

Delving deeper:

# Critical research needs for informing environmental management of deep-sea mining

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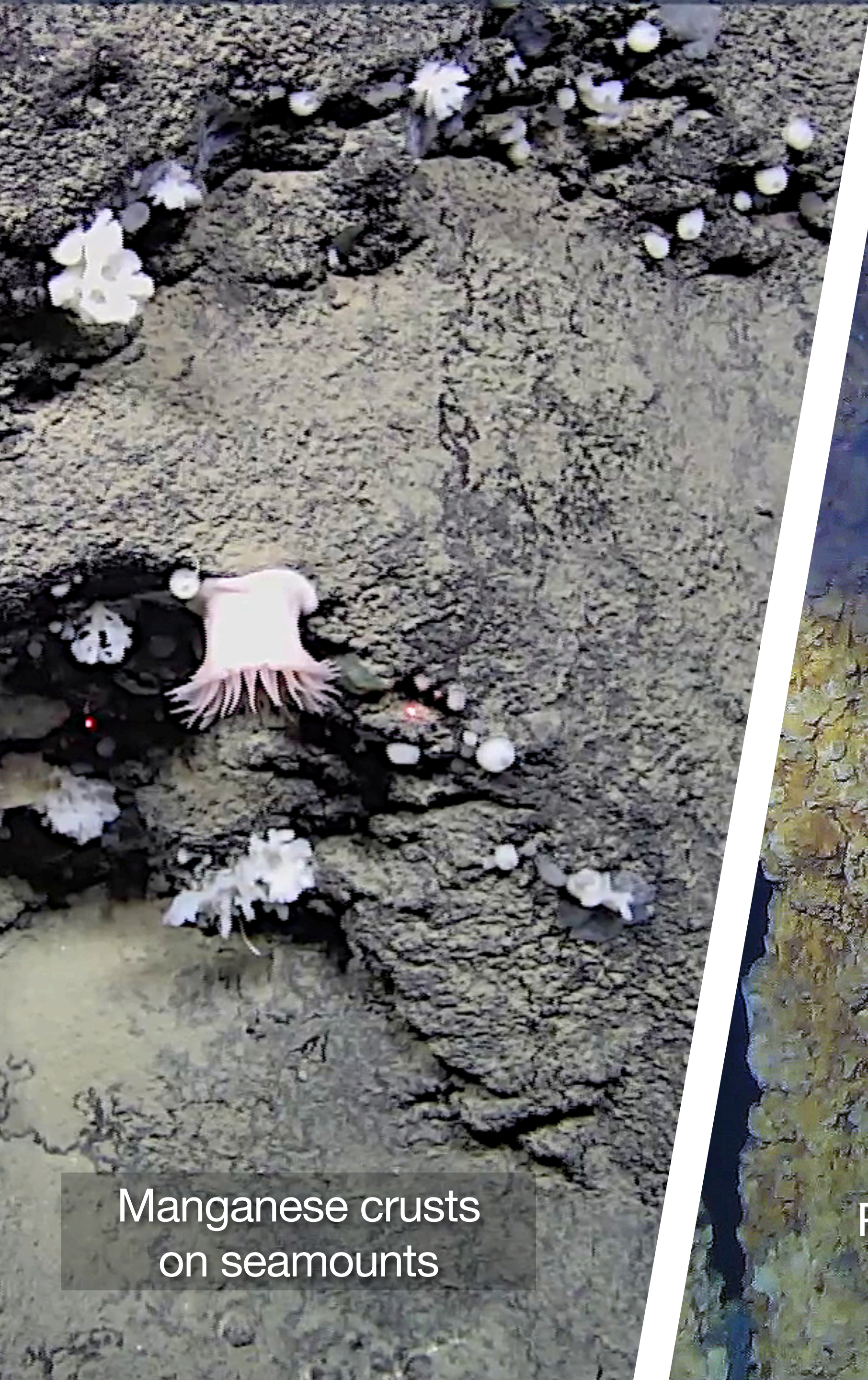
# Deep-seabed mining as a nascent industry

## Drivers:

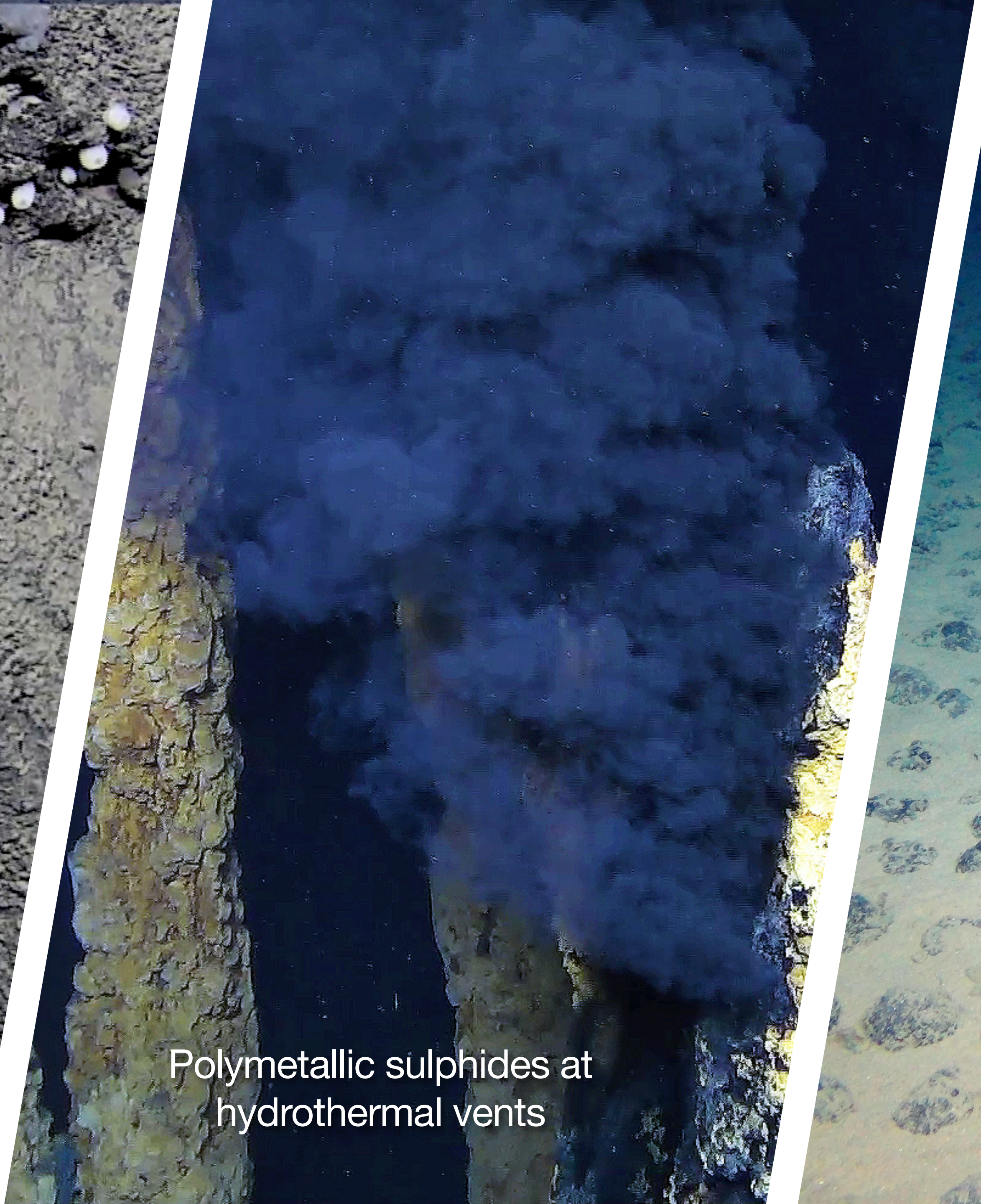
- The increasing need for minerals to enable the green shift (clean energy technology)
- Decrease of mineral resources on land
- The need to reduce impact of terrestrial mining



