GoNorth

Geosciences in the Northern Arctic

Project partners: NGU, NTNU, SINTEF, UiB, UiO, UiT and UNIS
with Akvaplan-niva, NERSC, NORSAR, NPI and UNI Research

Gunnar Sand, Matthias Forwick, Rolf Mjelde

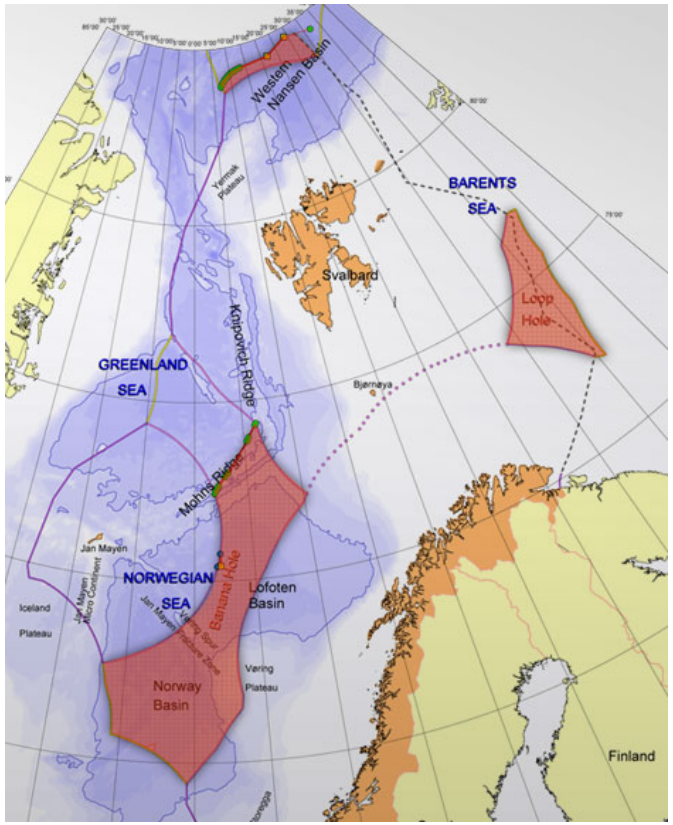
April 2018

Why an Arctic Ocean research program?

- Norway's claim to an extended continental shelf beyond 200 nm was accepted in 2009

  (*Commission on the Limits of the Continental Shelf)*

- Agreement between Norway and Russia on the maritime boundary in 2011
- We hardly know our new territories
- Other nations are active in exploring the Arctic Ocean, using ice breaking research vessels



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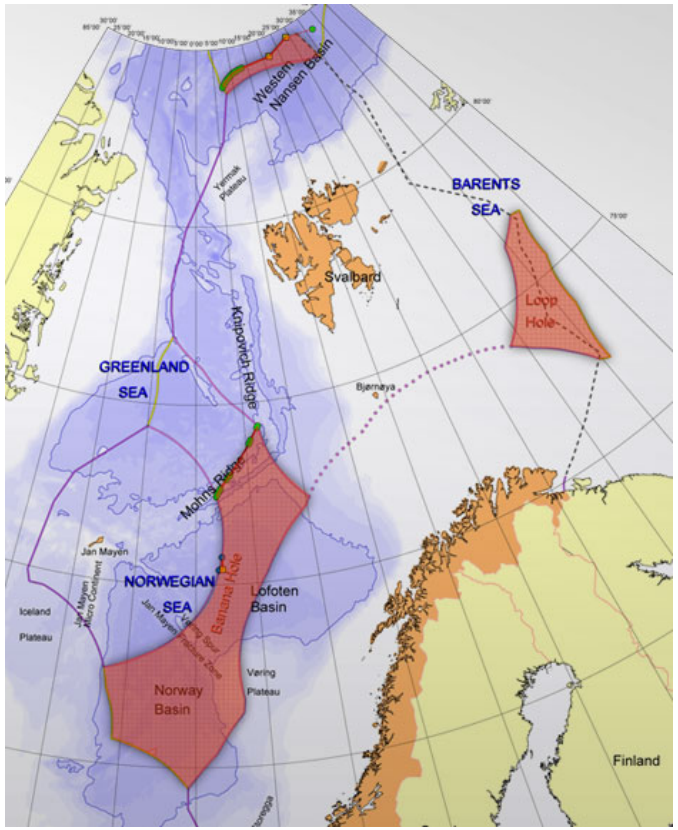
GoNorth – goals of the pre-project

- Develop a high quality scientific program
- Identify cost-effective logistics platforms and develop a logistics strategy
- Identify possible funders and develop a funding strategy
- Attract international partners who share our interests and ambitions

- The pre-project was supported by the Ministry of Foreign Affairs through the *Arctic 2030 program*



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GoNorth: Scientific work packages

WP 1	**Continental rifting/ break-up processes**	WP leaders: Jan Inge Faleide (UiO) and Susanne Buiter (NGU) – with Snorre Olaussen (UNIS), Alexander Minakov (UiO), Johannes Schweitzer (NORSAR), Rolf Mjelde (UiB)
WP 2	**Ultra-slow Oceanic Spreading**	WP leaders: Rolf B. Pedersen (UiB) and Carmen Gaina (CEED/UiO) – with Cedric Hamelin (UiB), Kuvvet Atakan (UiB), Johannes Schweitzer (NORSAR)
WP 3	**Greenhouse - Icehouse fluctuations**	WP leaders: Astrid Lysså (NGU) and Matthias Forwick (UiT) – with Jochen Knies (NGU), Katrine Husum (NPI), Tom Arne Rydningen (UiT), Lena Håkansson (UNIS), Jan Sverre Laberg (UiT), Nele Meckler (UiB), Bjørg Risebrobakken (Uni Research), Riko Noormets (UNIS)
WP 4	**Developing/ testing new technology**	WP leaders: Asgeir J. Sørensen (NTNU) and Rolf Birger Pedersen (UiB) – with Tore Aunaas, Kay Fjørtoft and Alf Melbye (SINTEF), Jørgen Berge and Alfred Hanssen (UiT), Tor Arne Johansen (UiB), Geir Johnsen, Martin Ludvigsen, Sveinung Løset and Roger Skjetne (NTNU)
WP 5	**Oceanography, marine biology**	WP leaders Oceanography: Hanne Sagen/Stein Sandven (NERSC), with Mathilde Sørensen (UiB) WP leaders Marine biology: Jørgen Berge (UiT) and Malin Daase (UiT)

34 scientists contributed to the pre-project scientific report

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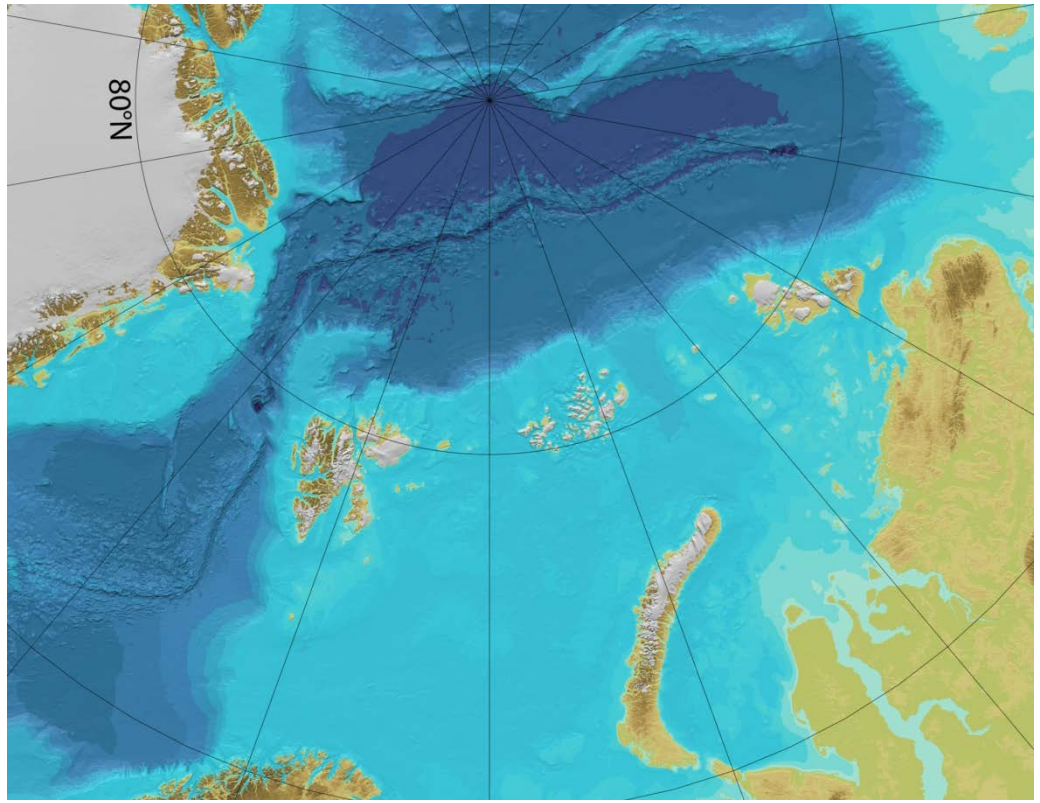
WP 1: Continental rifting and break-up processes

Scientific objectives:

