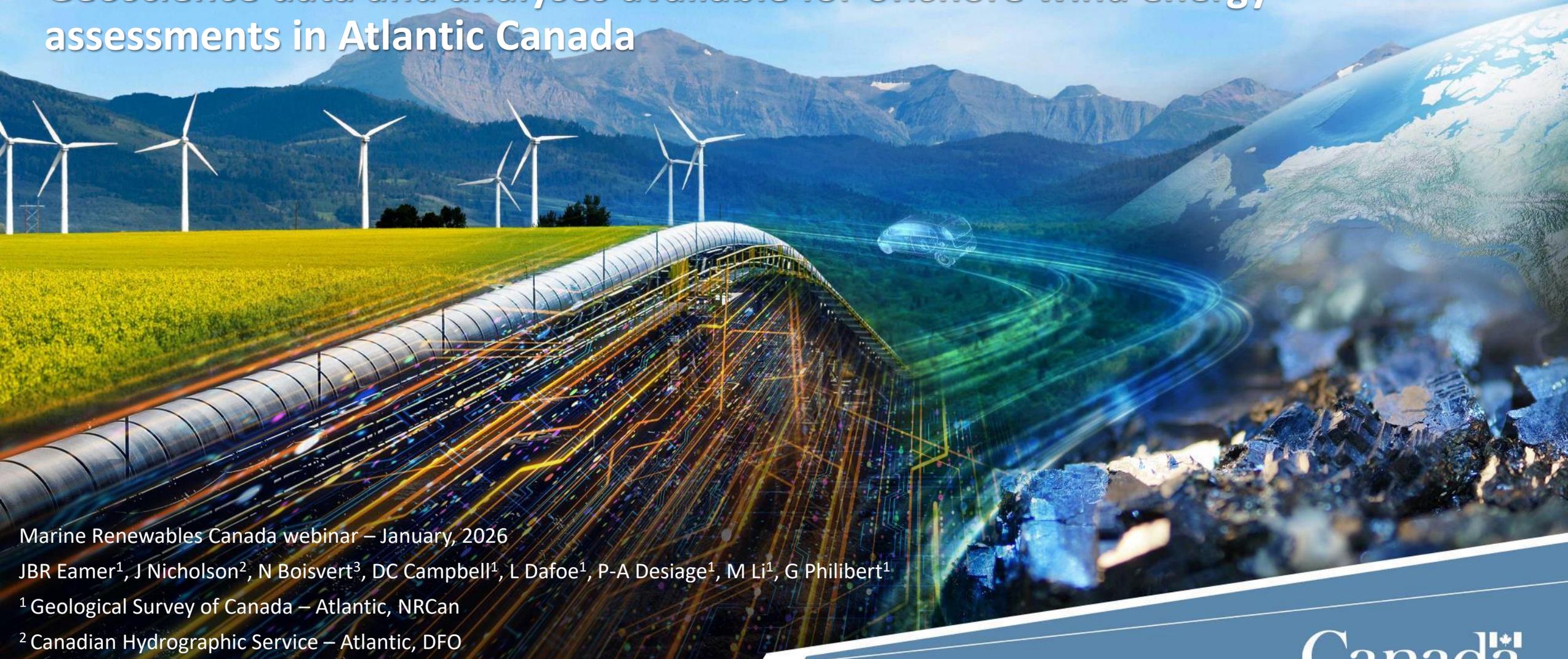




Geoscience data and analyses available for offshore wind energy assessments in Atlantic Canada



Marine Renewables Canada webinar – January, 2026

JBR Eamer¹, J Nicholson², N Boisvert³, DC Campbell¹, L Dafoe¹, P-A Desiagne¹, M Li¹, G Philibert¹

¹ Geological Survey of Canada – Atlantic, NRCan

² Canadian Hydrographic Service – Atlantic, DFO

³ Renewable Energy and Electricity Division, NRCan

Overview

- Introductions – GSC and the CHS
- Our understanding of the problem
- Our desktop studies and databases
- The Offshore Wind Predevelopment Program
- Preview of March workshops and data release



Seigneurie de Beaupré – Canada's largest windfarm
(2024) parcseolienseigneuriedebeaupre.com



Geological Survey of Canada- Marine Geoscience

- Co-located at Bedford Institute of Oceanography (BIO) Dartmouth, NS and Institute of Ocean Science (IOS), Sidney, BC
- Active research in Arctic, Pacific and Atlantic oceans
- Close collaborations with other government departments/agencies, universities and stakeholders
- Marine geoscience disseminated across multiple national programs focused on:
 - Sustainable development and public safety
 - Offshore natural resources
 - Ocean Governance