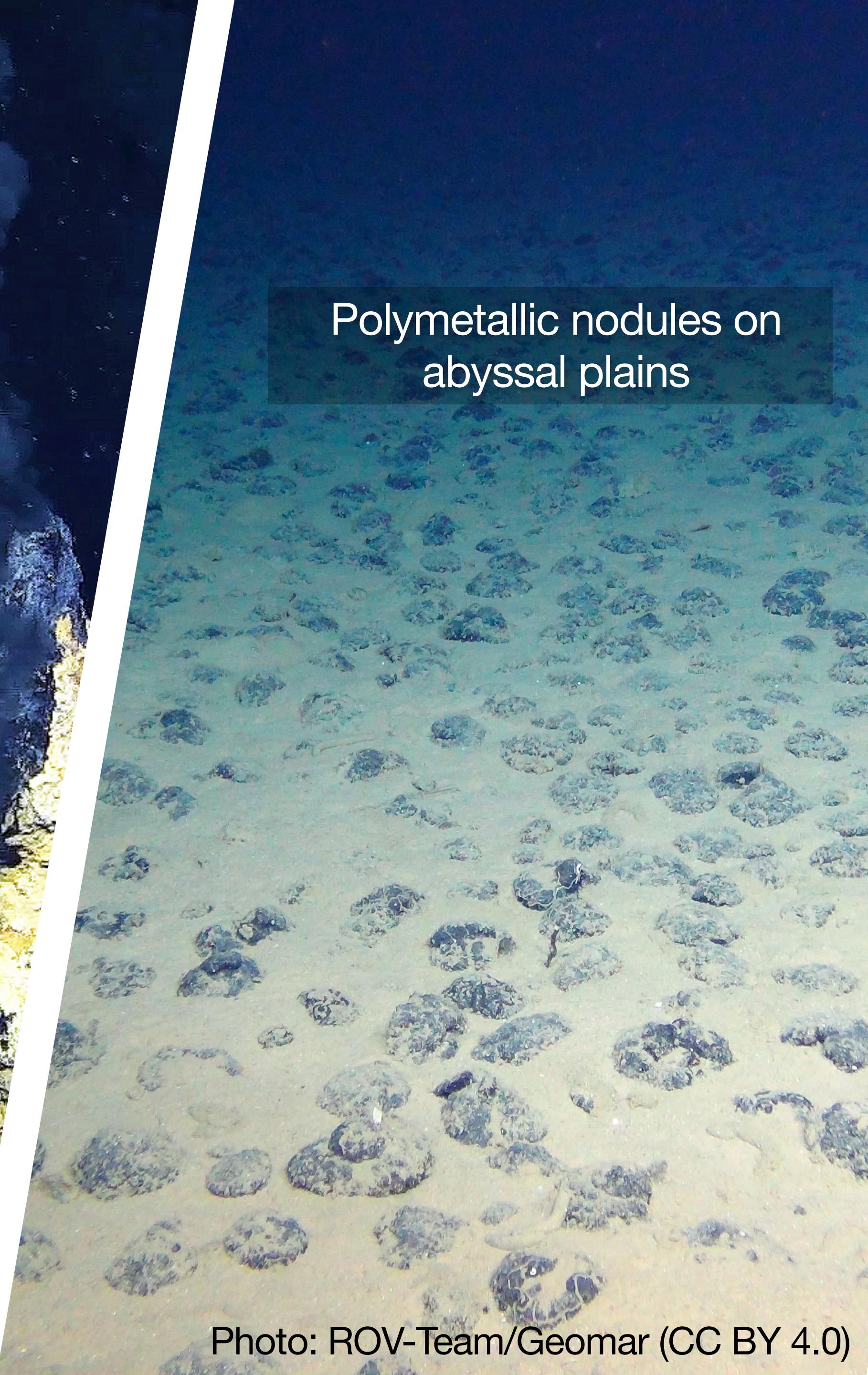




Manganese crusts  
on seamounts



Polymetallic sulphides at  
hydrothermal vents



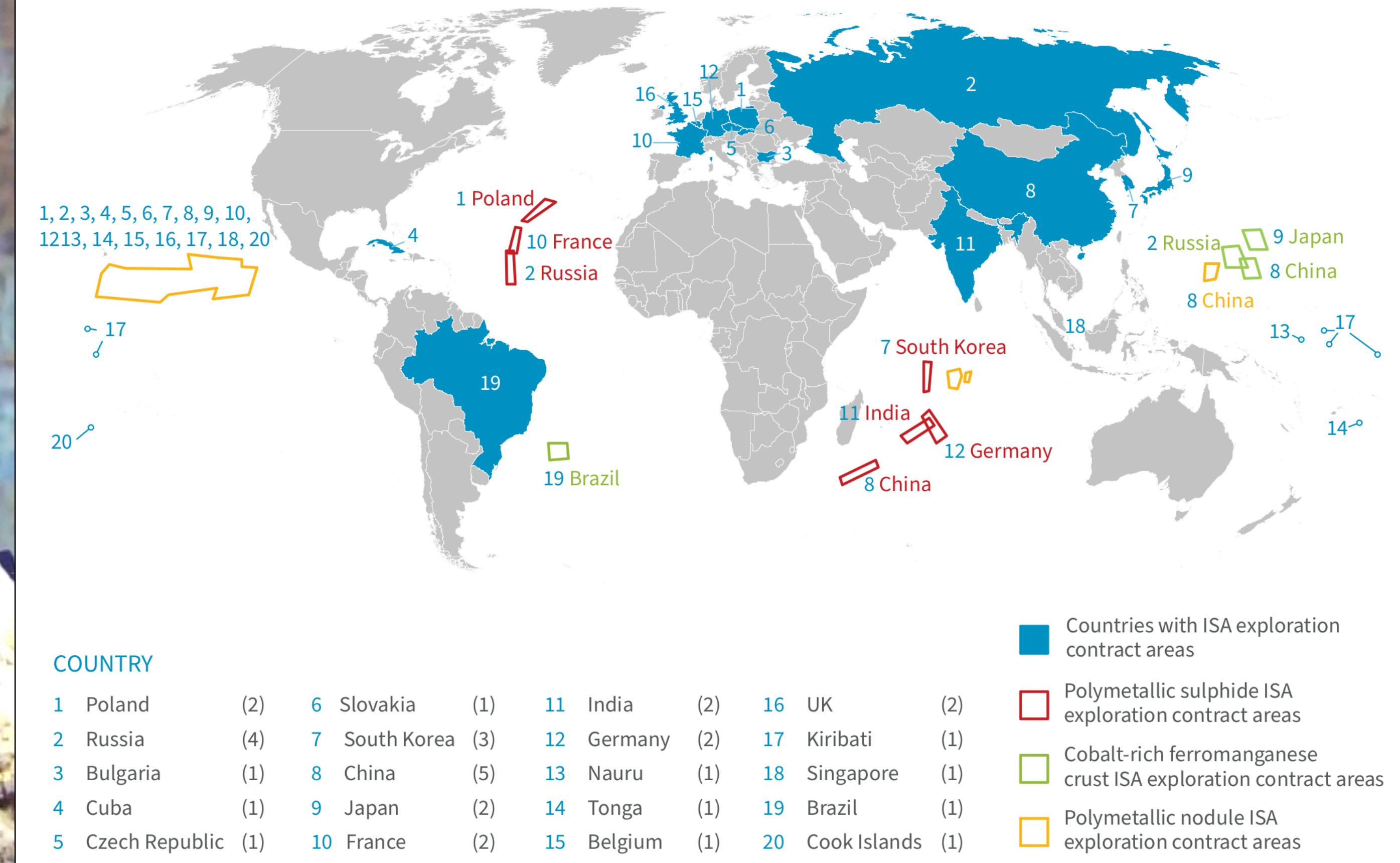
Polymetallic nodules on  
abyssal plains



# Areas beyond national jurisdiction

- The International Seabed Authority regulates **seabed mining** and the **effective protection** of the marine environment
- Mandated by UNCLOS, establishing mineral resources in the Area as **common heritage of (hu)mankind**
- Mineral activities must be conducted without causing **serious harm** to the environment
- Several exploration licenses granted

International exploration contracts from the ISA (Haugan et al., 2019).





# Areas beyond national jurisdiction

## Current status:

- Draft exploitation regulations and draft standards and guidelines under discussion
- Regional Environmental Management plans (REMPs) under development
- Nauru's trigger of the 2-year rule may:
  - accelerate completion and adoption of regulations;
  - or lead to a provisional approval of the contractor's plan of work for exploitation



ISBA/27/C/IWG/ENV/CRP.1  
8 February 2022  
English only

**Twenty-seventh session**  
Council session, part I  
Kingston, 21 March-1 April 2022

**Item 11 of the provisional agenda\***  
**Draft regulations on exploitation of mineral resources in the Area**

**Draft regulations on exploitation of mineral resources in the Area**

**Parts IV and VI and related Annexes**

**Prepared by the Facilitator, Ms. Raijeli Taga (Fiji), of the Informal Working Group on the protection and preservation of the marine environment**

27/C/11



**Twenty-seventh session**  
**Council session, part I**  
Kingston, 21 March-1 April 2022  
Item 11 of the provisional agenda\*  
**Draft regulations on exploitation of mineral resources in the Area**

**Draft guidelines for the establishment of baseline environmental data**

**Prepared by the Legal and Technical Commission**

**Twenty-seventh session**  
**Council session, part I**  
Kingston, 21 March-1 April 2022  
Item 11 of the provisional agenda\*  
**Draft regulations on exploitation of mineral resources in the Area**

**Draft guidelines for the preparation of Environmental Management and Monitoring Plans**

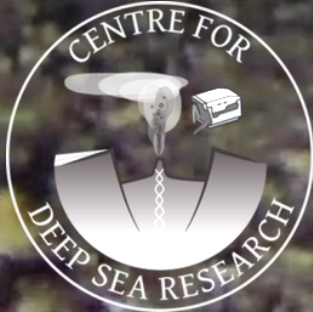
**Prepared by the Legal and Technical Commission**



# Areas within national jurisdiction the case of Norway

## The Seabed Minerals Act *entered into force on 1st July 2019*

- Relating to mineral activities on the Norwegian continental shelf
- Establishes principles for mineral exploitation in agreement with environmental, economic and societal goals
- Determines the different phases of activity:  
*opening / production license / production plan / cessation*
- Stipulates an **opening process** for seabed minerals



## NORSK LOVTIDEND

Avd. I Lover og sentrale forskrifter mv.

Utgitt i henhold til lov 19. juni 1969 nr. 53.

Kunngjort 22. mars 2019 kl. 15.15

PDF-versjon 22. mars 2019

22.03.2019 nr. 7

### Lov om mineralvirksomhet på kontinentalsokkelen (havbunnsmineralloven)

Prop.106 L (2017–2018), Innst.150 L (2018–2019), Lovvedtak 39 (2018–2019). Stortingets første og andre gangs behandling hhv. 12. og 19. februar 2019. Fremmet av Olje- og energidepartementet.

Endringer i følgende lover:

- 1 Lov 21. juni 1963 nr. 12 om vitenskapelig utforskning og undersøkelse etter og utnyttelse av andre undersjøiske naturforekomster enn petroleumforekomster.
- 2 Lov 21. juni 1985 nr. 83 om ansvarlige selskaper og kommandittselskaper (Selskapsloven).
- 3 Lov 19. juni 2009 nr. 101 om erverv og utvinning av mineralressurser (mineralloven).

### Kapittel 1. Innledende bestemmelser

#### § 1-1. Lovens formål

Denne loven skal legge til rette for undersøkelse og utvinning av mineralforekomster på kontinentalsokkelen i samsvar med samfunnsmessige målsettinger, slik at hensynet til verdiskaping, miljø, sikkerhet ved virksomheten, øvrig næringsvirksomhet og andre interesser blir ivarettatt.

#### § 1-2. Lovens saklige virkeområde

Denne loven gjelder virksomhet knyttet til undersøkelse og utvinning av mineralforekomster på havbunnen og grunnen under denne.

Loven gjelder ikke for vitenskapelig forskning på undersjøiske mineralforekomster.

Kongen kan gi forskrift om lovens anvendelse på marine arter, planter og genetisk materiale som tas opp som ledd i aktiviteter omfattet av første ledd.

Loven gjelder med de begrensningene som følger av overenskomster med fremmede stater eller folkeretten for øvrig.

#### § 1-3. Lovens geografiske virkeområde

Loven gjelder for mineralforekomster i Norges indre farvann, Norges sjøterritorium og på norsk kontinentalsokkel.

Med sjøterritoriet menes havområdet fra grunnlinjene ut til tolv nautiske mil som opprettet i medhold av lov 27. juni 2003 nr. 57 om Norges territorialfarvann og tilstøtende sone. Indre farvann omfatter

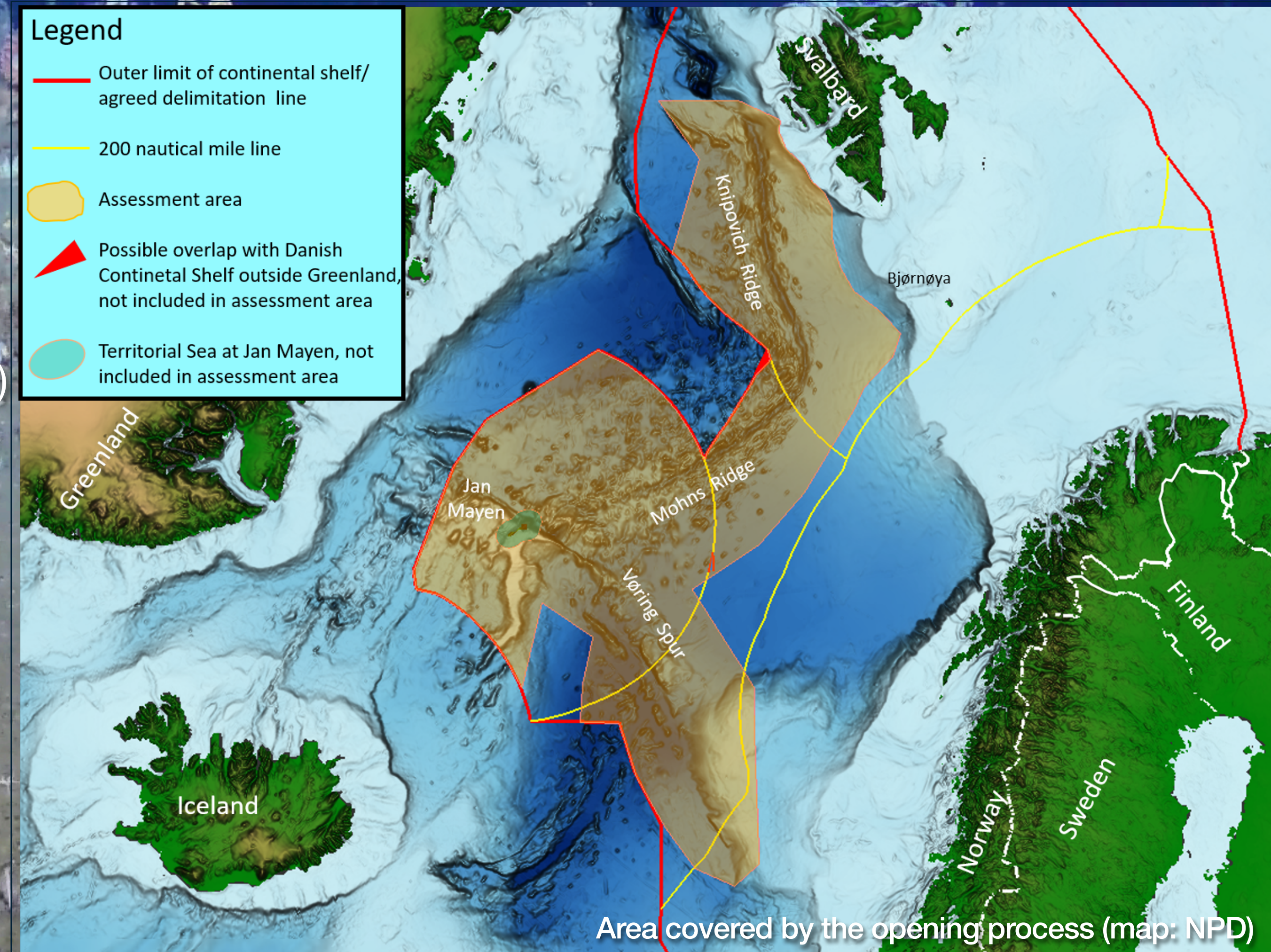
For ev. rettelser se nederst i den elektroniske versjonen: <https://lovdata.no/LTI/lov/2019-03-22-7>