- Rifting – continental breakup
- Crustal architecture (continent-ocean transition)
- Post-breakup evolution (source-to-sink <-> WP3)
  - Cenozoic uplift/erosion of Barents Shelf - Svalbard
  - Nansen Basin stratigraphy
- Recent geodynamic setting



Principal investigators:

- Jan Inge Faleide, UiO
- Susanne Buiter, NGU

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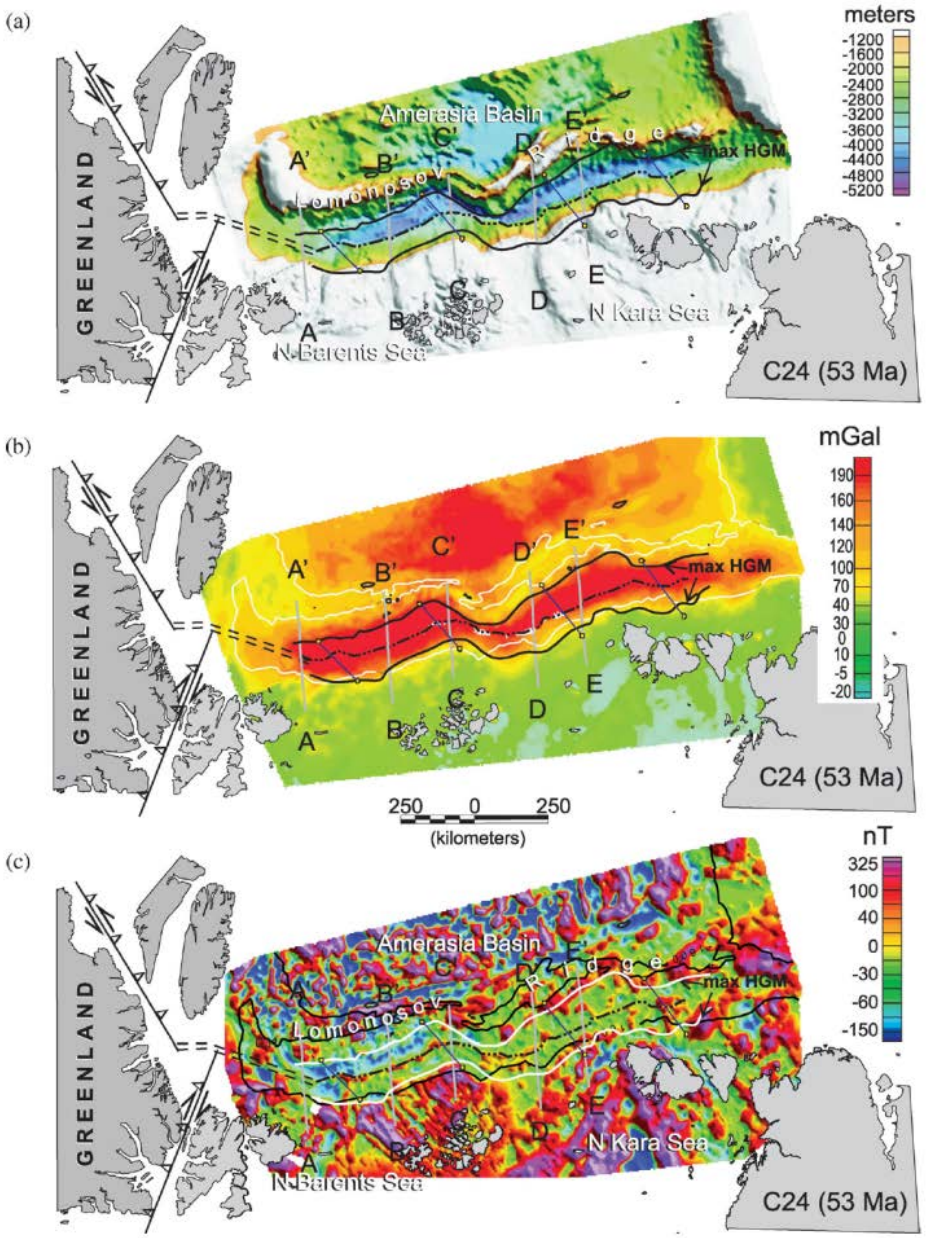
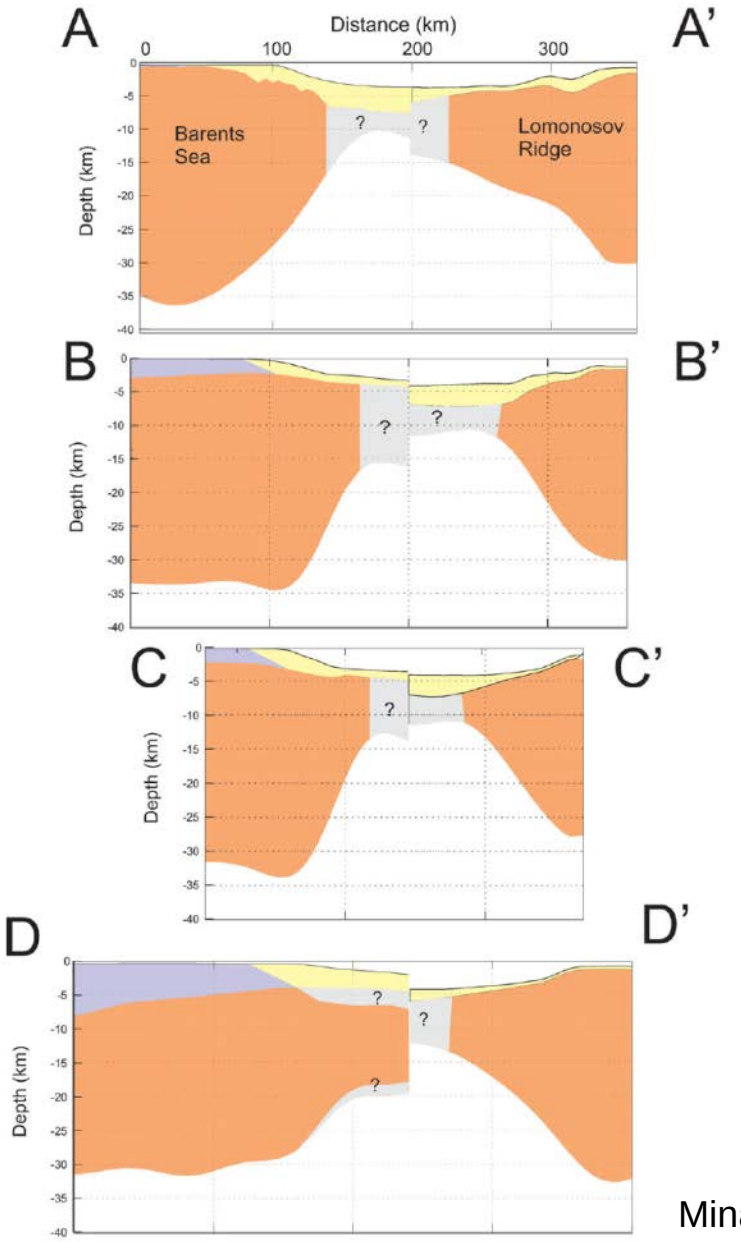
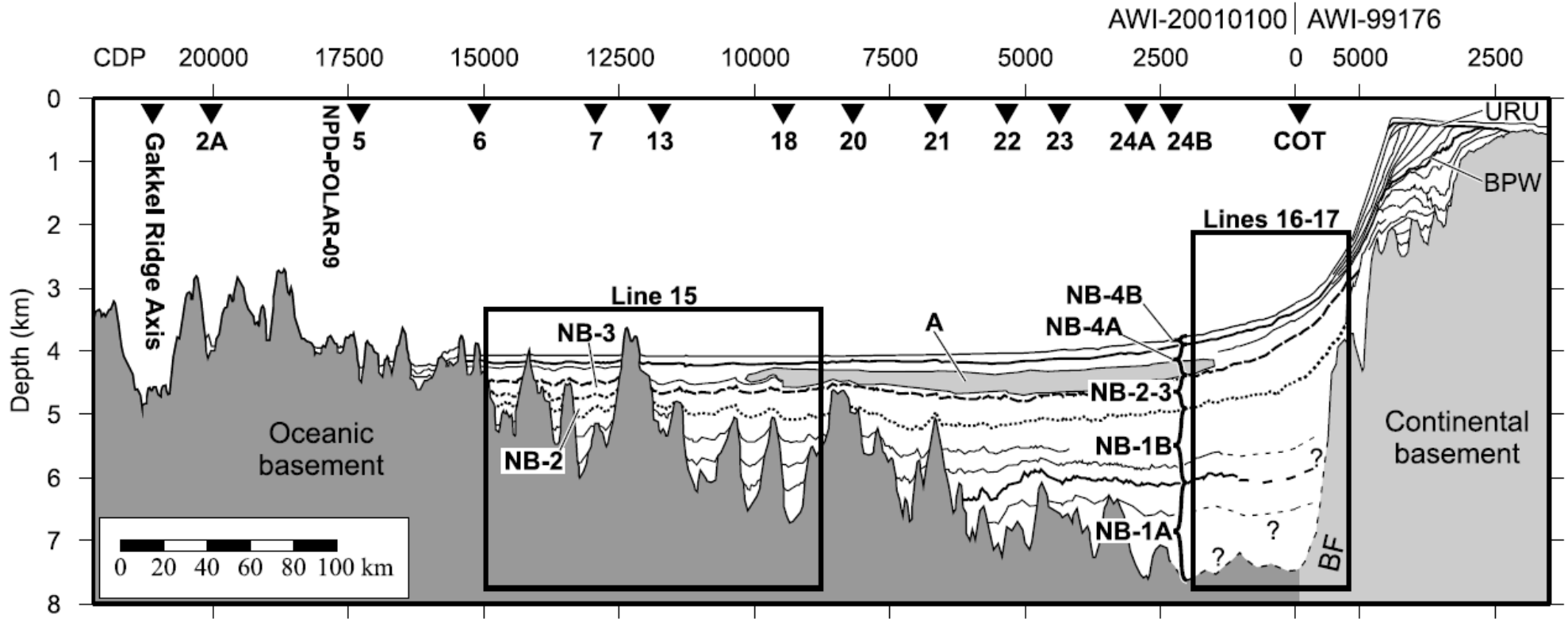