IFIED - NON CLASSIFIÉ

*Bedford
Institute of
Oceanography
(Dartmouth)*

*Institute of
Ocean Science
(Sidney)*



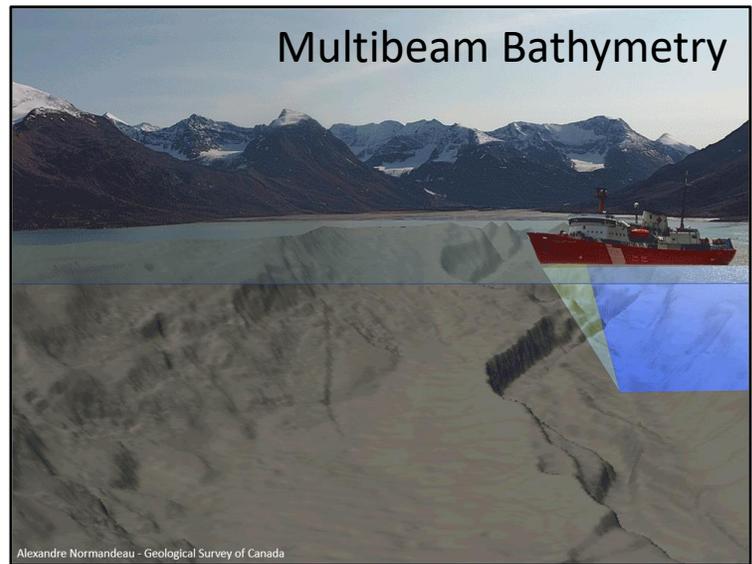
Natural Resources
Canada

GSC Labs
Canada

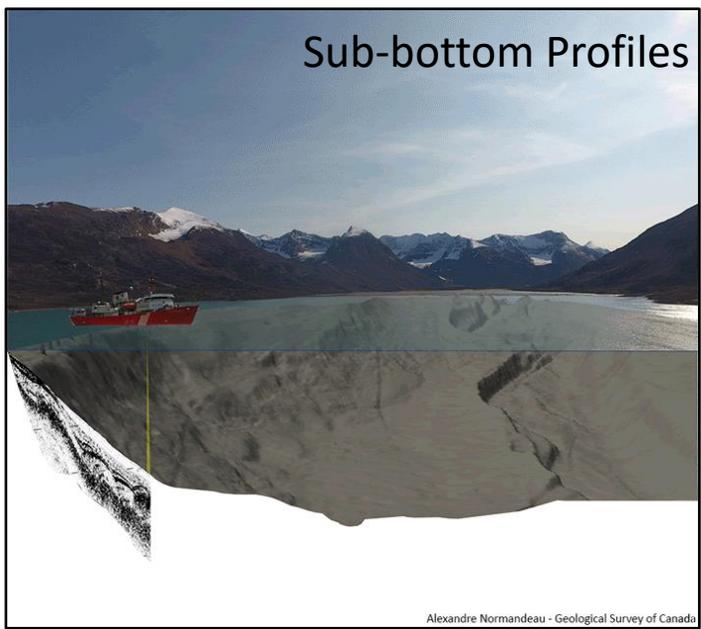
Canada

Marine Geoscience Tools

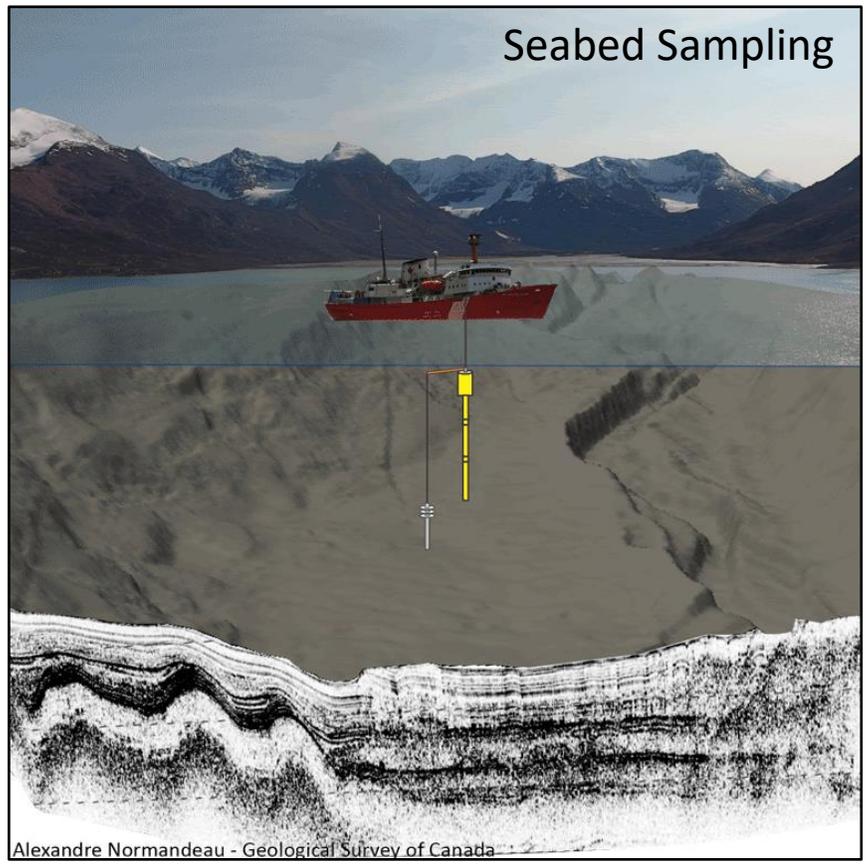
Multibeam Bathymetry



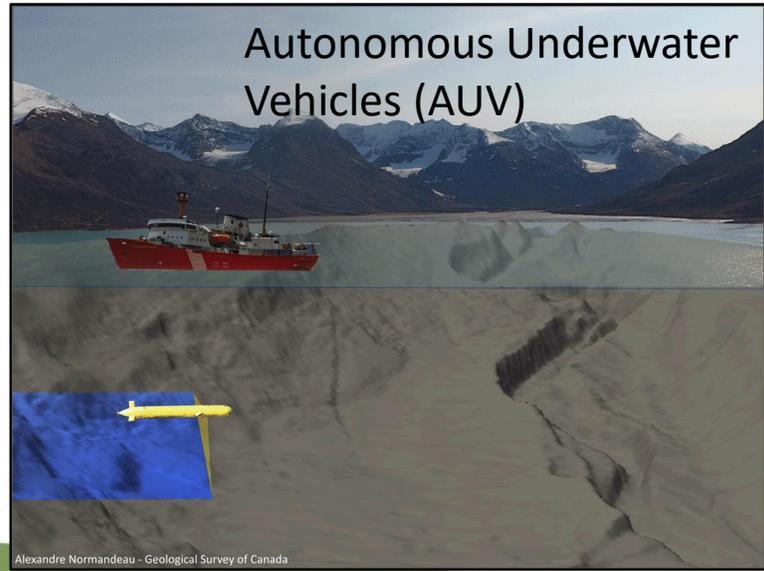
Sub-bottom Profiles



Seabed Sampling



Autonomous Underwater Vehicles (AUV)



Instrumented moorings



Science Infrastructure

Modern marine geoscience laboratories and collections facilities.

Seabed sedimentology, geotechnical properties, geochemistry, other physical properties.

Programs benefit from 65 years of marine geoscience data acquisition and knowledge products by GSC.