# Areas within national jurisdiction the case of Norway

## The opening process for seabed minerals

- Led by the Ministry of Petroleum and Energy (MPE)
- Mandated by the MPE, the Norwegian Petroleum Directorate (NPD) conducts the assessment study, including resource mapping
- Nearly 600,000 km<sup>2</sup> to cover
- Presence of sulfides and crusts



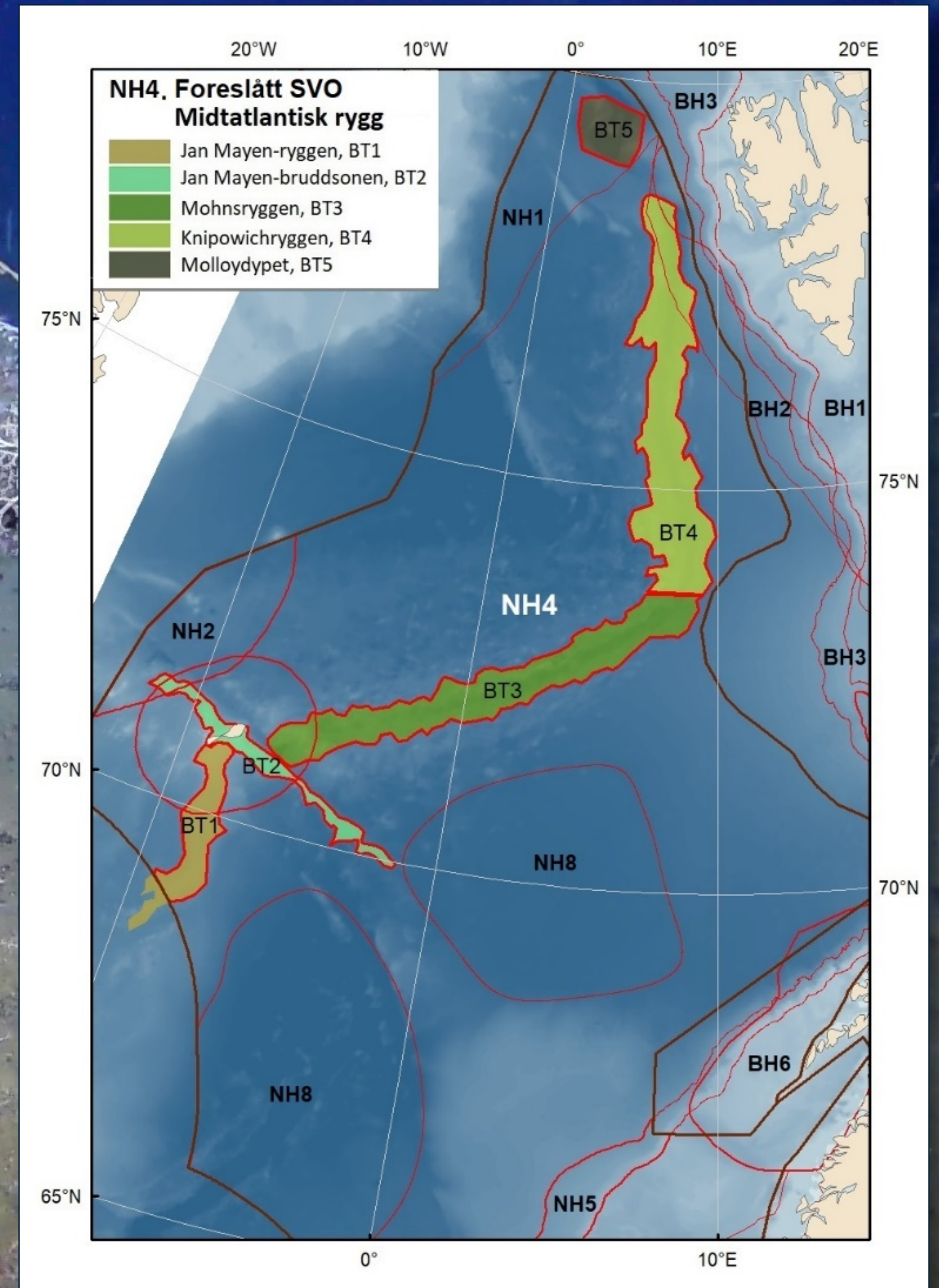
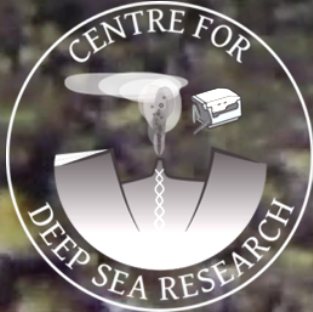


# Areas within national jurisdiction the case of Norway

## The opening process for seabed minerals

■ A new Particularly Valuable and Vulnerable Area (SVO) for the Mid-Atlantic Ridge (NH4) within the Norwegian EEZ recently proposed (Eriksen et al., 2021).

- *abundance of endemic and unique fauna*
- *high productivity*
- *spawning and rearing area for slow-growing species*
- *very vulnerable benthic communities*
- *limited or no capacity to recover*

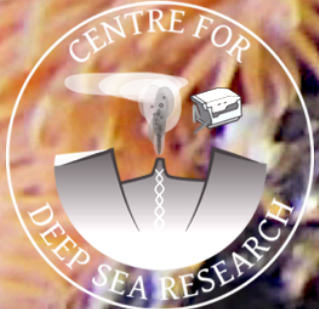




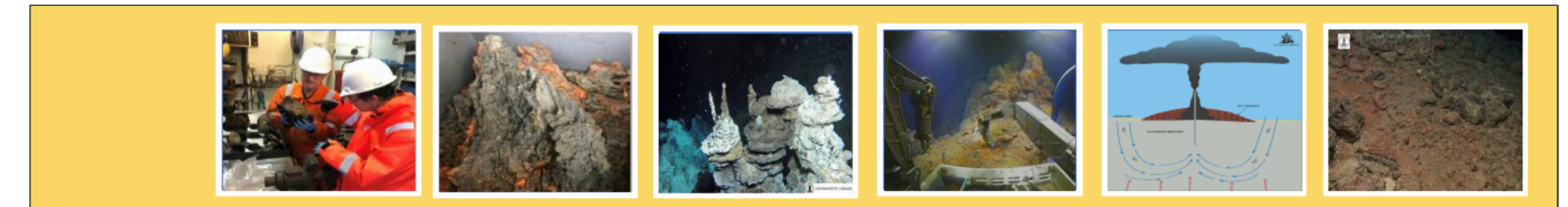
# Areas within national jurisdiction the case of Norway

## The assessment study

- EIA programme has been on public consultation
- Comments from consulted institutions will be incorporated in the final report



### Høringsdokument



### Åpningsprosess for undersøkelse og utvinning av havbunnsmineraler på norsk kontinentalsokkel

Forslag til program for konsekvensutredning etter havbunnsmineralloven

12. januar 2021





# Areas within national jurisdiction the case of Norway

## Background reports

Seafloor environment (UiB)

Pelagic ecosystems (IMR)

Seabirds (NP)

Fisheries (Fdir)

Technology (DnV/NTNU)

Shipping (KV)



## FAGUTREDNING MINERALRESSURSER I NORSKEHAVET LANDSKAPSTREKK, NATURTYPER OG BENTISKE ØKOSYSTEMER

SENTER FOR DYPHAVSFORSKNING  
UNIVERSITETET I BERGEN

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Institutt for biovitenskap, UiB
- 3) Geofysisk Institutt, UiB
- 4) Universitetsmuseet i Bergen
- 5) Høgskulen på Vestlandet
- 6) NORCE