Minakov et al. (2012)

Northern Barents Sea margin



Jokat & Micksch (2004)
Engen et al. (2009)

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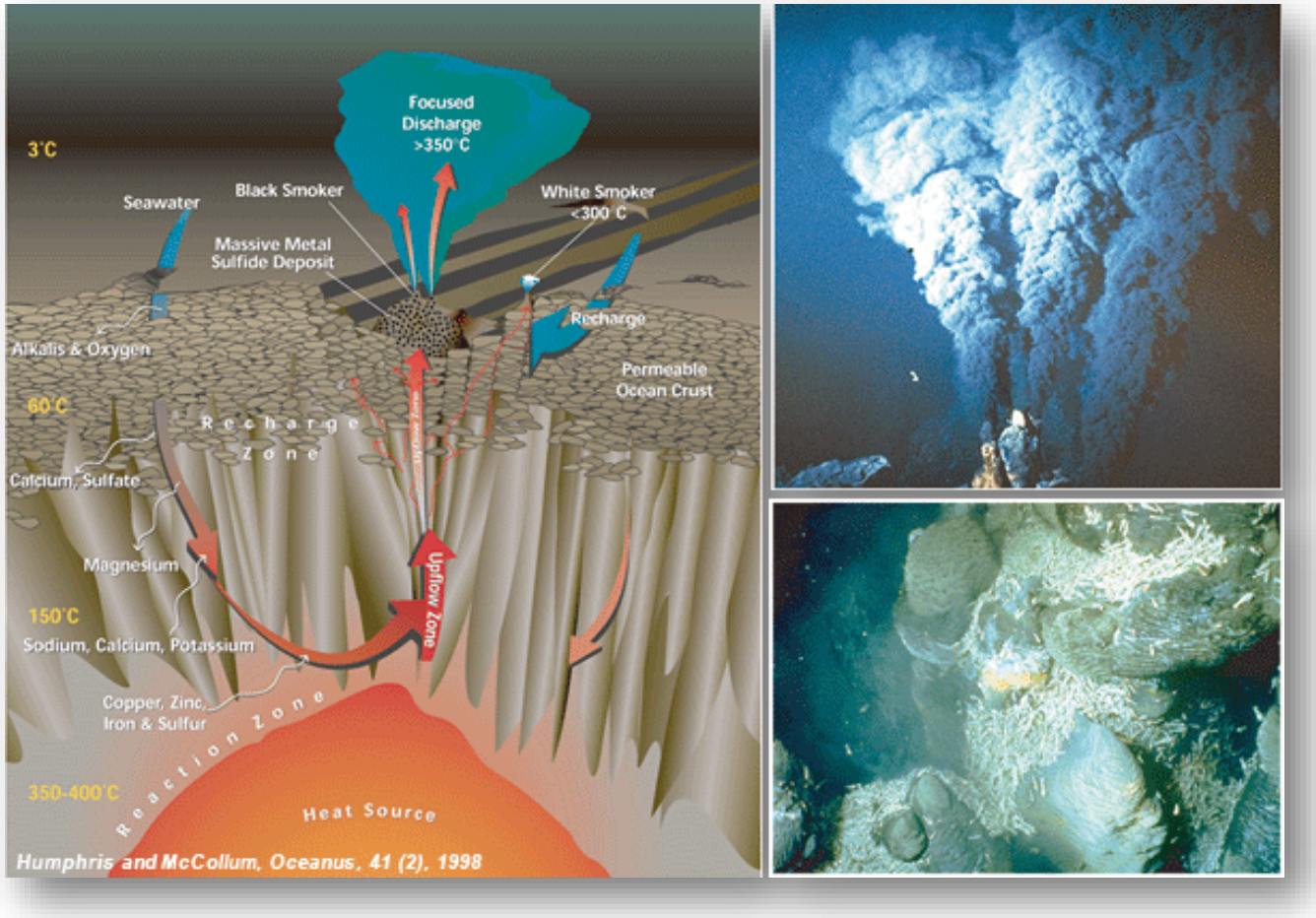
WP 2: Ultra-slow spreading at the Gakkel Ridge

and oceanic crust formation in the Eurasian Basin

Principal investigators:

- Rolf Birger Pedersen, UiB
- Carmen Gaina, UiO



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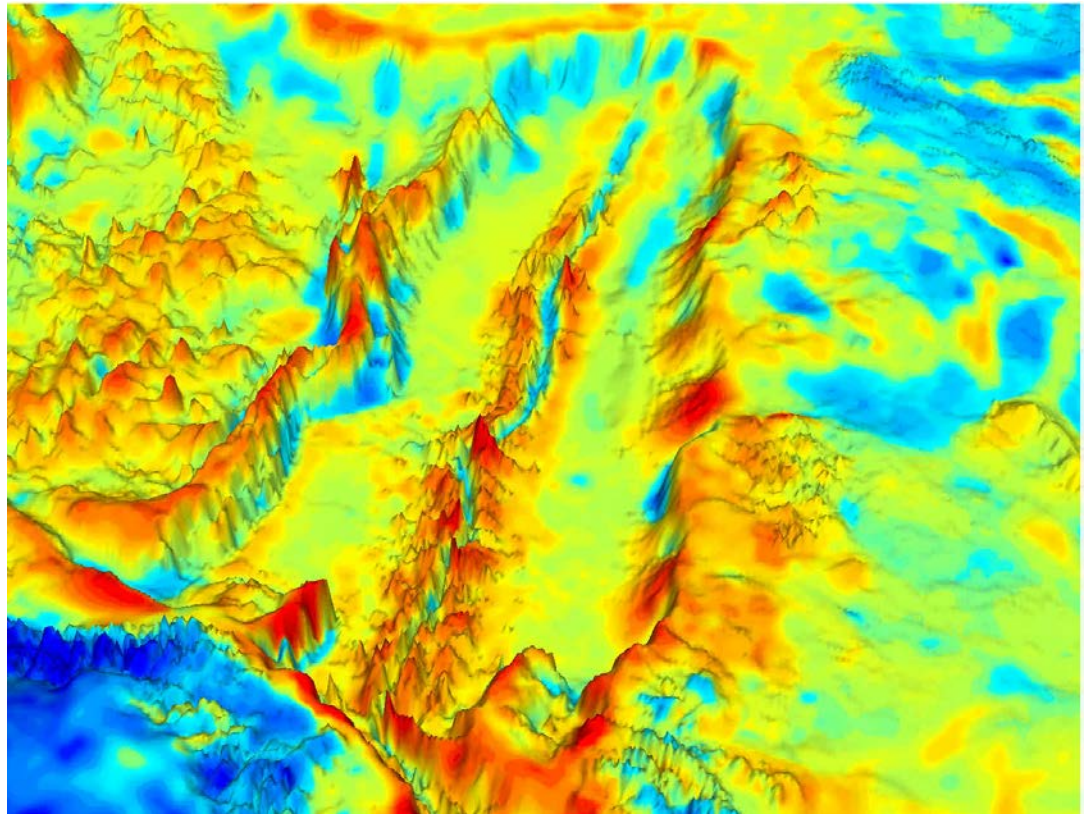
Target Areas: Western Gakkel Ridge

Scientific objectives:

- Ultraslow spreading
- Amagmatic + magmatic spreading
- Diverse hydrothermal activity
- Evolution from rift to drift
- Aerial geophysical surveys
- Evolution of Arctic mantle boundary
- High resolution seafloor mapping
- Sampling of ridge for volcanology/petrology
- Deployment of seismometers for tectonics/seismology



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WP 3: Post Break-up Sedimentary Processes

Greenhouse – Icehouse – Cenozoic Evolution

Integrating marine and terrestrial records

Principal investigators:

- Astrid Lysså, NGU
- Matthias Forwick, UiT

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Work package Goals

Climate, glacial and oceanographic history in the Arctic Ocean throughout the last 65 Ma

- Complete Cenozoic stratigraphy and climate history
- Resolve hot and cold climate extremes

