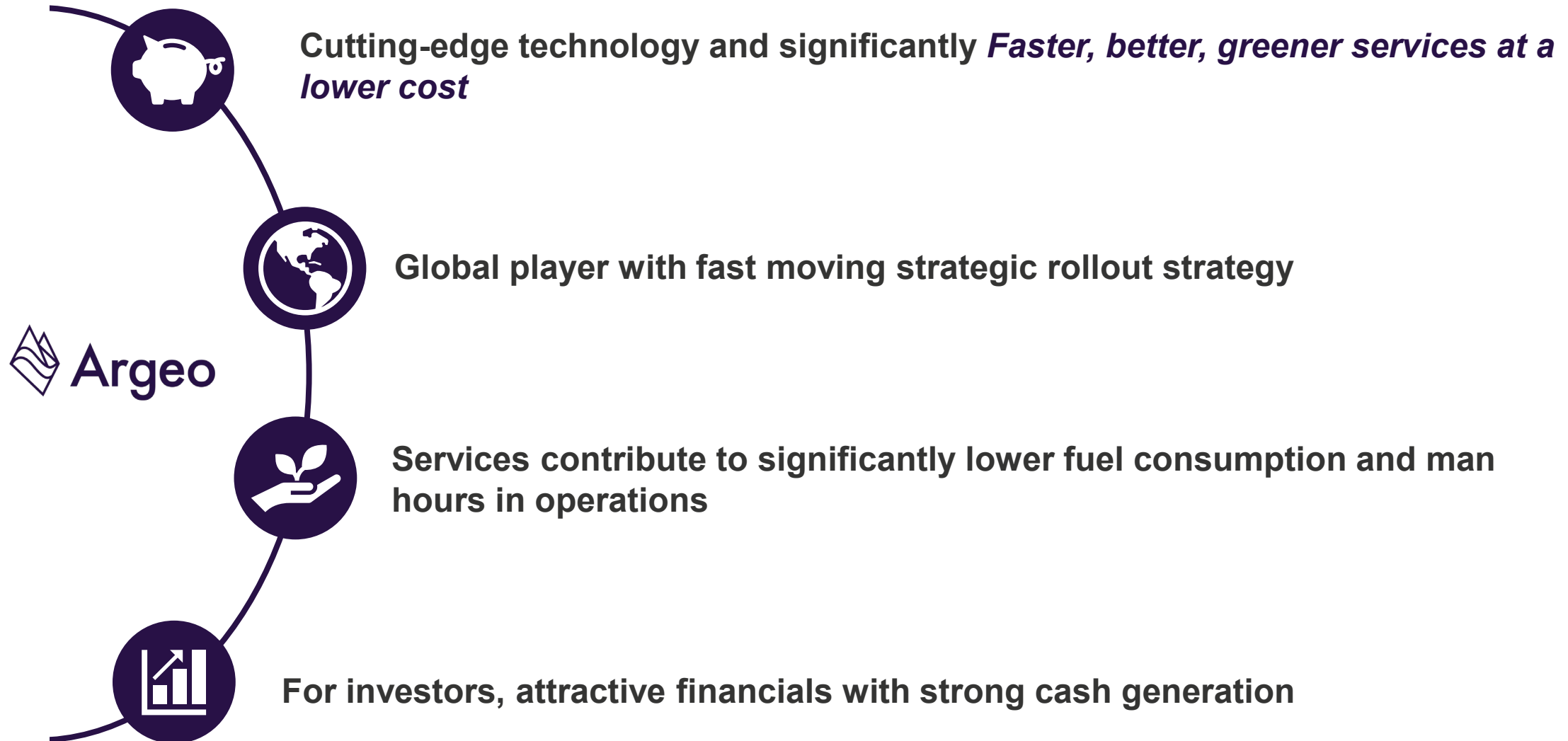
Argeo’s “Digital Twin” – Lifecycle data management and AI driven analysis

- Support every project from initial exploration to decommissioning
- SaaS project based business model
- No limit to data types and view points
- Allows customer to assess results in 4D (Time-Laps)



 **Argeo**
Digital Ocean Space

Argeos contribution to the emerging DSM market





Thank you !