### INNHOOLD

*Forord*

*Sammendrag*

*Del I:*

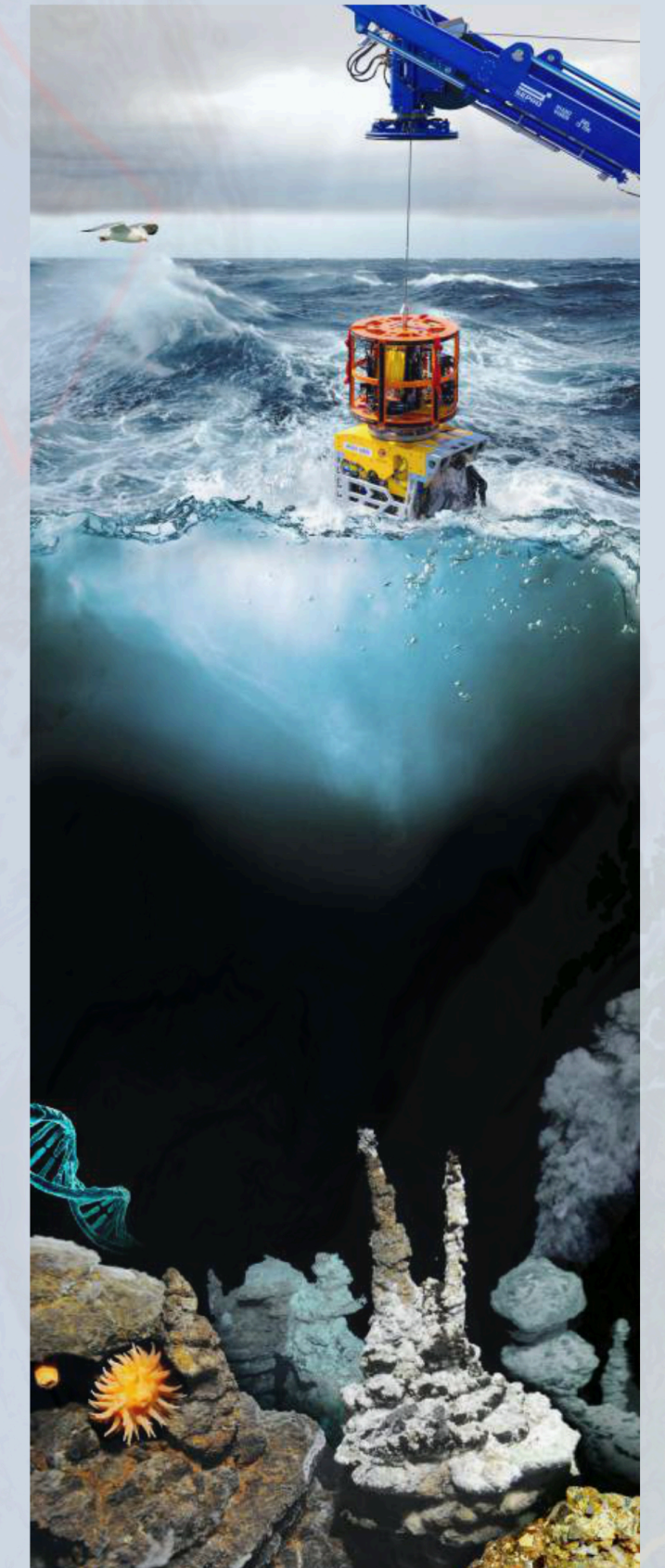
*Landskapstrekk og  
naturtyper*

*Del II:*

*Bentiske økosystemer*

*Appendiks I:*

*Bunnskart og gradientkart*





# Areas within national jurisdiction

## the case of Norway

### Timeline for the opening process

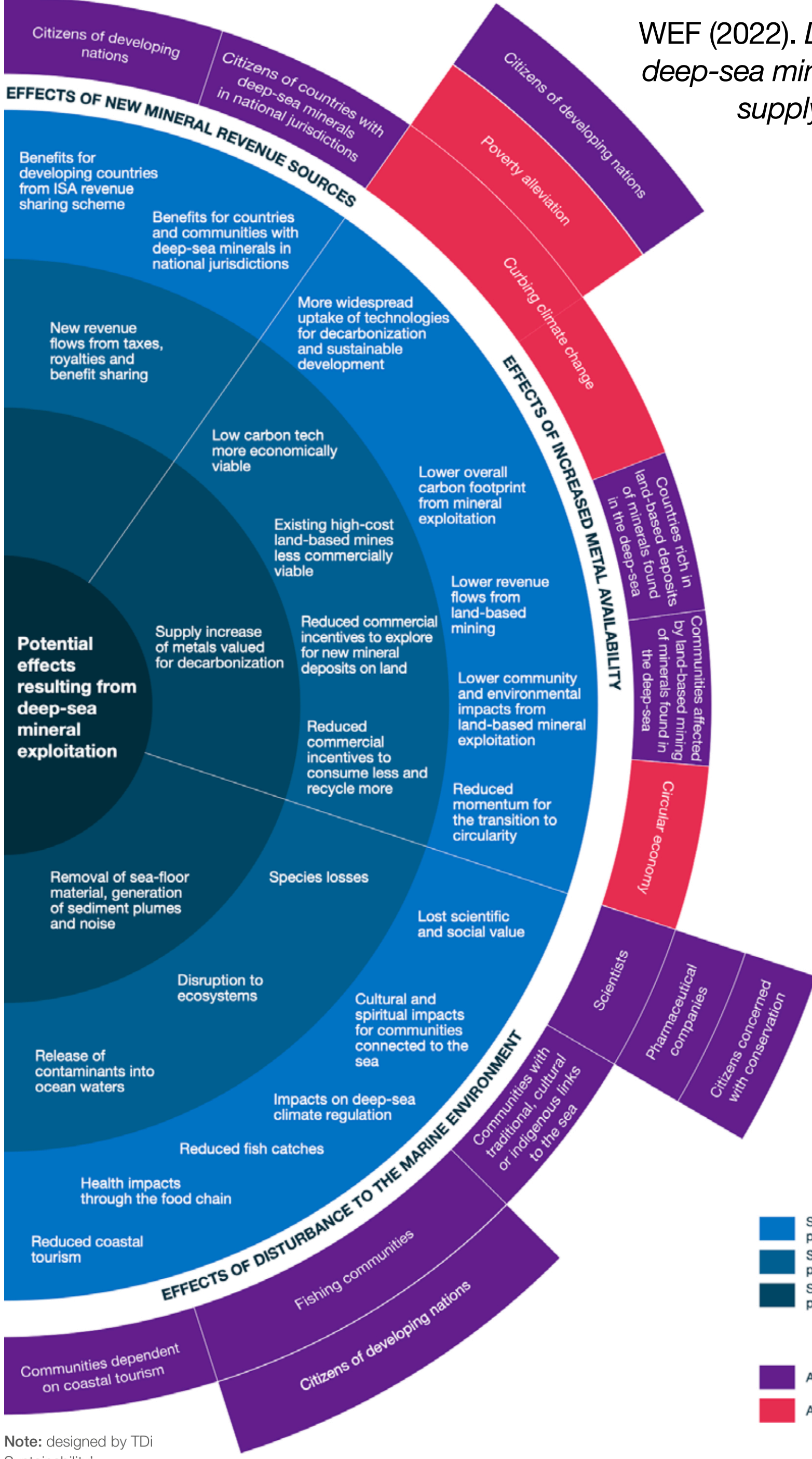


Proposed Programme for Impact Assessment according to the Seabed Minerals Act. Norwegian Ministry of Petroleum and Energy (Jan 2021)





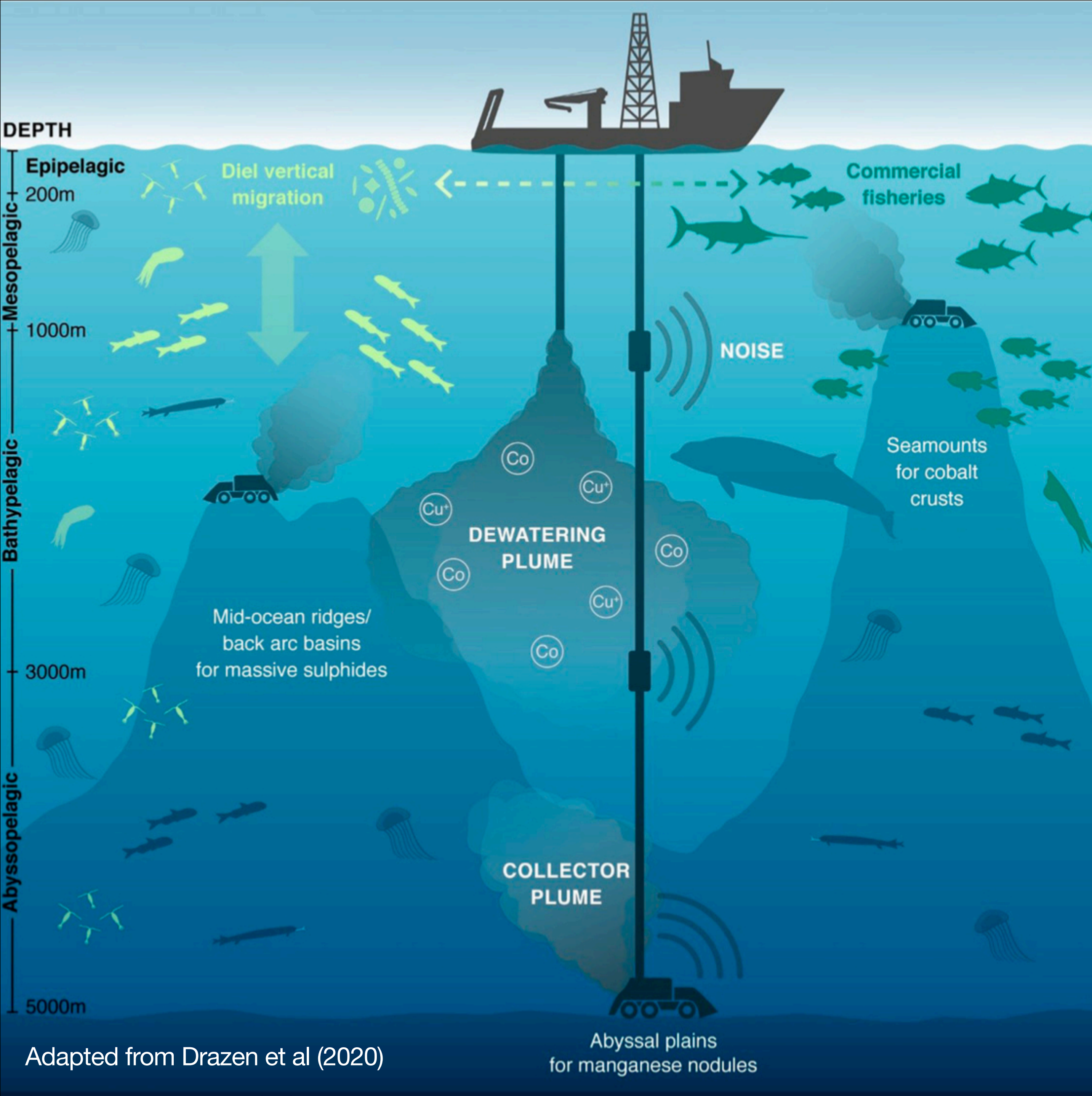
WEF (2022). *Decision-making on deep-sea mineral stewardship: a supply-chain perspective*



Note: designed by TDi Sustainability'







## Knowledge needs:

- Detailed characterisation of the natural environment - **baseline**
- Quantification of potential **mining impacts**
- Development of effective **monitoring** and **mitigation** strategies



## Environmental baseline

### Oceanography

Currents  
Temperature  
Salinity  
Turbidity  
Dissolved O<sub>2</sub>  
etc.





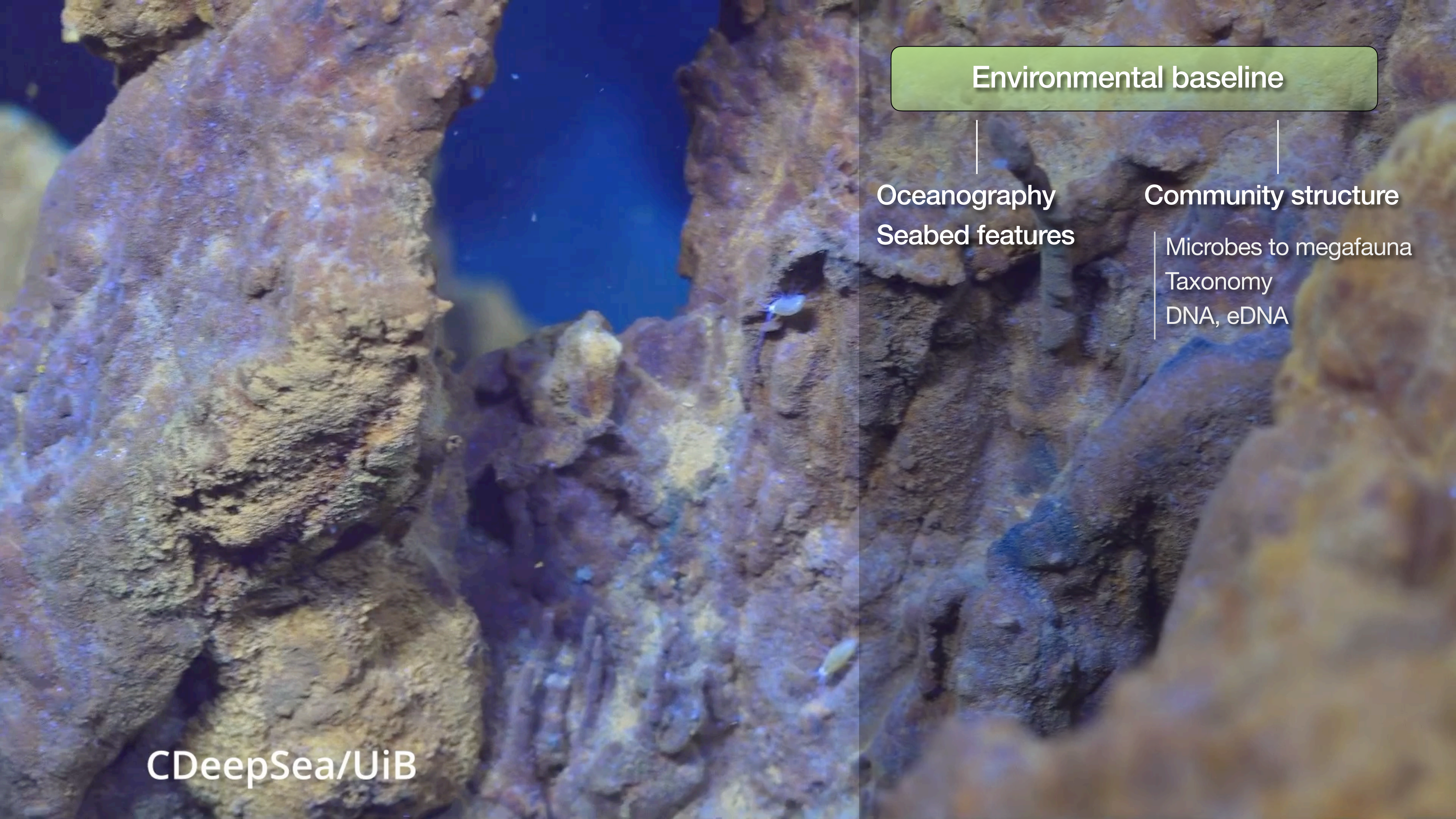
## Environmental baseline

Oceanography  
Seabed features

Topography  
Morphology  
Geochemistry  
Sedimentation rates  
etc.