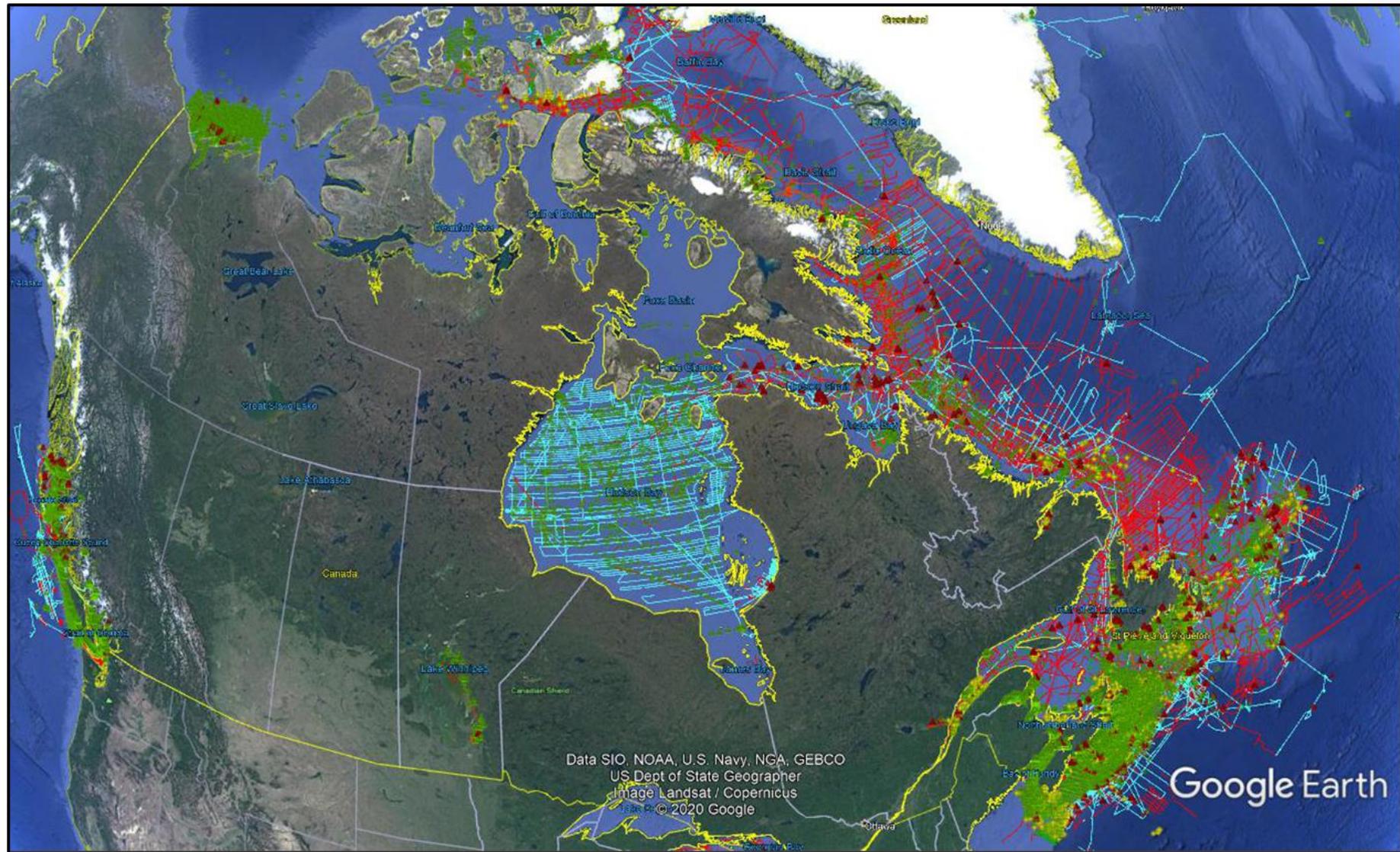


Science Infrastructure

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Natural Resources
Canada

Ressources naturelles
Canada

Canada

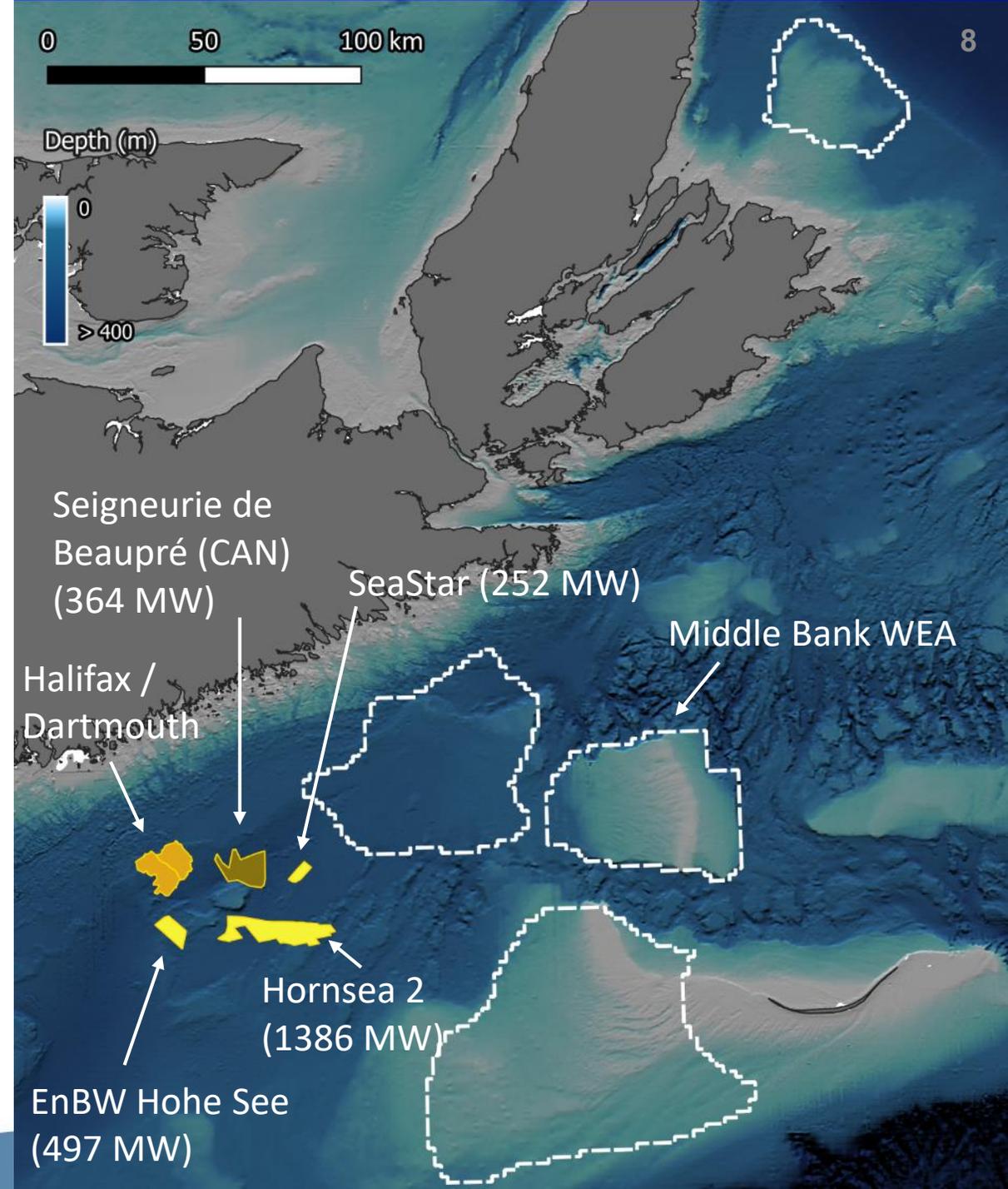


The **Canadian Hydrographic Service (CHS)**, part of [Fisheries and Oceans Canada](#), is Canada's official body for nautical charts and marine data, providing essential tools (like charts, tides, currents) for safe navigation, using advanced tech for surveying underwater landscapes, and offering data for ocean science, resource management, and the blue economy through portals like the [CHS NONNA Data Portal](#).



Basic numbers (2025)

- Nova Scotia total generating capacity (~3200 MW)
- NS offshore wind capacity goal, first round (5000 MW)
- Largest wind farm in Canada (170 km²) comparable in area to largest offshore wind farm in Europe (202 km²), but with ¼ the capacity
- Likely minimum size commercial project to be economical in Canada (~500 MW) comparable in size to Dartmouth urban area
- Can fit 11 Hornsea 2's into the Middle Bank WEA





Hornsea 2 (foreground) ewind.es



Hornsea 1 - azocleantech.com



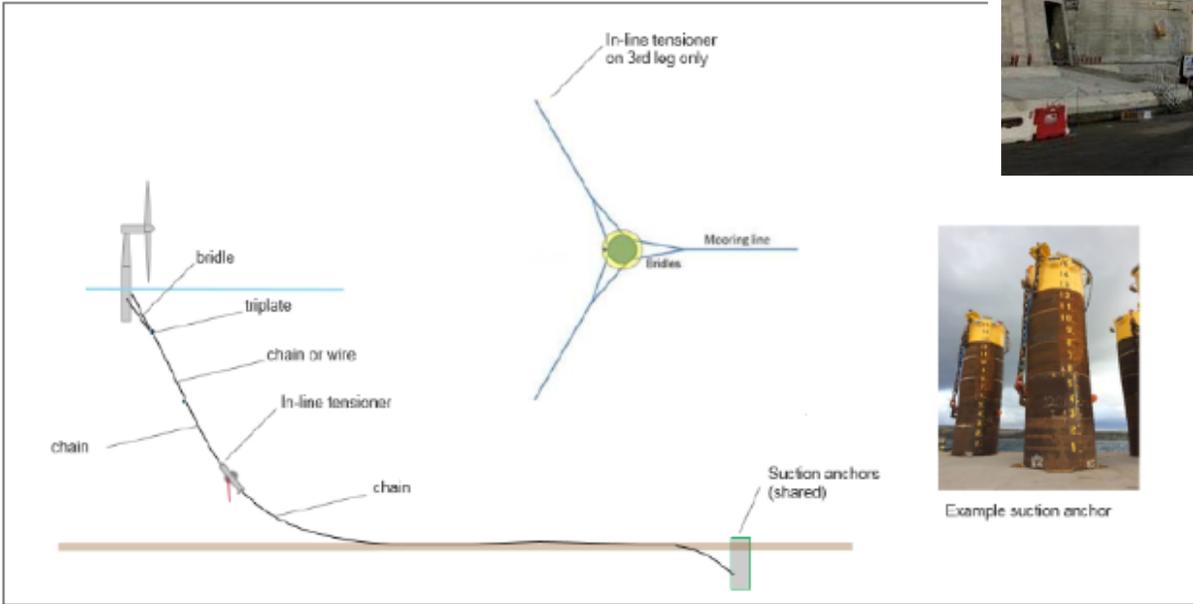
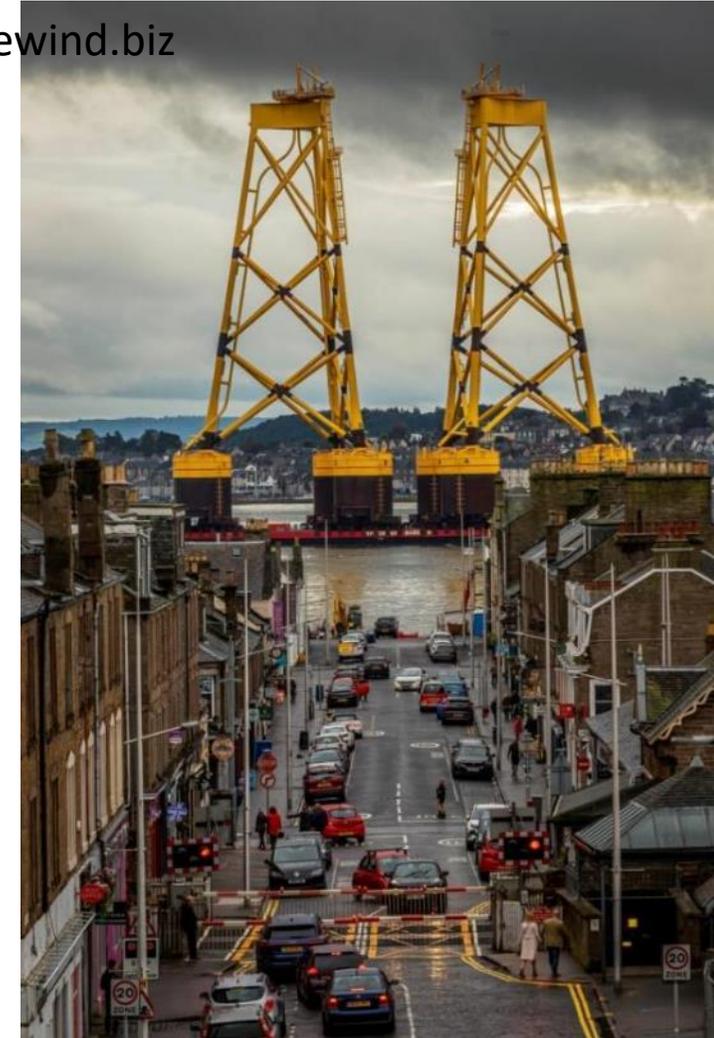