Calibration of processes

- Analogues studies for present ice sheets
- Baseline for future projections


Photo: E. Speelman


Photo: M. Forwick

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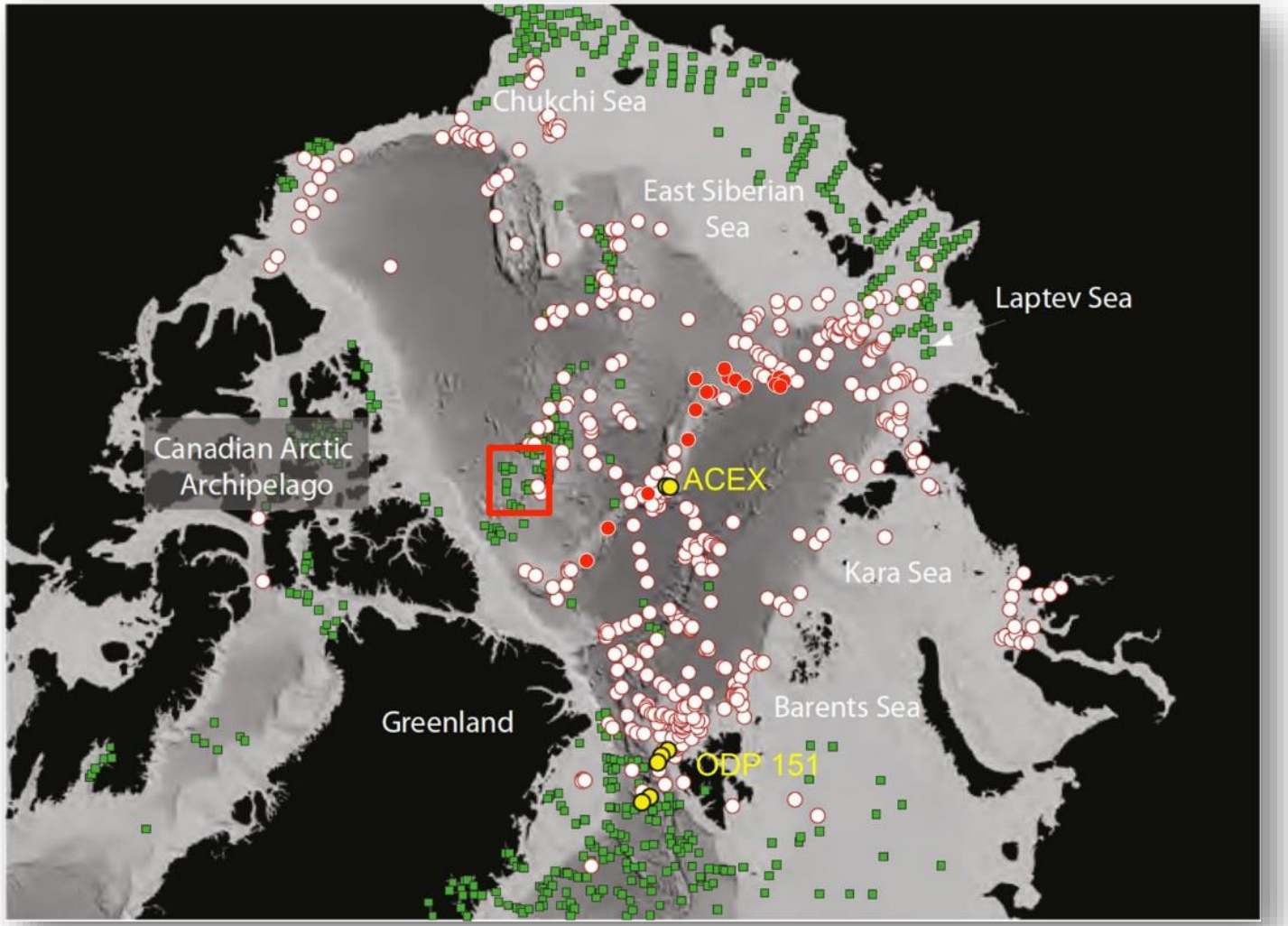
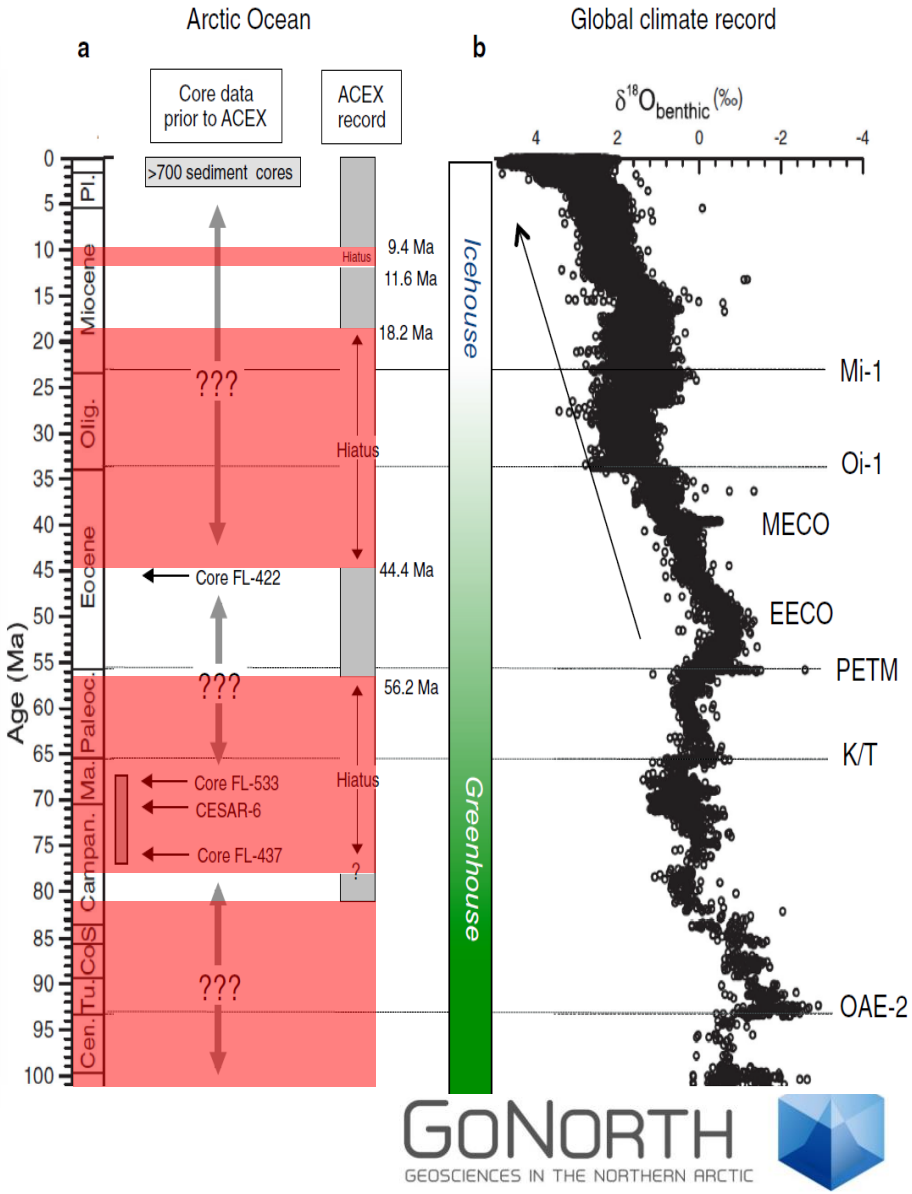
State of knowledge



From Stein et al., 2015



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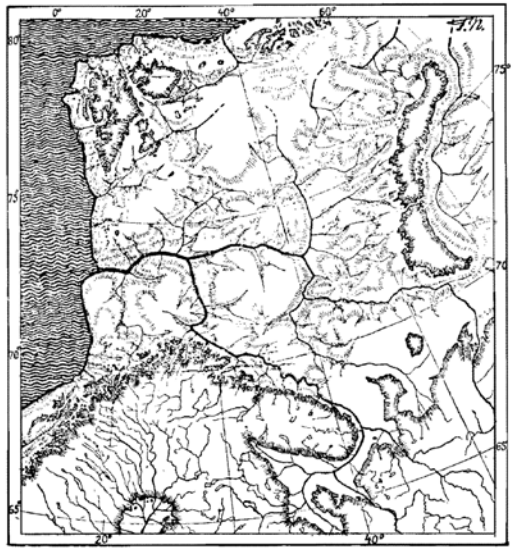
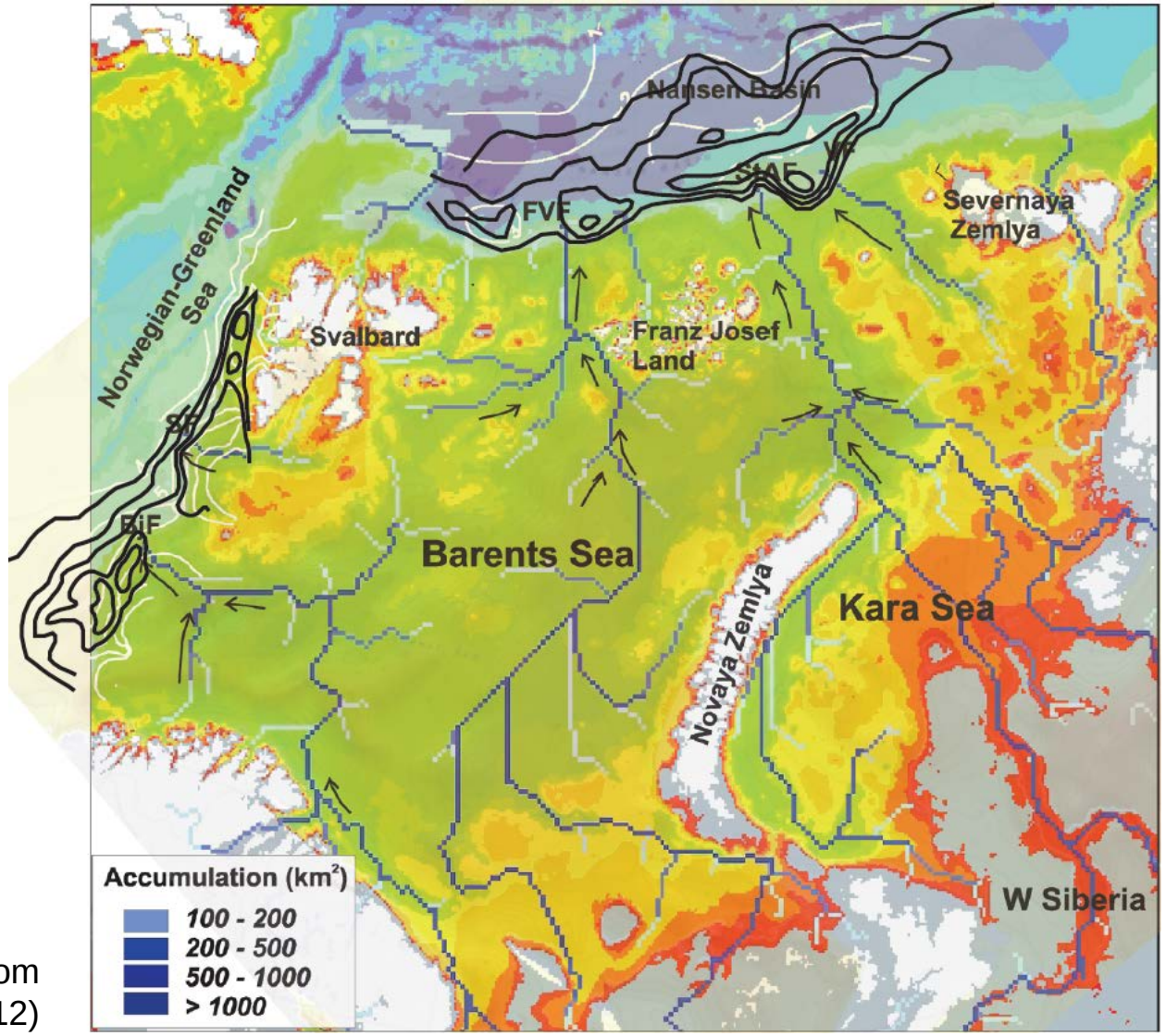
Source-to-sink:

Late Cenozoic uplift/erosion sedimentary fans



Nansen (1920)



Modified from Minakov et al. (2012)

WP 4: Testing and developing new technology

- Autonomous vehicles
- Environmental surveillance
- Drilling under extreme conditions
- Ice mechanics, sea ice monitoring
- Navigation/communication
- Safety, working conditions
- Polar lows, icing

Principal investigators:

- Asgeir Sørensen, NTNU
- Rolf Birger Pedersen, UiB

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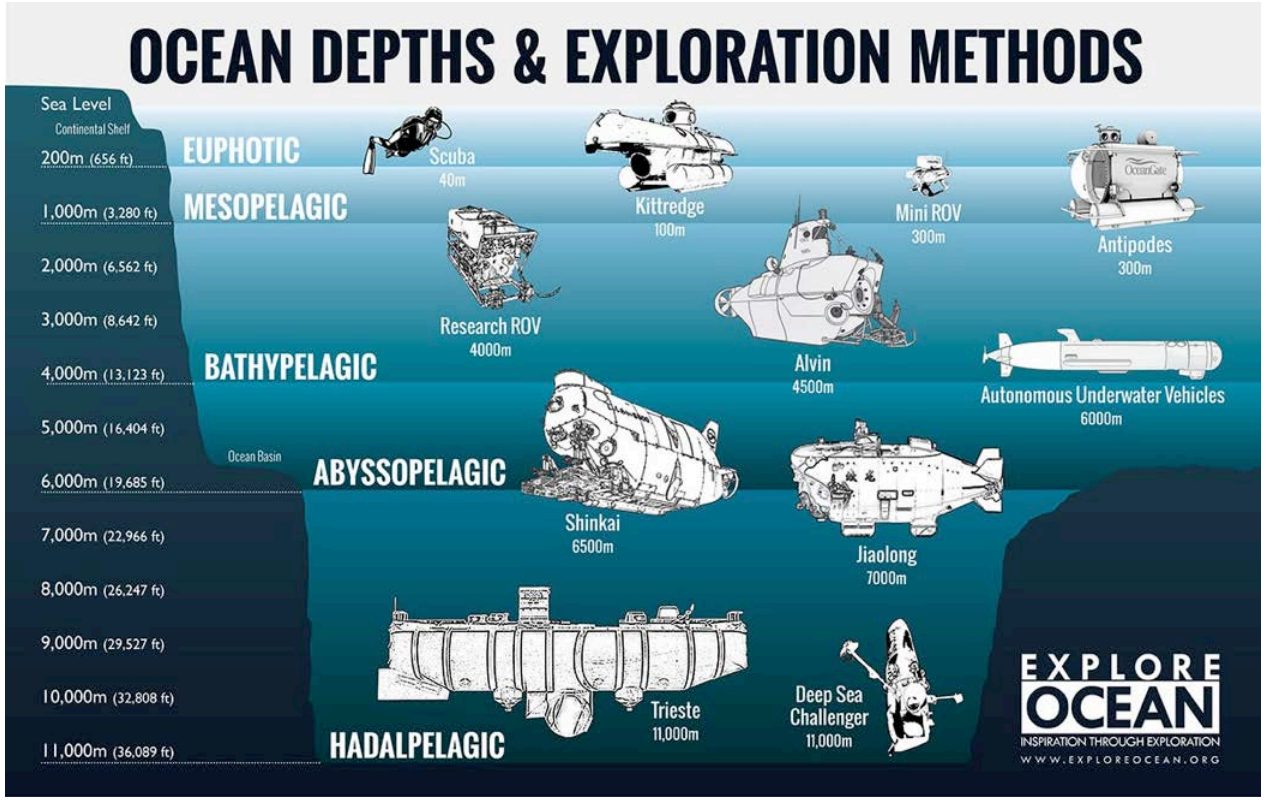
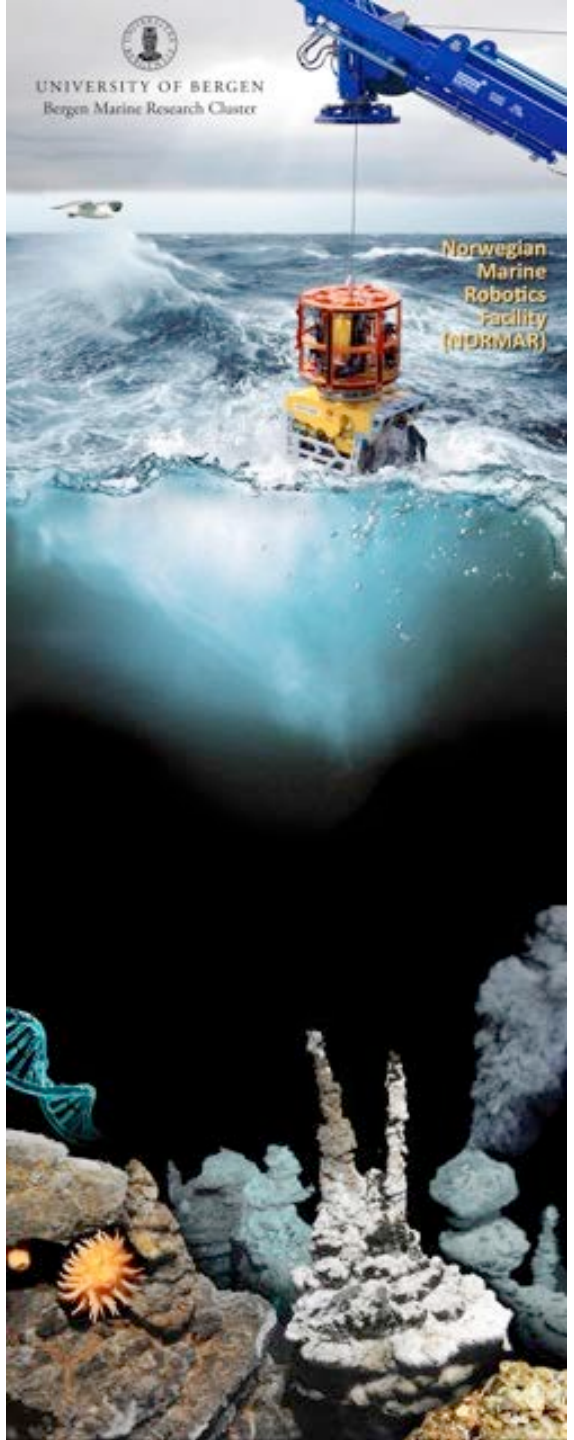
Norwegian Marine Robotics Facility