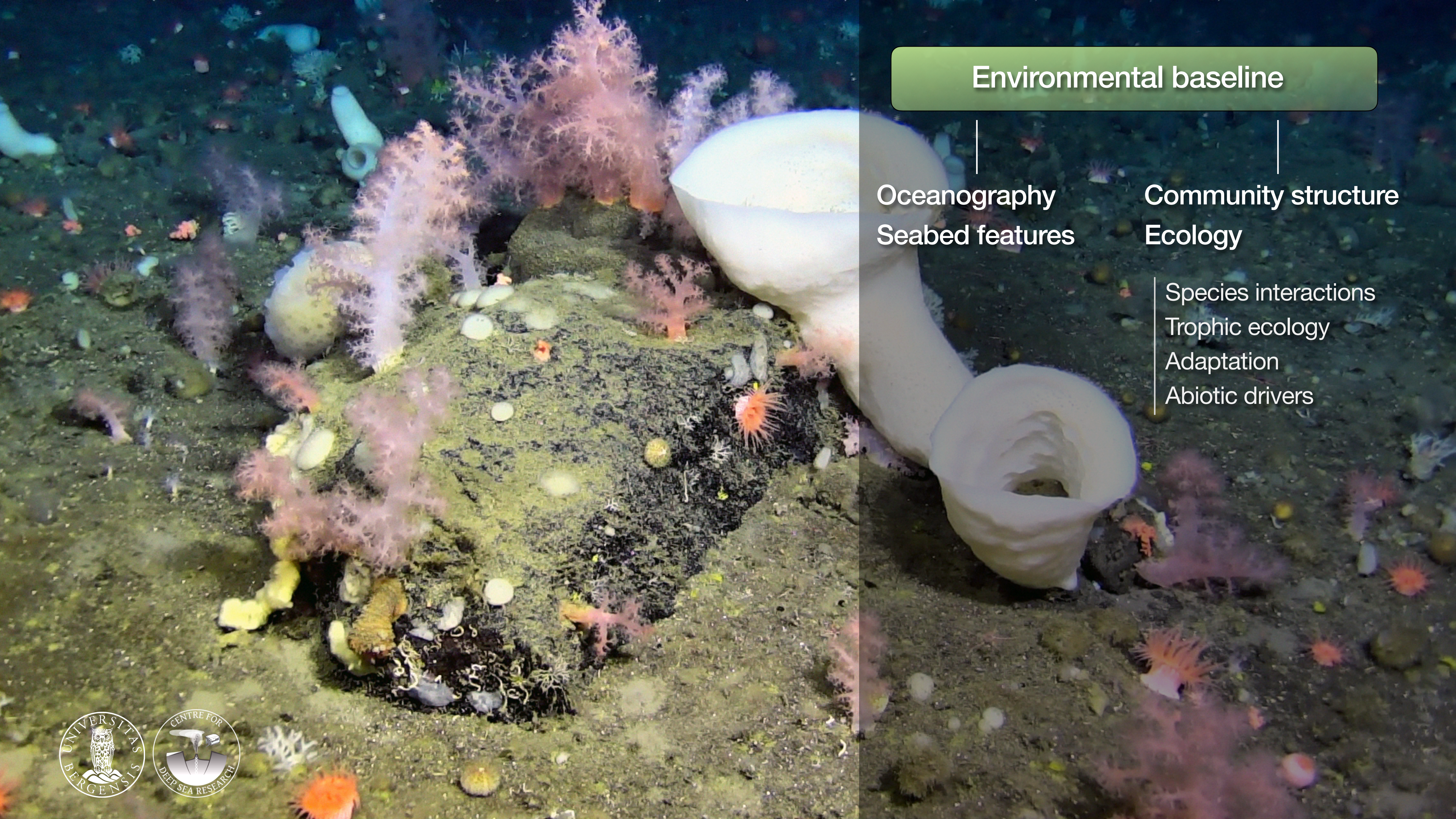


Environmental baseline

Oceanography  
Seabed features

Community structure  
Microbes to megafauna  
Taxonomy  
DNA, eDNA





Environmental baseline

Oceanography  
Seabed features

Community structure  
Ecology

Species interactions  
Trophic ecology  
Adaptation  
Abiotic drivers



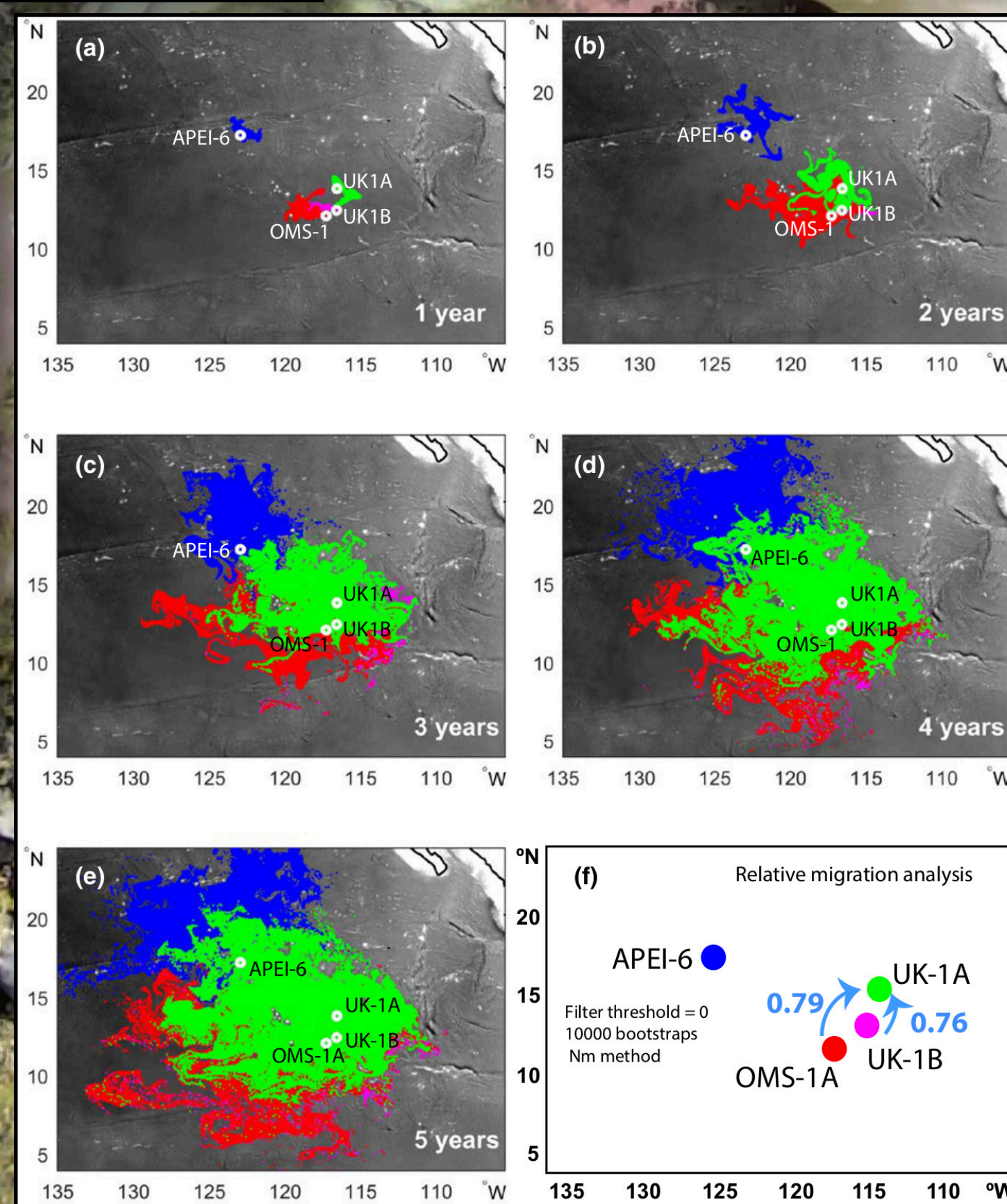
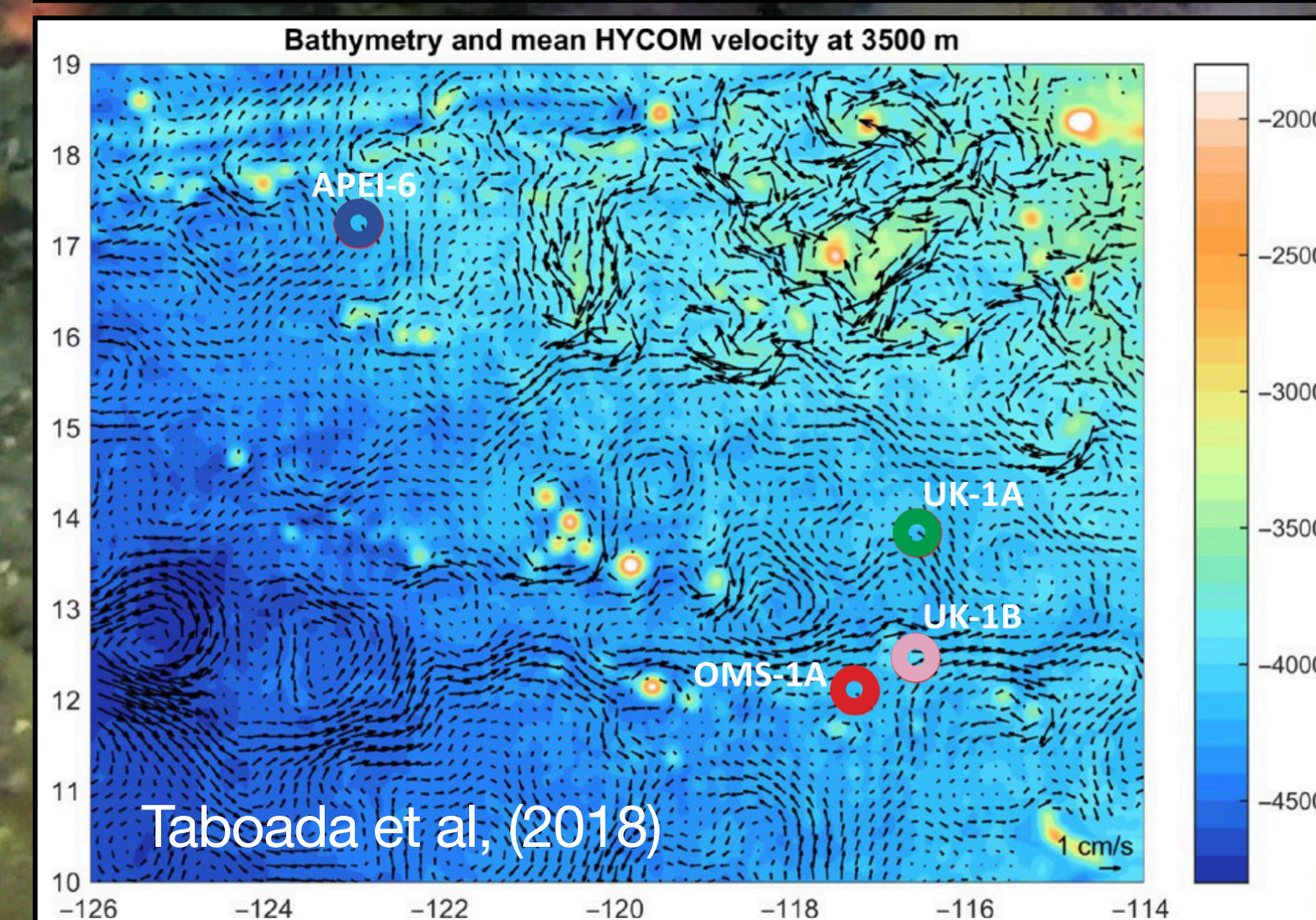
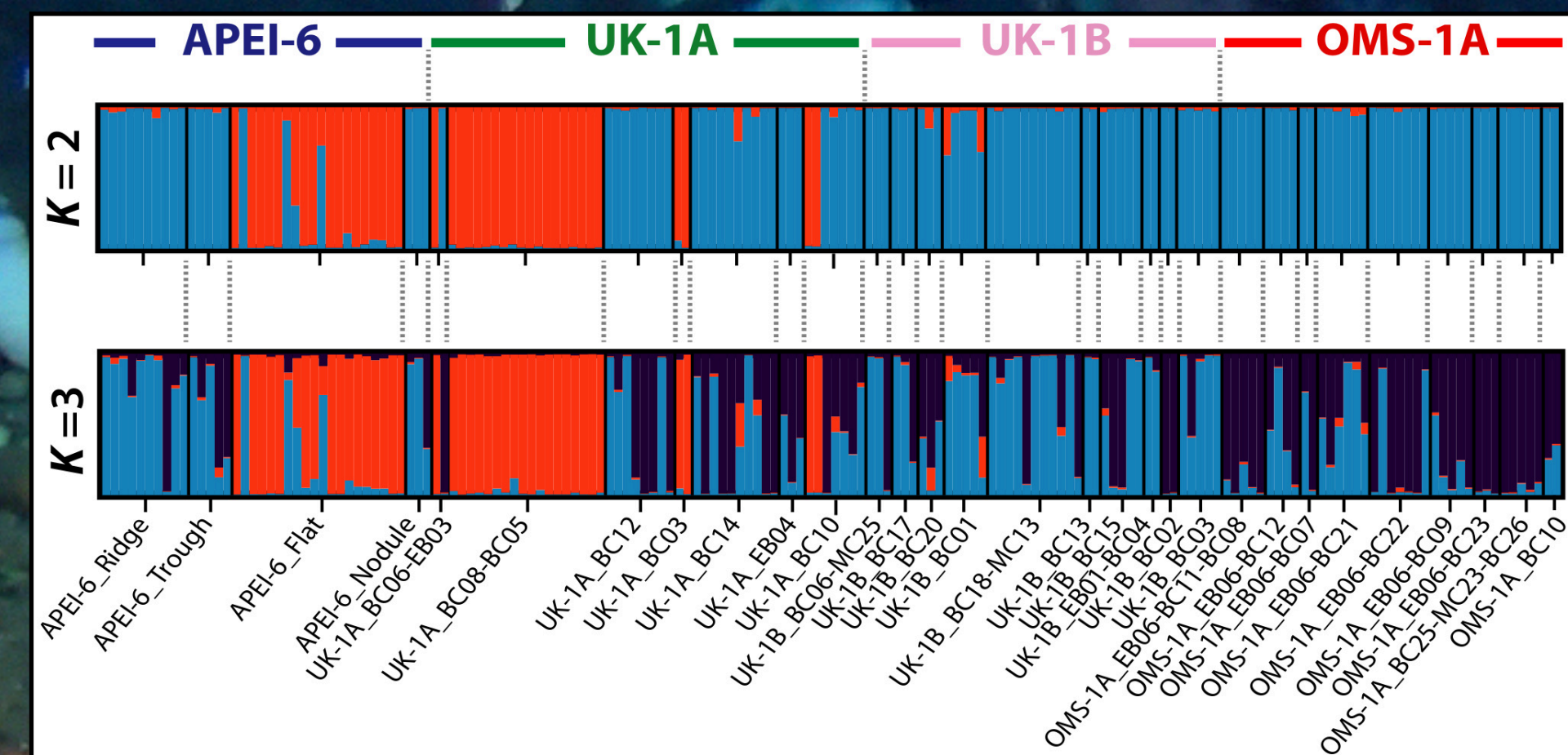