Examples of wind turbine foundations

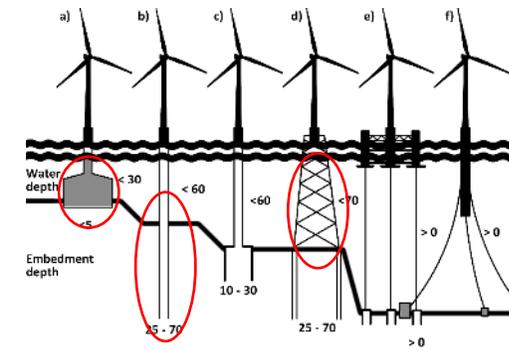
Monopiles in Halifax Harbour – photo Eamer



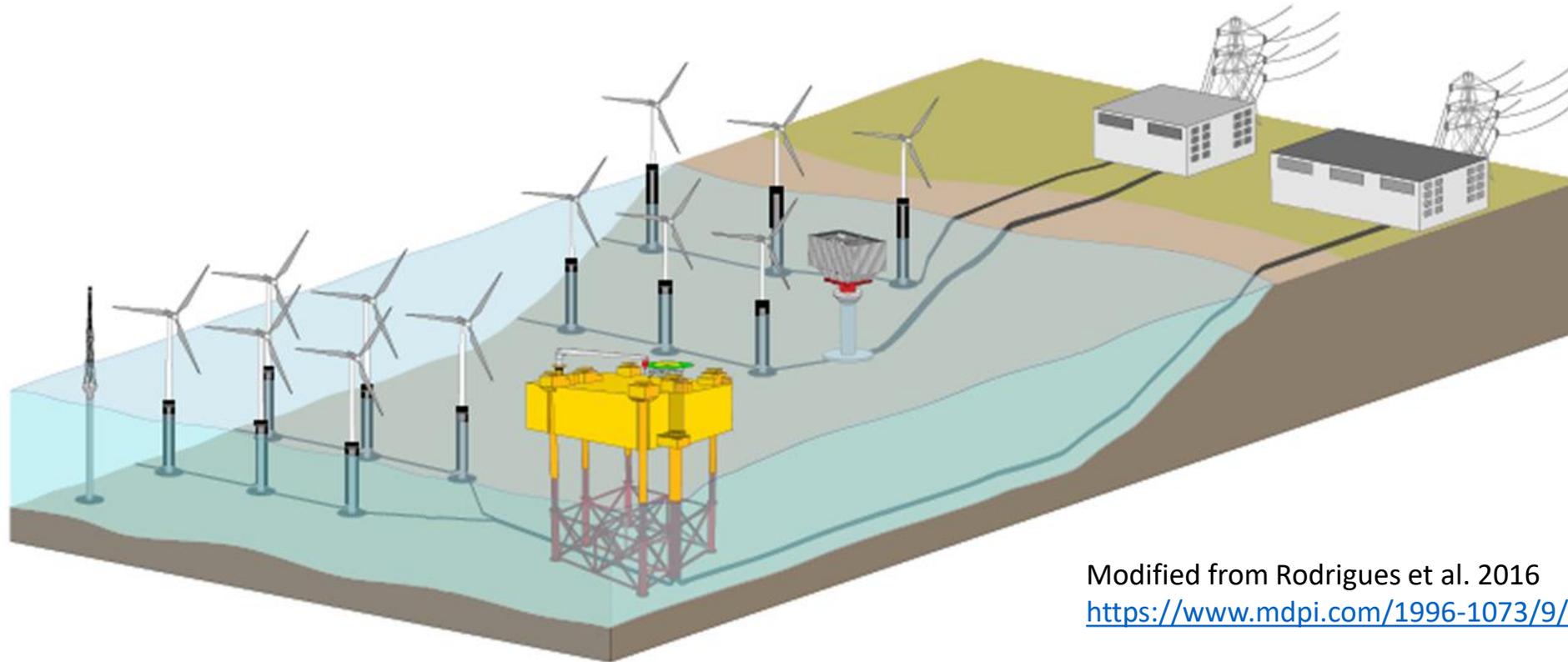
Offshorewind.biz



Example suction anchor



Foundations are just one part of what goes in or on the seabed



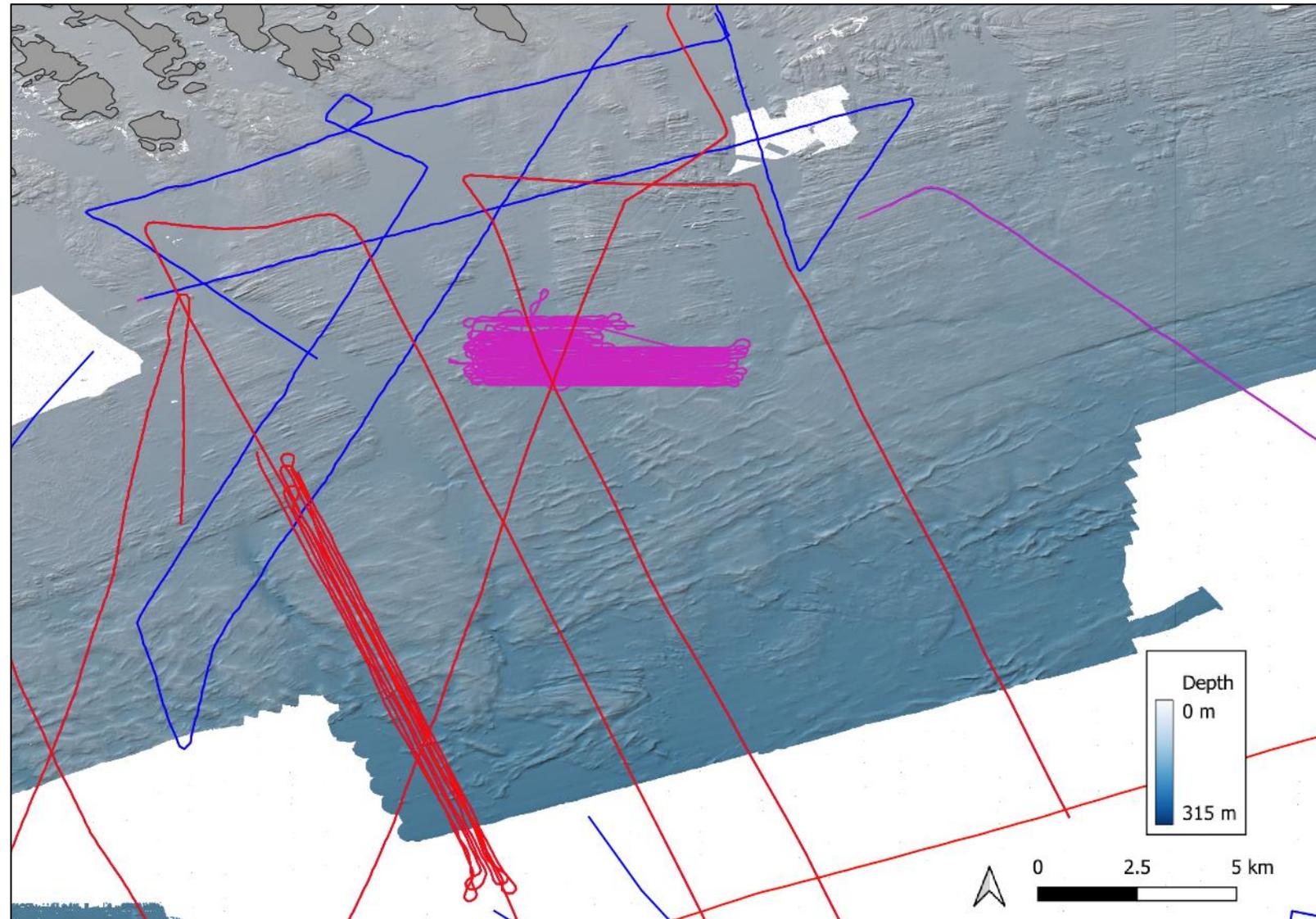
Modified from Rodrigues et al. 2016

<https://www.mdpi.com/1996-1073/9/3/216#>



Important geoscience for offshore wind