Ægir 6000 – a world class ROV for deep sea and under-ice research



WP 5: Arctic Ocean Ecosystems

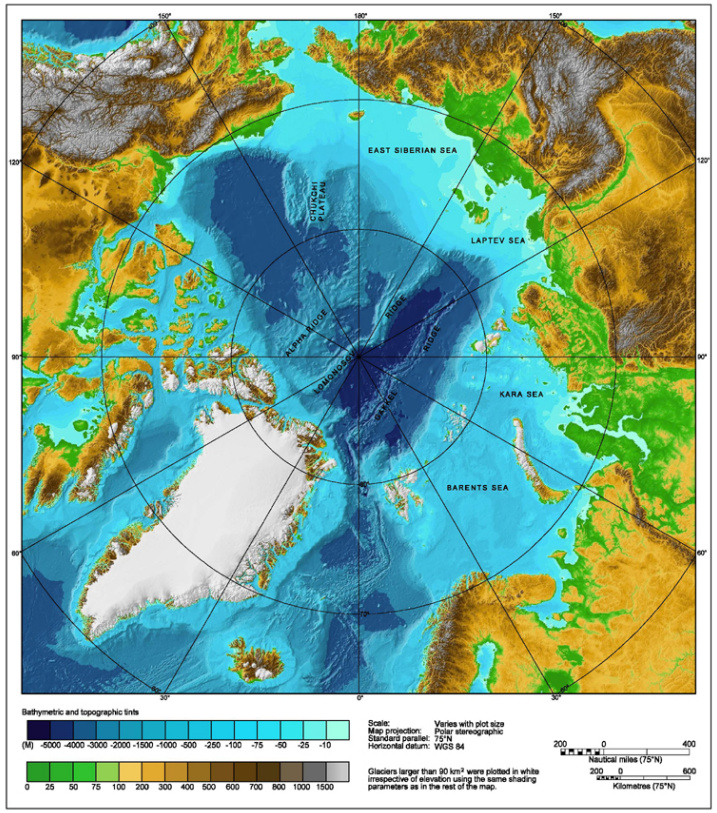
- Observations of water column and sea ice cover
- Physical oceanography and sea ice
- Water column biology

Principal investigators:

- Stein Sandven, NERSC
- Jørgen Berge, UiT

WP 6: Mapping our new territories

- Mapping depth and sea-floor for the Mapping Authority?
- Performing seismic studies for the Petroleum Directorate?
- Collecting geological field data for the Geological Survey?
- Collecting environmental data for the Environmental Directorate?



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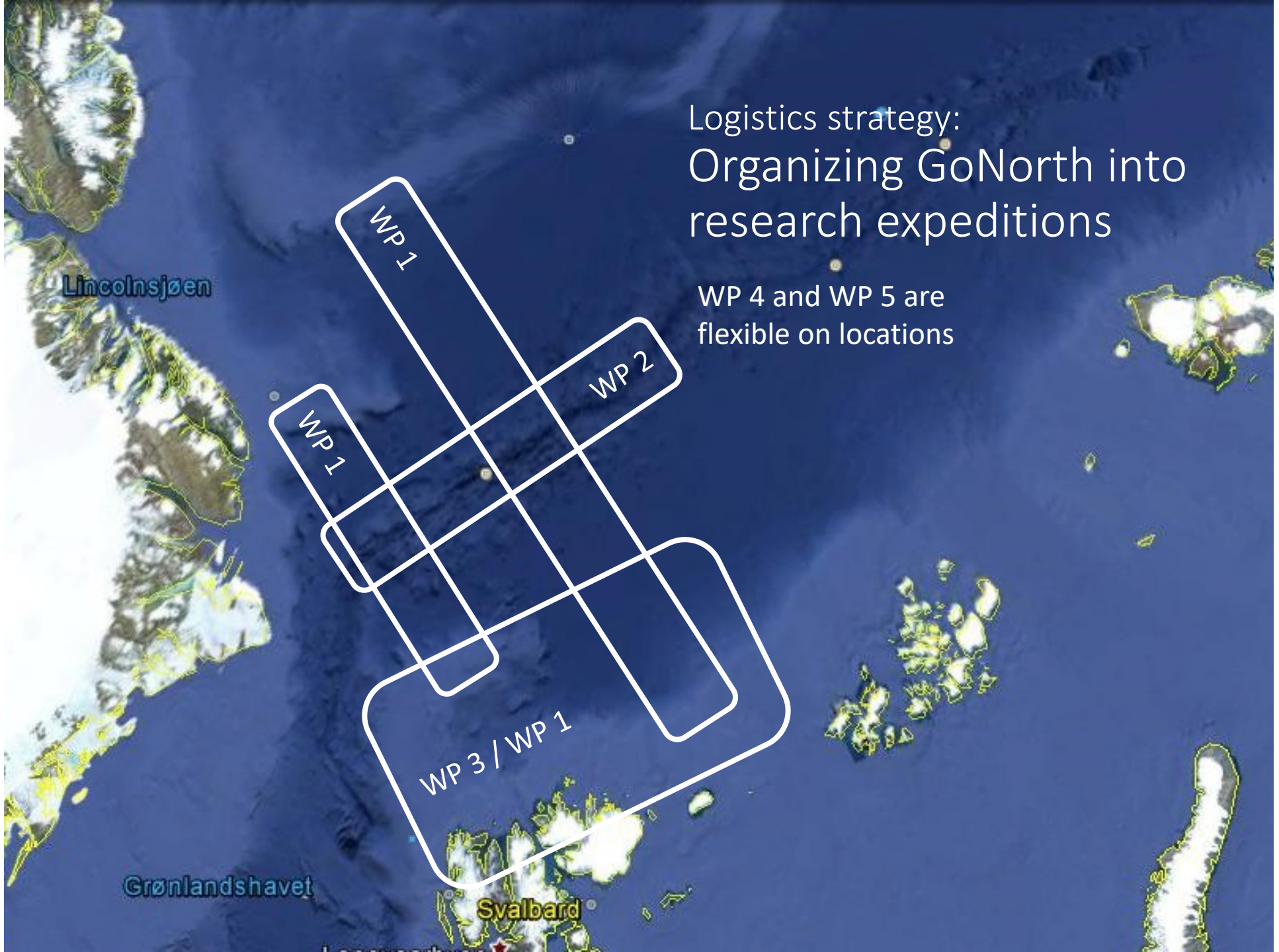
Logistics strategy:
Organizing GoNorth into research expeditions
WP 4 and WP 5 are flexible on locations
WP 1
WP 2
WP 1
WP 3 / WP 1
Lincolnsjøen
Grønlandshavet
Svalbard

Education is part of the program

We want to introduce a new generation of polar researchers to the Arctic Ocean

Main conclusions from the pre-project

- **A Norwegian program for exploring the Arctic Ocean is realistic and feasible – with some pre-conditions.**
- Norwegian research communities must cooperate to reach their goals.
- The program must serve several missions: (1) Basic research, (2) Technology development, (3) Mapping the territories, (4) Demonstrating Norwegian presence in the Arctic Ocean.
- Knowledge generated by GoNorth must be considered useful in a political and management context. We propose a government funded, MAREANO-type program, for mapping the new Norwegian territories.
- Research and technology development may be funded through existing instruments (NRC, EU and Nordic).
- Cooperation with international partners is a key to success. Norwegian research communities are well respected abroad, but international researchers have been far more active in the Arctic Ocean in recent years.
- *Kronprins Haakon* is an outstanding vessel which we want access to, but it can not serve all our needs.
- Access to ice-breakers is a major challenge which requires international cooperation and cost-sharing.
- Private companies may be interested in supporting a Norwegian Arctic Ocean exploration program.

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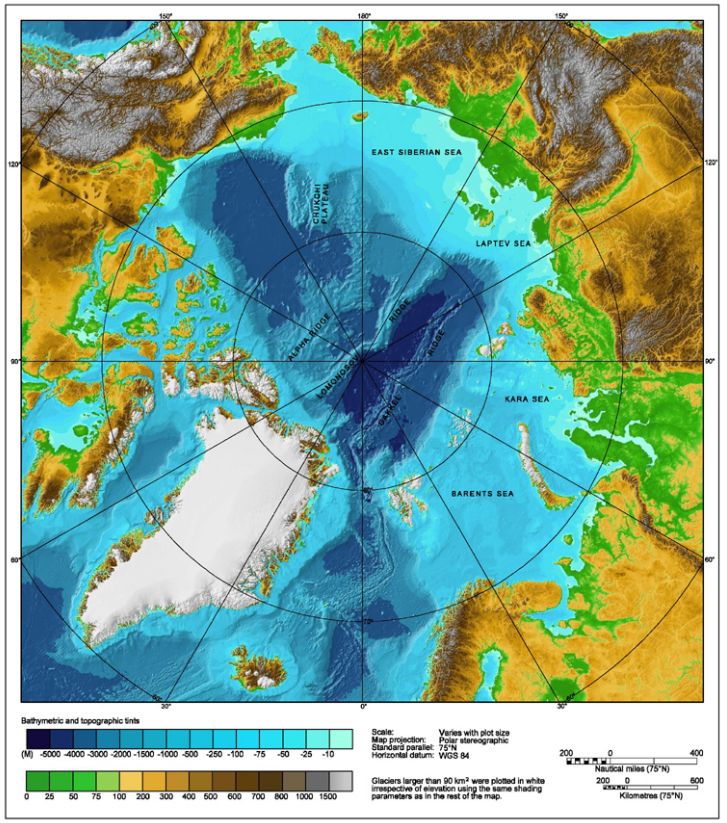
Phase 2: Operationalize the pre-project

Transform research program into international research expeditions

- We have a number of options – combining different partners in different scientific fields on different ships to different locations
- Each expedition has to be developed as a separate project with a separate budget, drawn from multiple sources
- Mapping the new territories needs to be performed in cooperation with stakeholder government agencies