## Environmental baseline

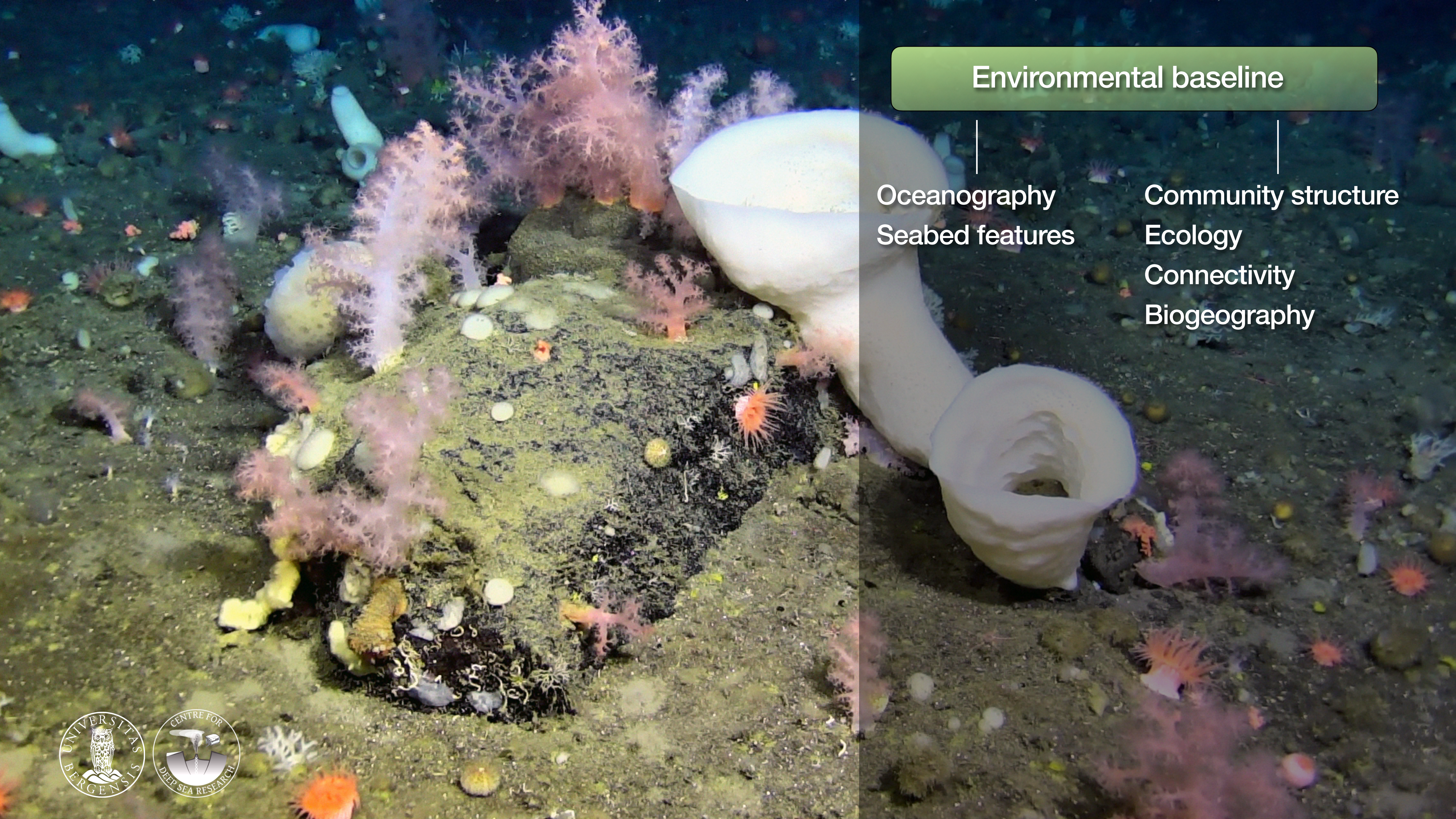
Oceanography  
Seabed features

Community structure  
Ecology  
Connectivity

Dispersal modeling  
Population genetics







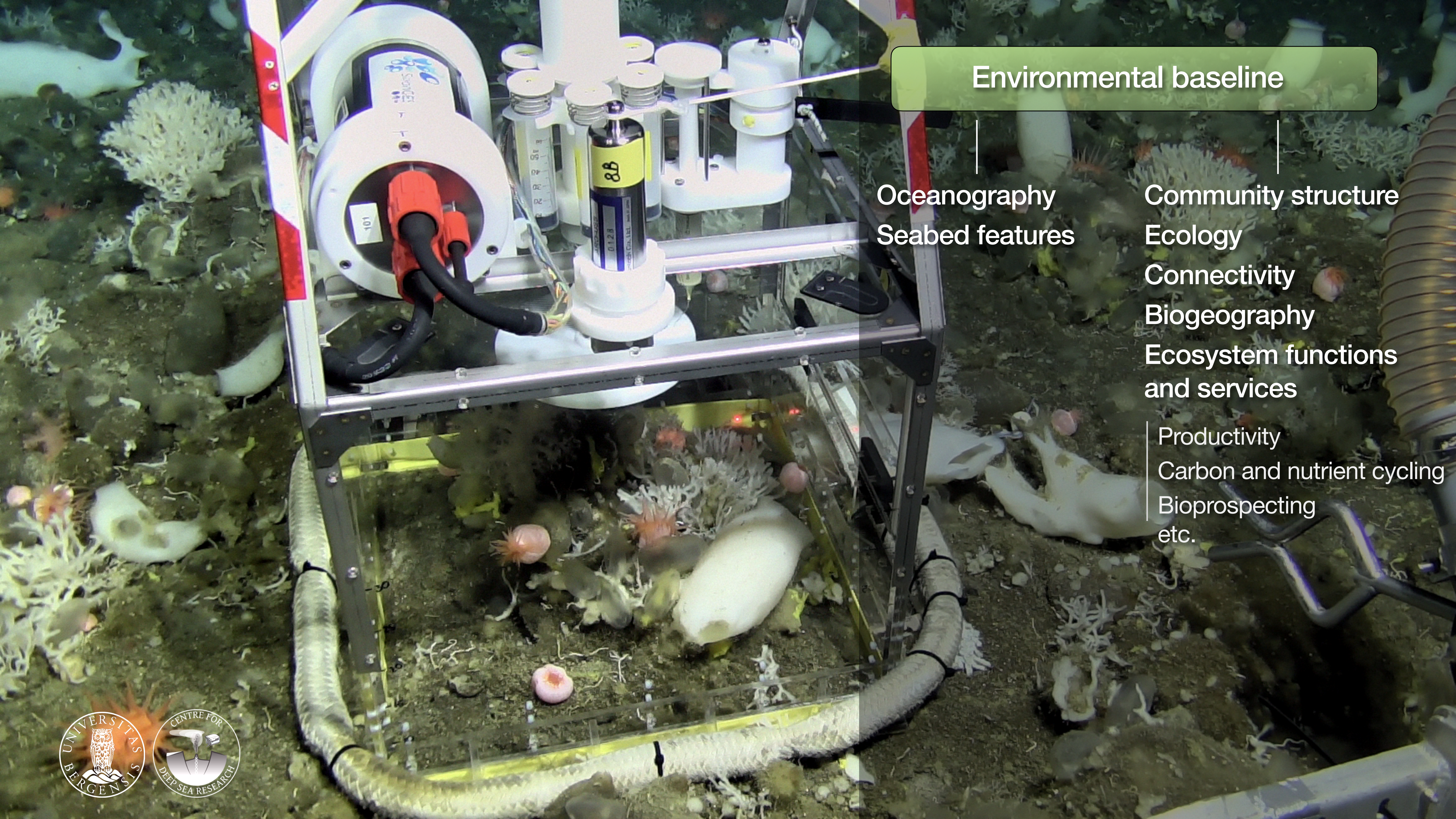
Environmental baseline

Oceanography  
Seabed features

Community structure  
Ecology  
Connectivity  
Biogeography







## Environmental baseline

Oceanography  
Seabed features

Community structure  
Ecology  
Connectivity  
Biogeography  
Ecosystem functions  
and services

Productivity  
Carbon and nutrient cycling  
Bioprospecting  
etc.