- Water depths

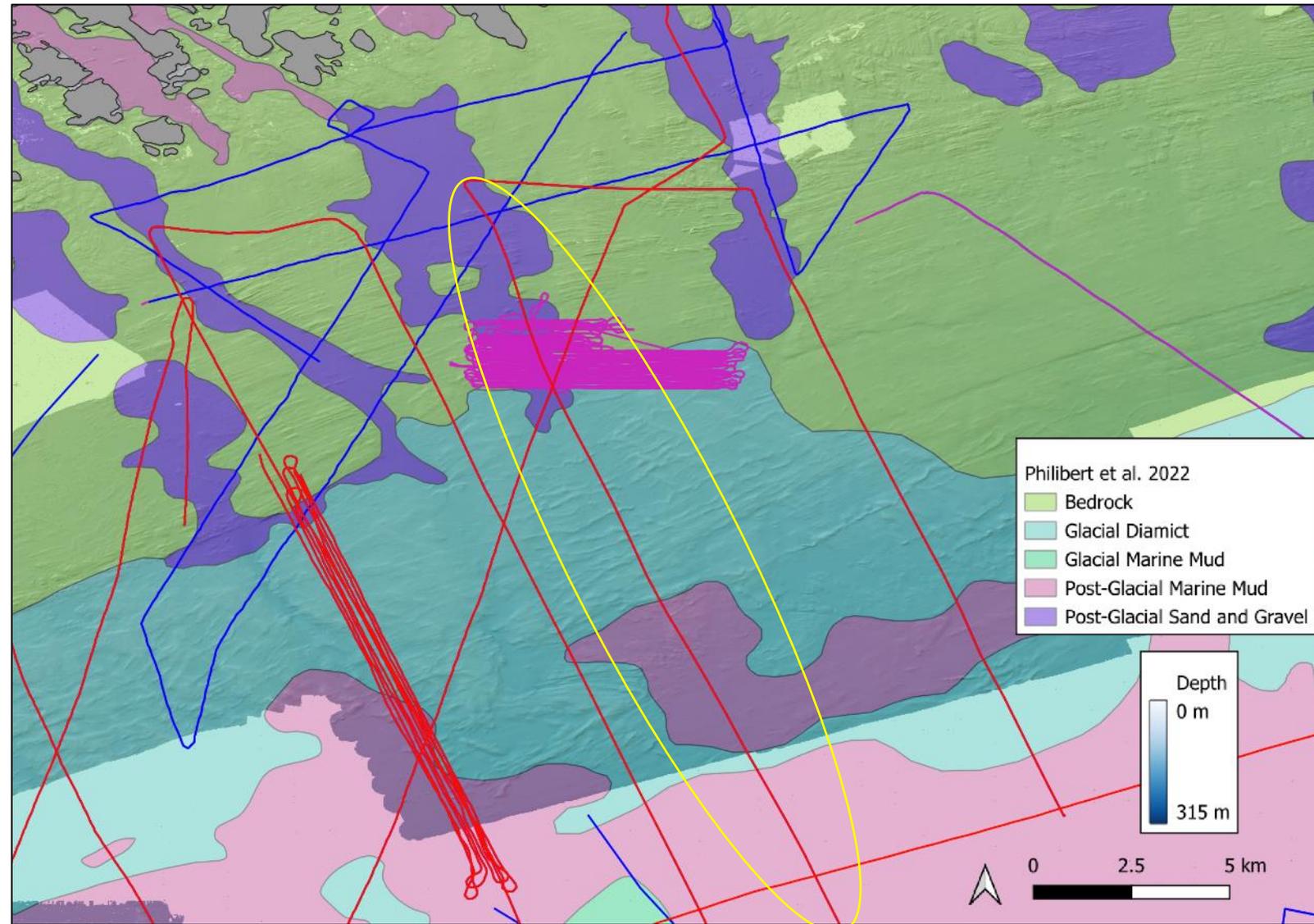


Data sources – Nonna10 (bathymetry), Expedition database (shallow seismic navigation)



Important geoscience for offshore wind

- Water depths
- Seabed sediments



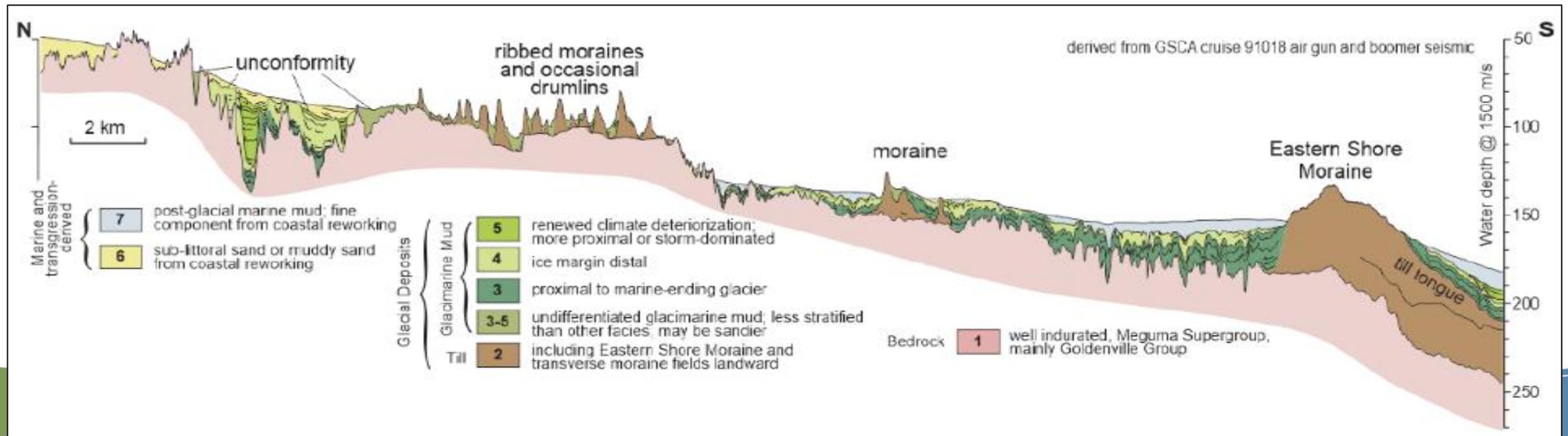
Data sources – Nonna10 (bathymetry), Expedition database (shallow seismic navigation), Philibert et al. 2022 - <https://doi.org/10.4095/330474>