- Proposal for funding forwarded to Arctic 2030-program



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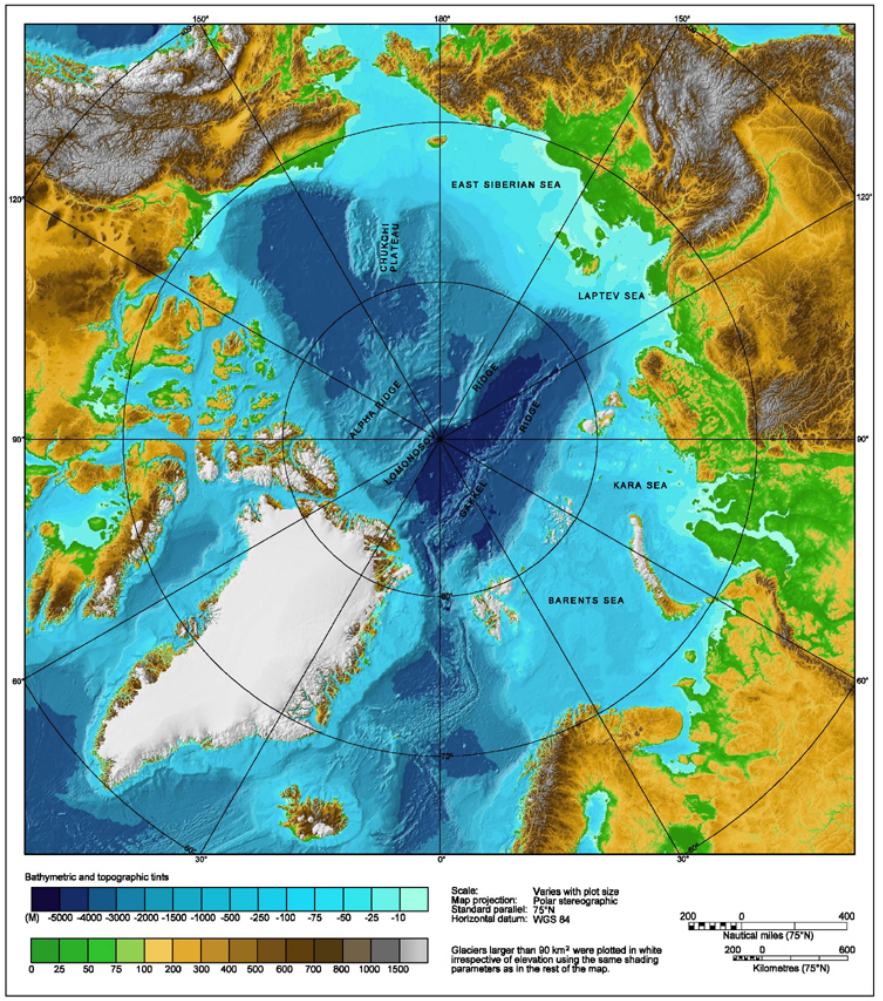
International Cooperation

International cooperation is needed for scientific and logistical reasons, Norway can't operate on its own in the entire study area

We have discussed cooperation with researchers from:

- The Swedish Polar Research Secretariat
- University of Stockholm
- University of Copenhagen
- Geological Survey of Denmark and Greenland (GEUS)
- Alfred Wegener Institute (AWI)
- Bundesanstalt für Geowissenschaften und Rohstoffe (BGR)
- The Polish Academy of Sciences
- Contacts with Russian, Korean, Japanese and Chinese institutes



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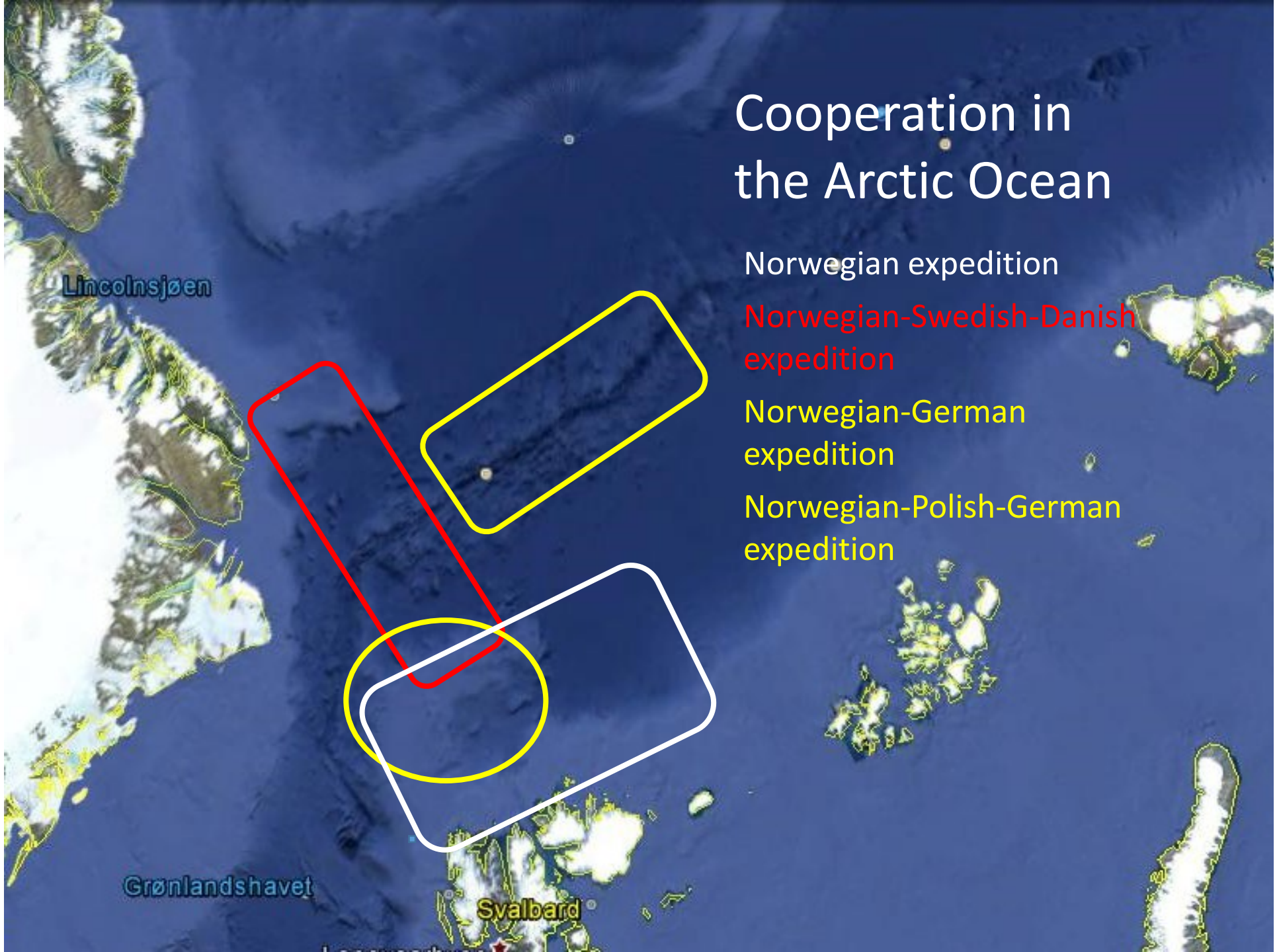
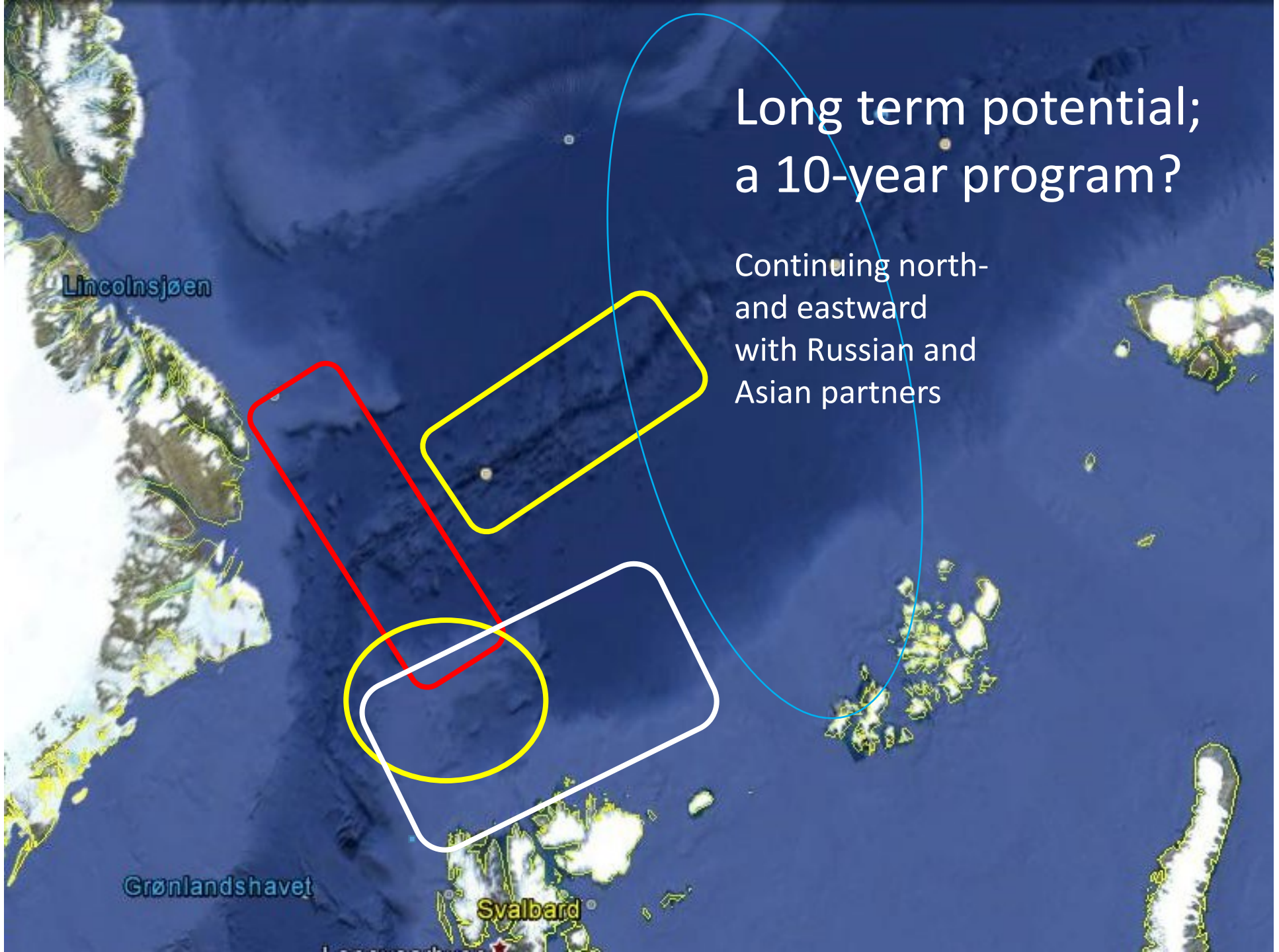