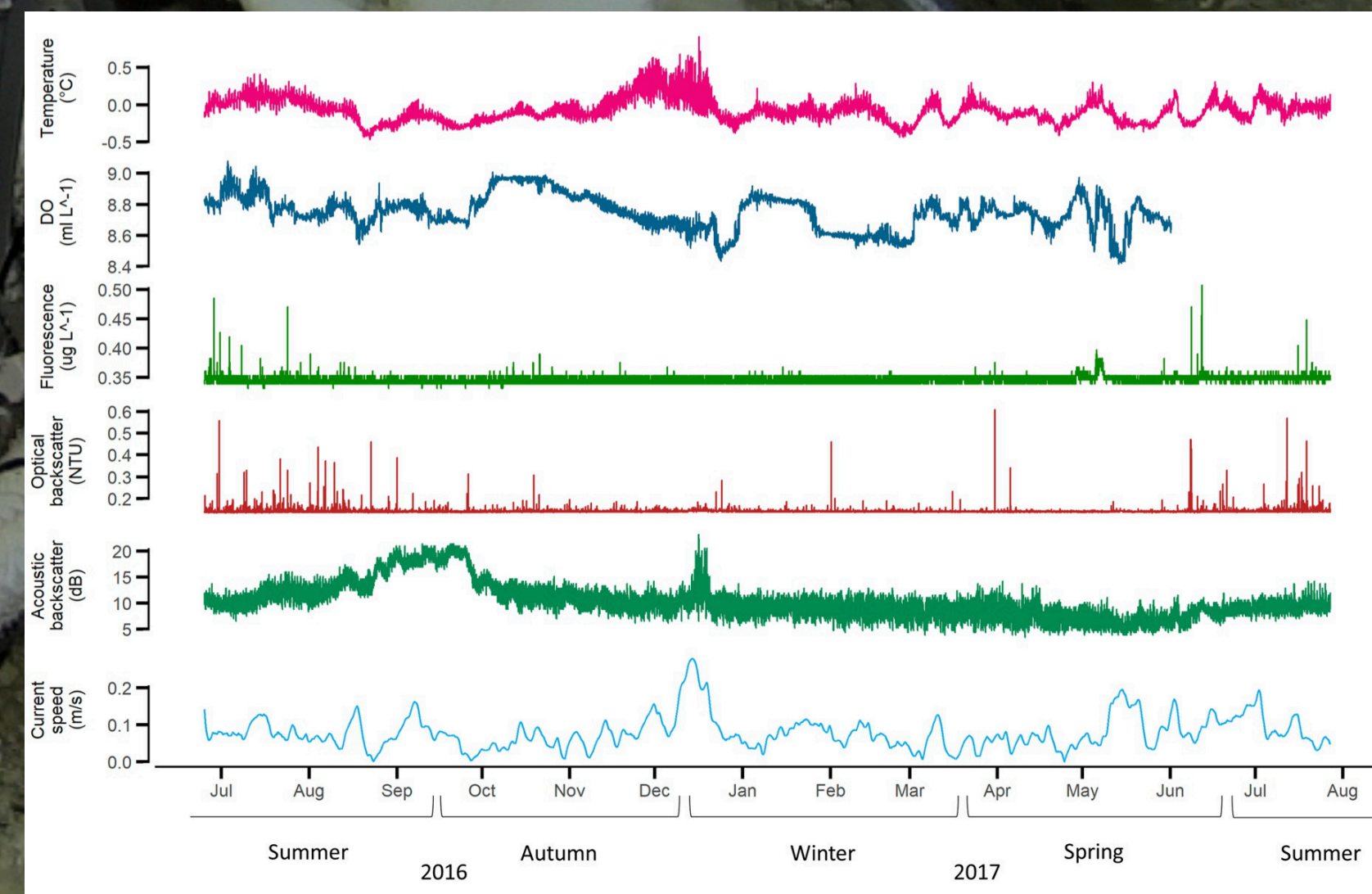


## Environmental baseline

Oceanography  
Seabed features

Community structure  
Ecology  
Connectivity  
Biogeography  
Ecosystem functions  
and services

Measuring natural variability is key





An underwater photograph of a hydrothermal vent. In the foreground, a large, white, porous mineral structure, likely a carbonate chimney, dominates the lower half of the frame. A red laser pointer beam is visible, pointing towards the structure. The background shows a sandy ocean floor with small rocks and a dark, deep blue water column.

## Environmental impacts

### Potential impacts

- Habitat removal

- Sediment plumes

- Noise, light (machinery)

- Cumulative impacts (multiple sources)



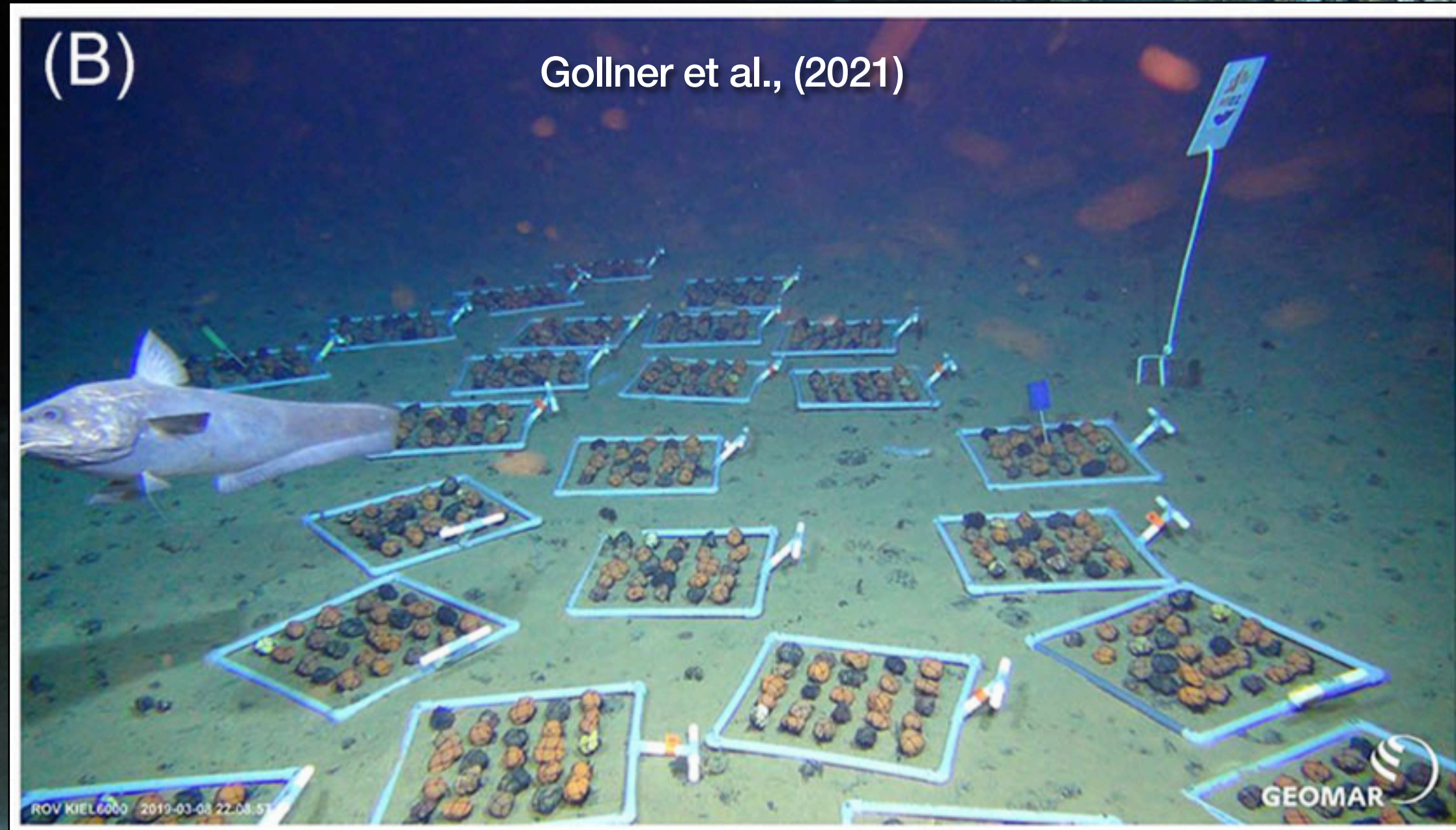
## Environmental impacts

### Potential impacts

- Habitat removal
- Sediment plumes
- Noise, light (machinery)
- Cumulative impacts (multiple sources)