Important geoscience for offshore wind

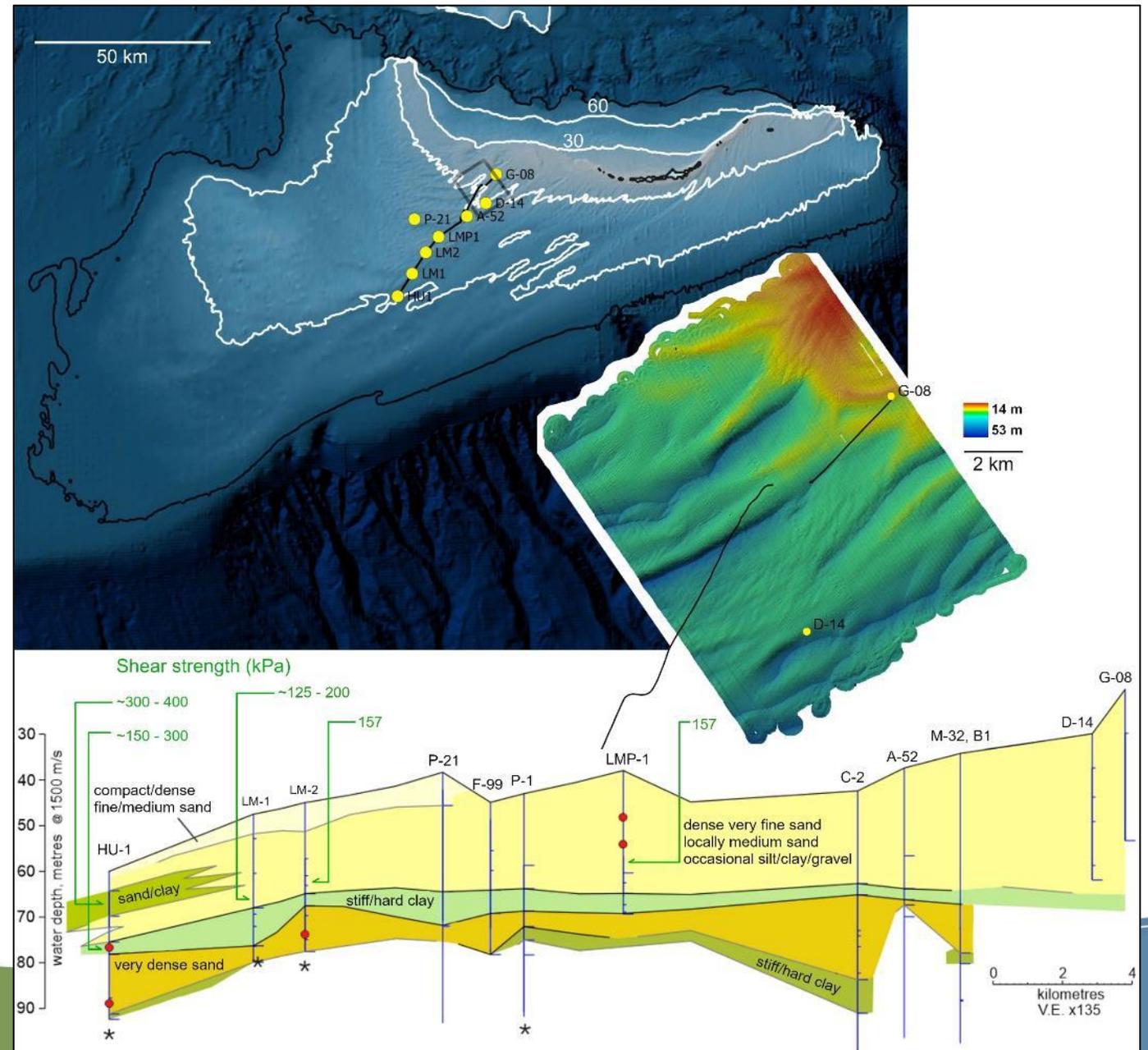
- Water depths
- Seabed sediments
- Sediments below the surface

Eastern Shore interpreted geological profile modified from King (2018) - <https://doi.org/10.4095/308454>



Important geoscience for offshore wind

- Water depths
- Seabed sediments
- Sediments below the surface
- Engineering characteristics



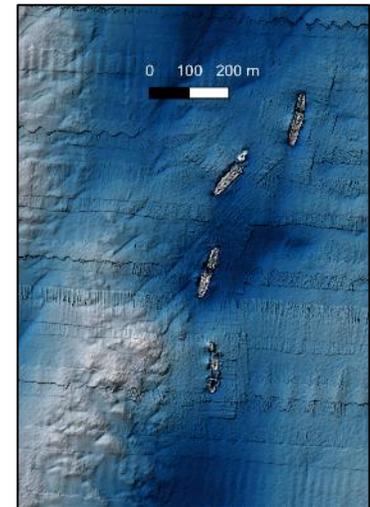
From Eamer et al., 2021 -
<https://doi.org/10.1016/j.csr.2020.104297>,
 Original interpretation E. King



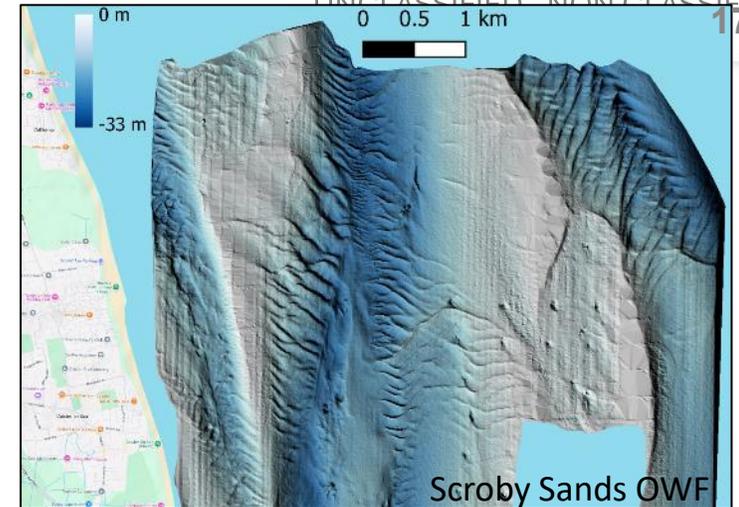
Important geoscience for offshore wind

Sources – Eamer et al. 2021 (top), Nonna10 (bottom)

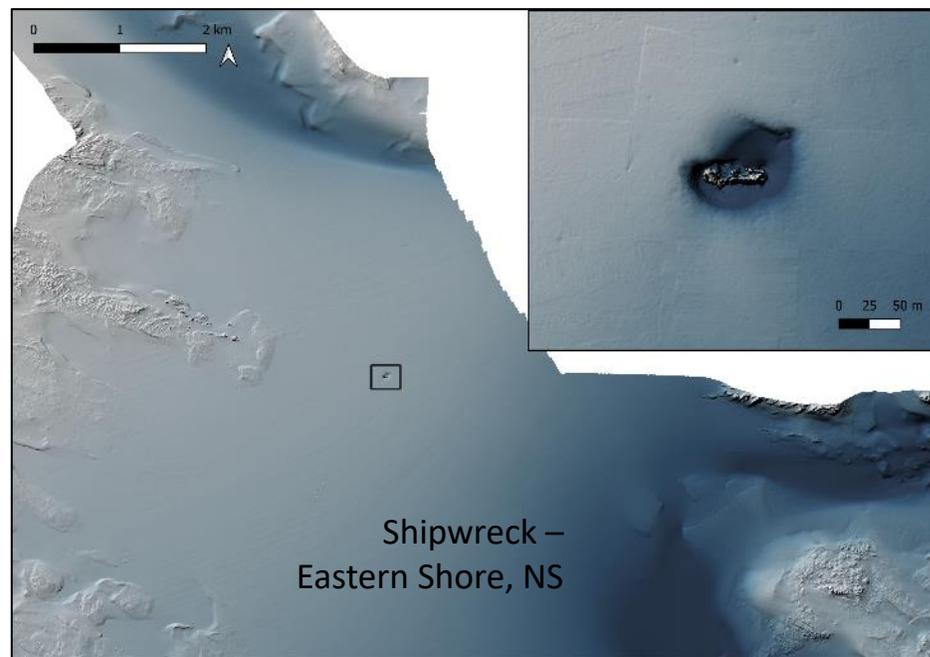
- Mobile sediments
- Hazards (e.g. underwater landslides, gas, salt)
- Anthropogenic features