Cooperation in the Arctic Ocean
Norwegian expedition
Norwegian-Swedish-Danish expedition
Norwegian-German expedition
Norwegian-Polish-German expedition
Lincolnsjøen
Grønlandshavet
Svalbard



Long term potential; a 10-year program?

Continuing north- and eastward with Russian and Asian partners

Photo: M. Forwick

On-going dialogue with AWI

Northern Margin expedition in 2019-20

Gakkel Ridge expedition in 2021-22

Yermak drilling expedition in 2025

Grønlandshavet

Svalbard

The first GoNorth cruise needs to be Norwegian

- Starting on the Svalbard shelf with *Kronprins Haakon* in 2019?
- Cooperation with *Arven etter Nansen, MAREANO* or *Centers of Excellence?*
- Then continue northward

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Additional option: Kjell Inge Røkke's vessel *"REV"*

- Ice-going vessel, well equipped, with a capacity of 50-60 scientists
- Available to science 4 months a year, starting in 2020
- The owner has a particular interest in environmental and multidisciplinary research

Bilde: TRG

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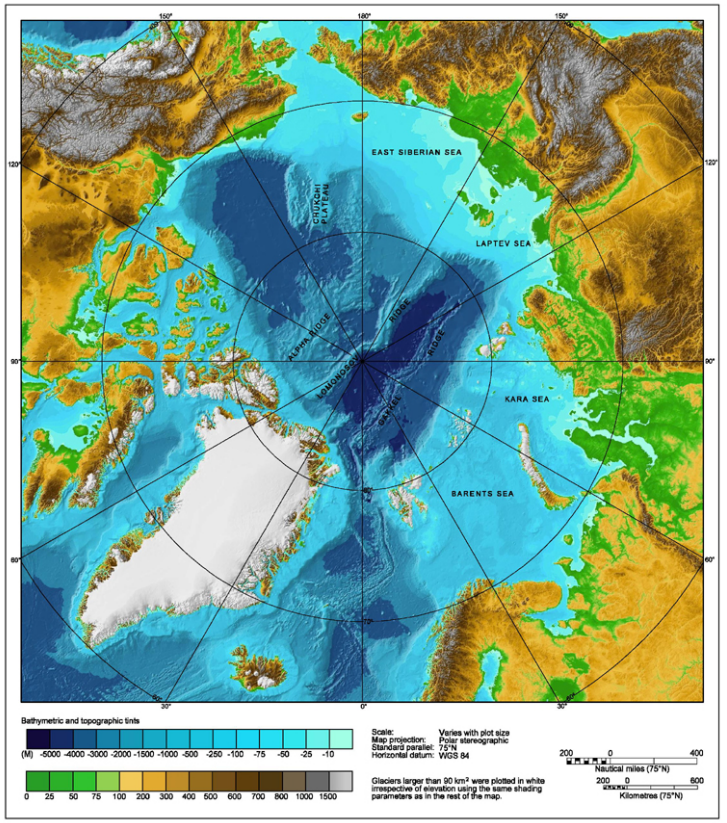
Extending the Norwegian partnership

Pre project partners:

- Univ. of Bergen
- Univ. of Oslo
- Univ. of Tromsø
- NTNU
- UNIS
- NGS
- SINTEF

New partners Phase 2:

- NORSAR
- NERSC
- NPI
- Akvaplan-niva
- UNI Research



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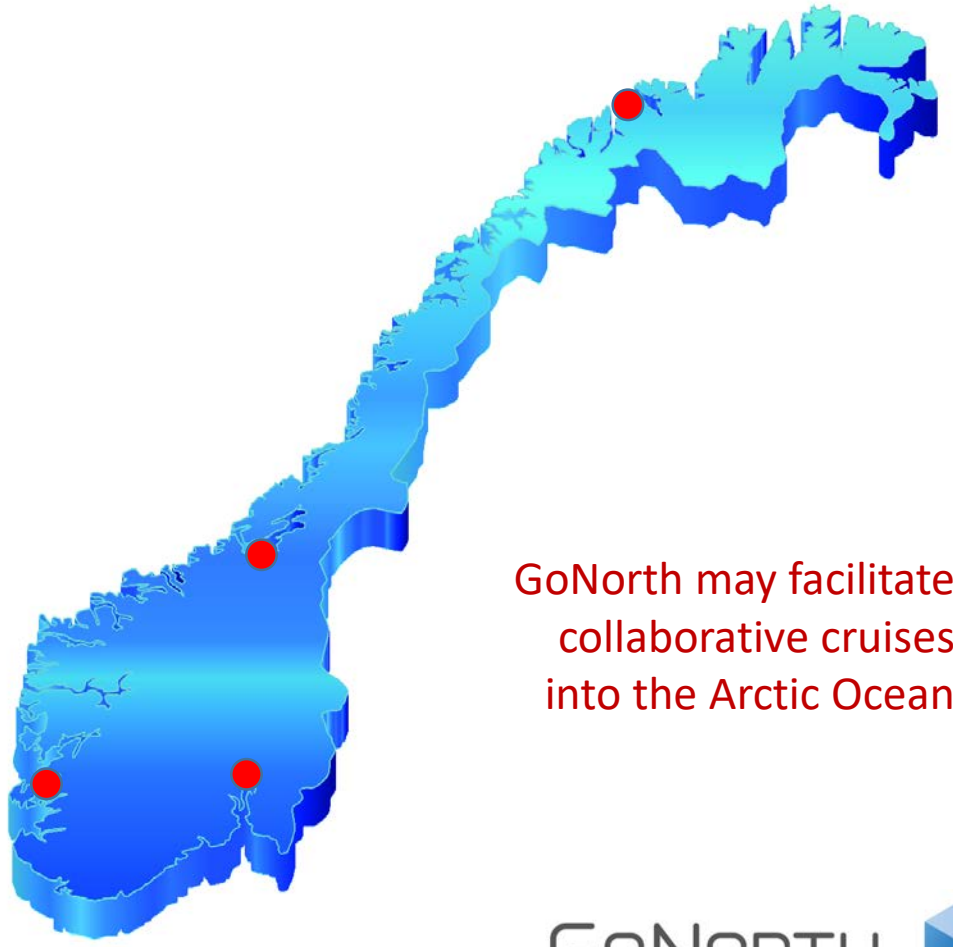
Supporting Research Centres and Centres of Excellence

- ARCEx – Research Center for Arctic Petroleum Exploration (Tromsø)
- CAGE – Centre for Arctic Gas Hydrate, Environment and Climate (Tromsø)
- AMOS – Centre for Autonomous Marine Operations and Systems (Trondheim)
- CGB – Centre for Geobiology/ Norwegian Ocean Laboratory (Bergen)
- CEED – Centre for Earth Evolution and Dynamics (Oslo)
- SAMCoT – Sustainable Arctic Marine and Coastal Technology (Trondheim)
- Bjerknes Centre for Climate Research (Bergen)



GoNorth may facilitate collaborative cruises into the Arctic Ocean

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Short summary

- GoNorth is …:
  - a multi-disciplinary basic-research programme proposed by a «national team» focussing on:
    - Continental rifting/ break-up processes
    - Ultra-slow Oceanic Spreading
    - Greenhouse - Icehouse fluctuations
    - Developing/testing new technology
    - Oceanography, marine biology
    - Mapping of new territories
  - Planning multiple expeditions, in collaboration with international partners
  - Currently identifying funding sources


Photo: M. Forwick

Thank you for Your attention!

For more information, contact:

Gunnar Sand: gunnar.sand@sintef.no

Rolf Mjelde: rolf.mjelde@uib.no

Matthias Forwick: matthias.forwick@uit.no