### Ecosystem resilience / recovery

- Natural ability
- Restoration approaches





## Environmental impacts

### Potential impacts

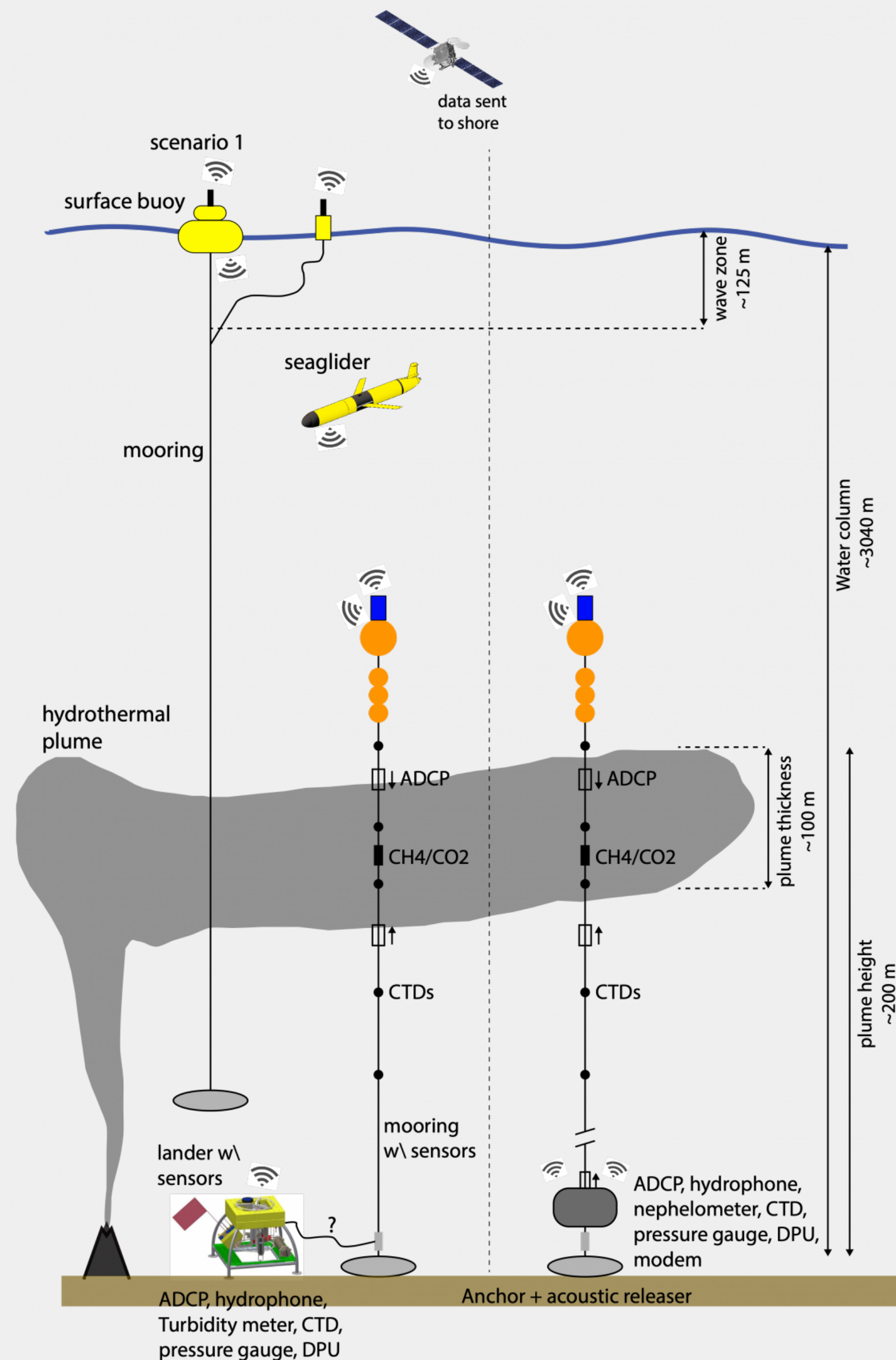
- Habitat removal
- Sediment plumes
- Noise, light (machinery)
- Cumulative impacts (multiple sources)

### Ecosystem resilience / recovery

- Natural ability
- Restoration approaches

### Management and monitoring

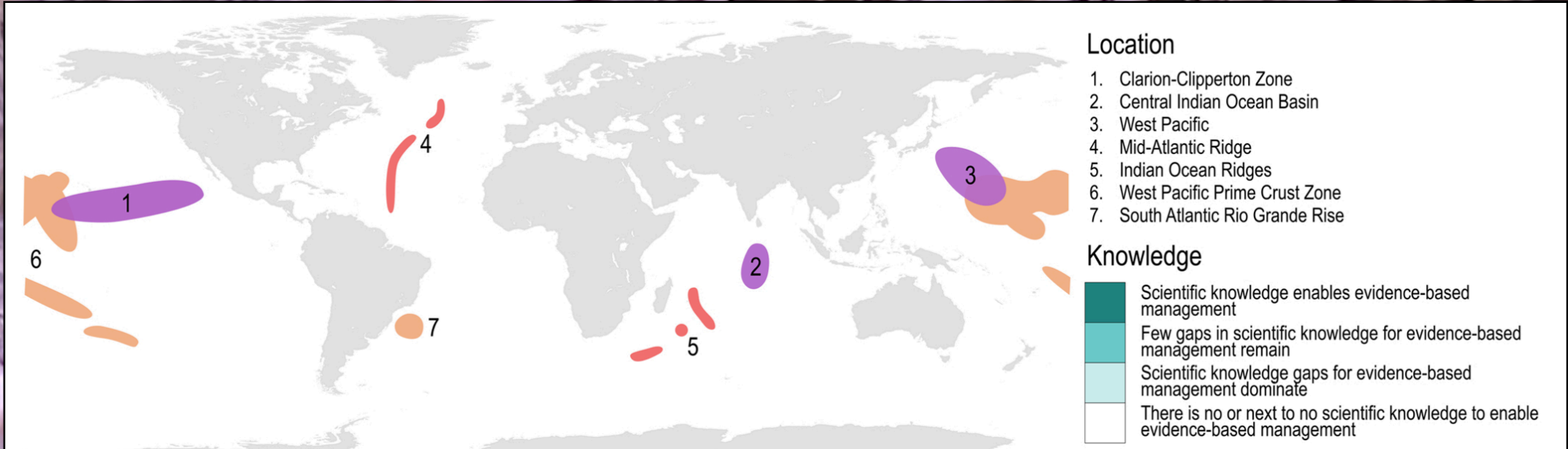
- Goals
- Indicators
- Standards
- Monitoring systems
- Mitigation actions



NorEMSO/EMSO-Mohn observatory. Credit: Dr. Thibaut Barreyre (UiB)







Key Scientific Gaps			Habitat								
			Nodules			Active Sulfides		Inactive Sulfides		Cobalt-rich Ferromanganese Crusts	
Theme	Topic	Sub-Topic	1	2	3	4	5	4	5	6	7
Environmental Baselines	Abiotic	High-resolution bathymetry									
		Oceanographic setting (e.g., currents, oxygen minimum zones, temperature, turbulence levels, sound, suspended particles)									
		Seabed properties (e.g., sediment characteristics, oxygen penetration, redox zonation, metal reactivity)									
		Natural disturbance regimes									
	Biotic*	Species taxonomy									
		Trophic relationships									
		Life histories (e.g., age of maturity, longevity, reproduction, fecundity)									
		Spatial variability									
		Temporal variability									
		Connectivity (e.g., dispersal mechanisms, species ranges, source/sink populations)									
		Ecosystem functions and services									
Deep-Seabed Mining	Impacts	Removal of resources									
		Plumes									
		Contaminant release and toxicity									
		Noise, vibration and light									
		Cumulative impacts									
	Resilience										
	Management	Environmental goals and objectives									
		Survey and monitoring criteria									
		Effectiveness of mitigation strategies									

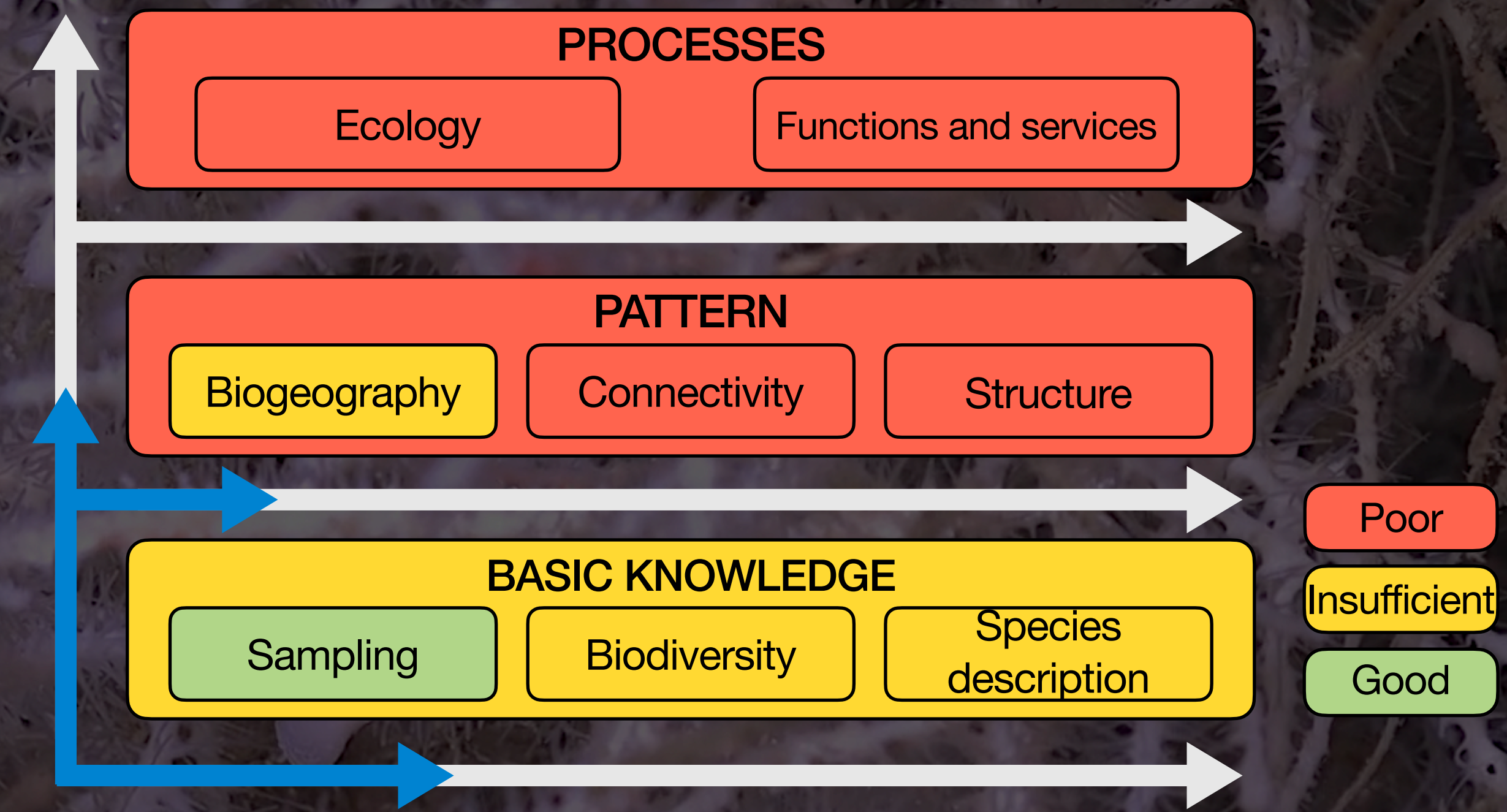
Key scientific gaps in license areas managed by the ISA (Amon et al. (2022)).







# Norwegian Sea



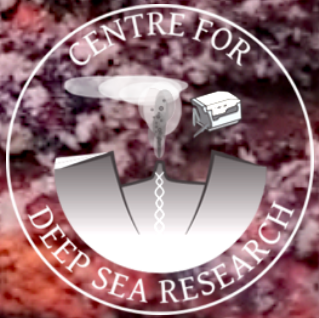
Modified from: Olsen et al. (2021). *Expert assessment on mineral resources in the Norwegian Sea, Part 2: benthic ecosystems*. University of Bergen.





# Summary

- Seabed minerals co-occur with fragile deep-sea ecosystems
- Science gaps prevent effective environmental management of deep-seabed mining
- Closing those gaps will require considerable research effort and time
- Collaboration among stakeholders is crucial





# Eco-Safe Ridge Mining project

[ecosafe.w.uib.no](http://ecosafe.w.uib.no)

*Addressing knowledge gaps about benthic deep-sea ecosystems in Norwegian waters*

**WP7 Dissemination and communication**  
Public, stakeholders, authorities

**WP1 Benthic communities**  
Biodiversity, habitat mapping

**WP2 Ecosystem functioning**  
Sensors, in-situ experiments

**WP3 Connectivity**  
Genetics, dispersal modeling

**WP4 Plume dispersal**  
Observatory, sensors, modeling

**WP5 Ecotoxicology**  
Laboratory experiments

**WP6 Environmental risk**  
Framework, analysis