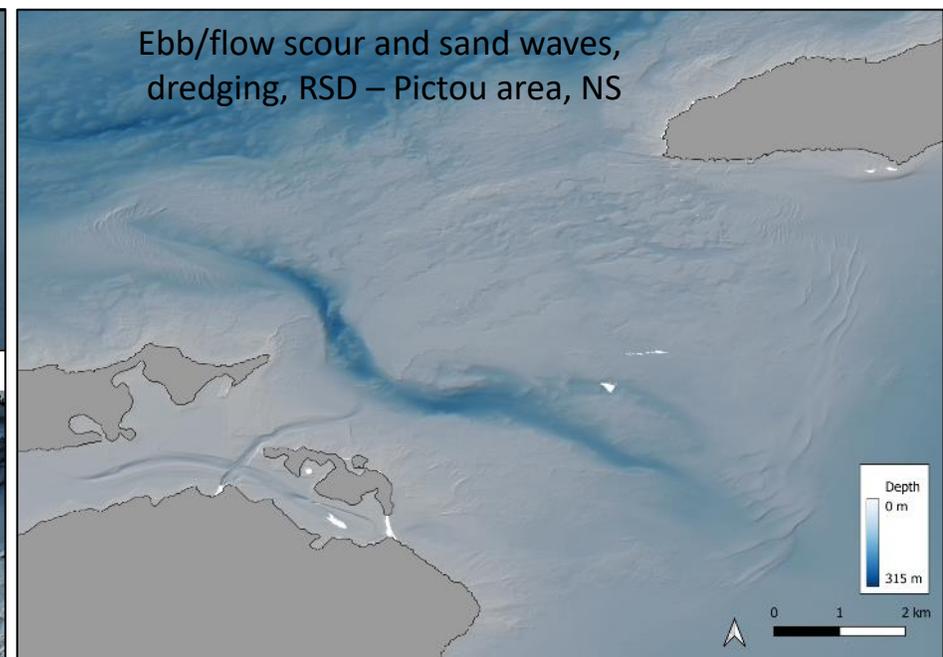
Shipwrecks
Coastal Virginia OWF



Scroby Sands OWF



Shipwreck –
Eastern Shore, NS

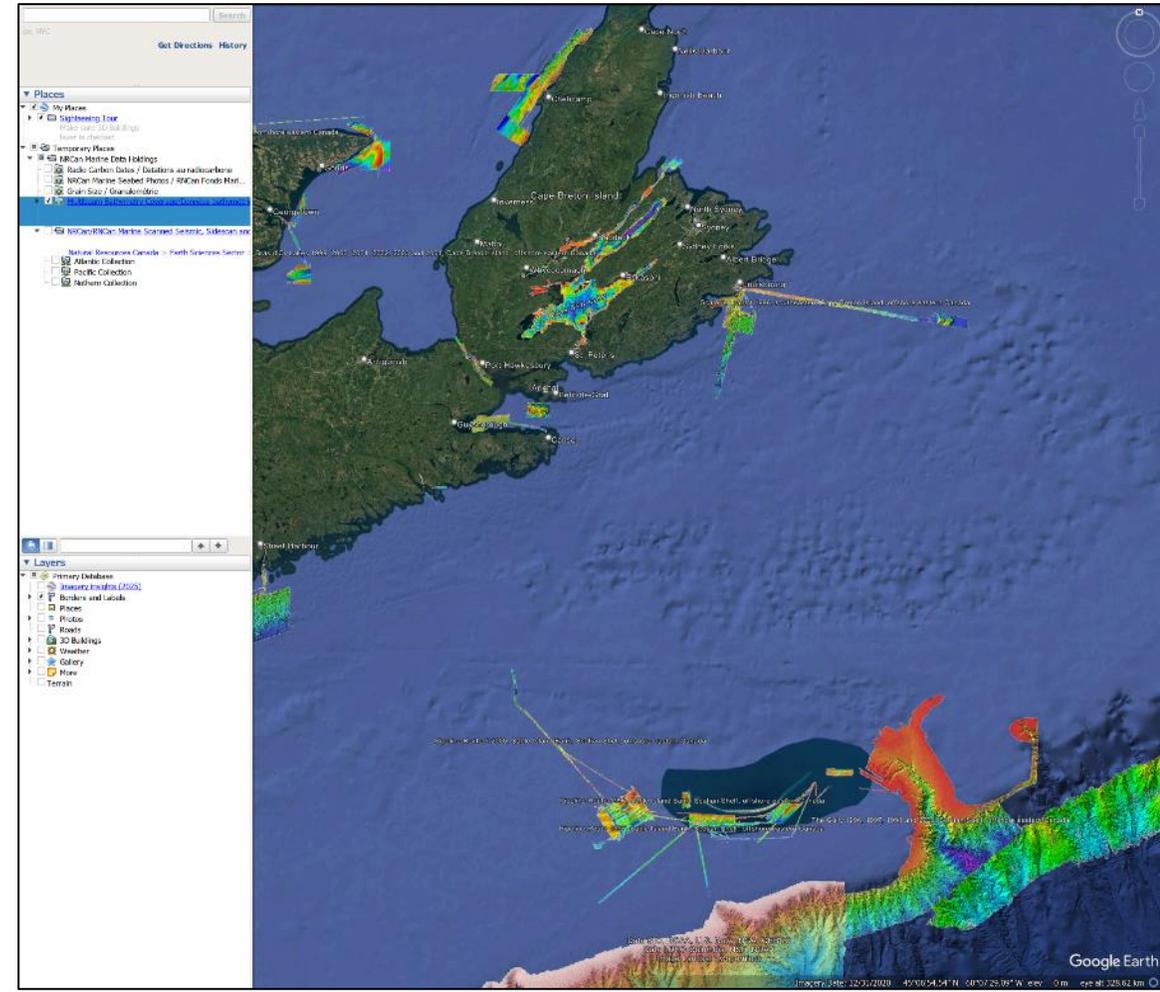
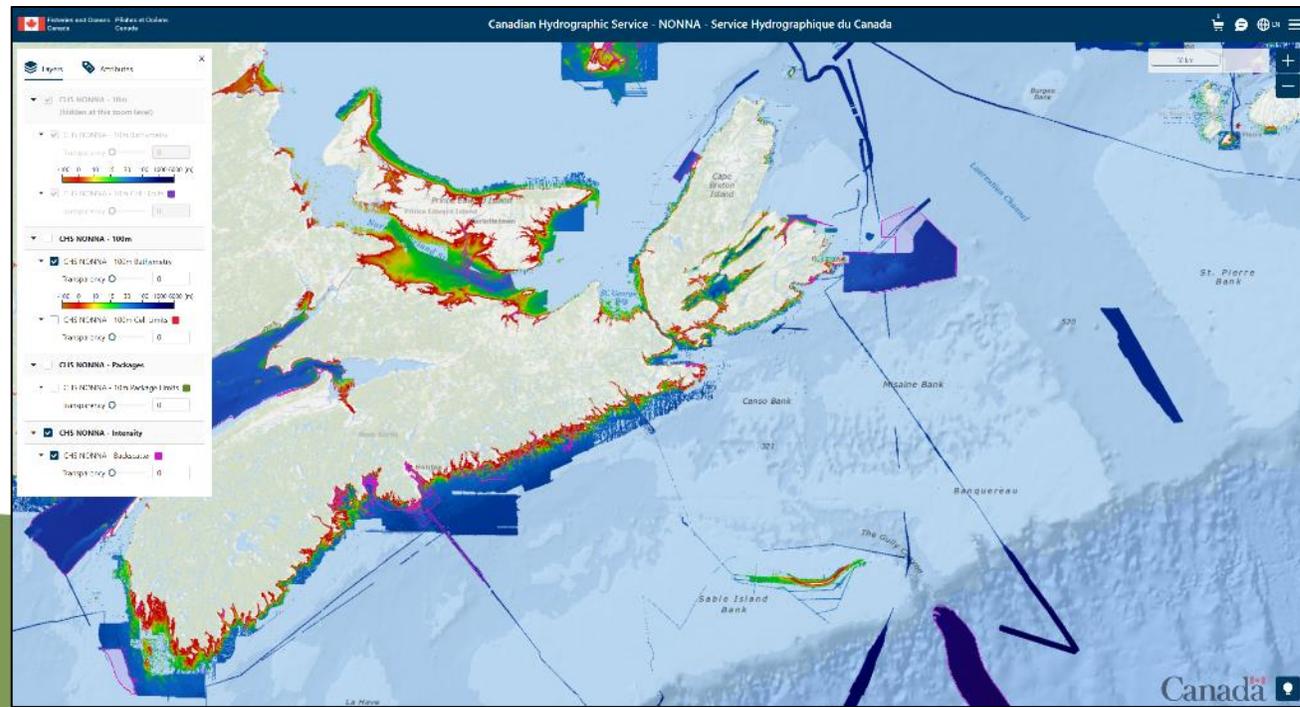


Ebb/flood scour and sand waves,
dredging, RSD – Pictou area, NS

Desktop studies

- To investigate seabed conditions in 2020, use existing databases:
 - Bathymetry – Nonna10, CHS, GSCA

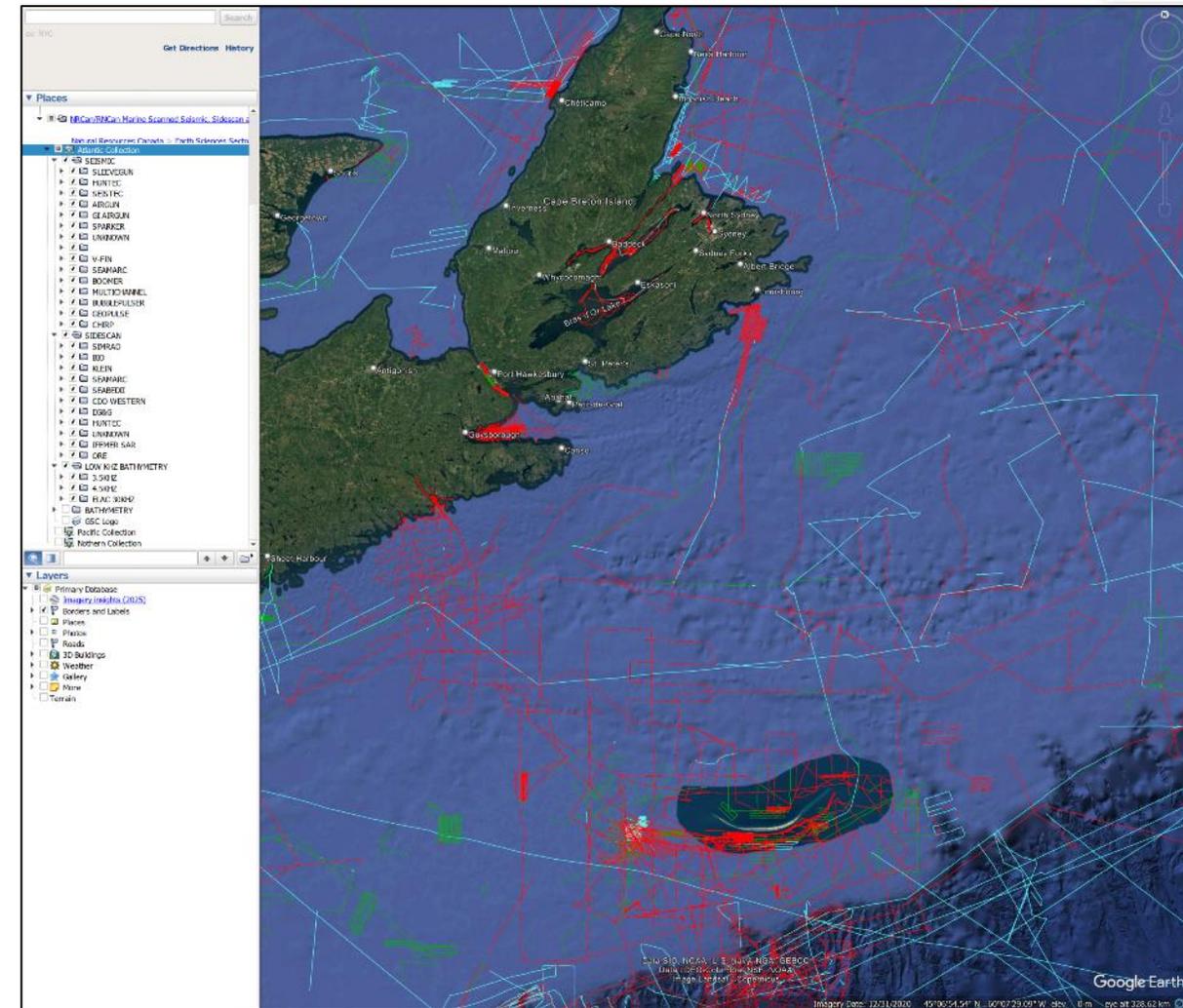
<https://data.chs-shc.ca/dashboard/map>



https://ftp.maps.canada.ca/pub/nrcan_nrcan/raster/marine_geoscience/NRCAN%20Windows%2010%20Software/

Desktop studies

- To investigation seabed conditions in 2020, turn to existing databases:
 - Bathymetry – Nonna10, CHS, GSCA
 - Seismics – GSCA seismic data archive



https://ftp.maps.canada.ca/pub/nrcan_rncan/raster/marine_geoscience/NRCAN%20Windows%2010%20Software/

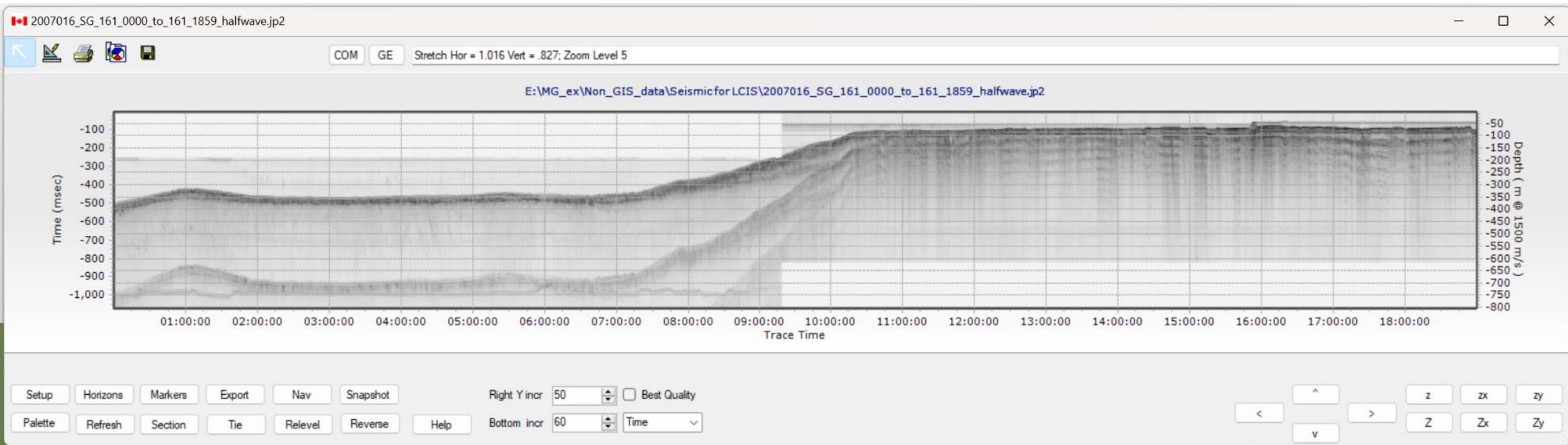


Desktop studies

- To investigation seabed conditions in 2020, turn to existing databases:
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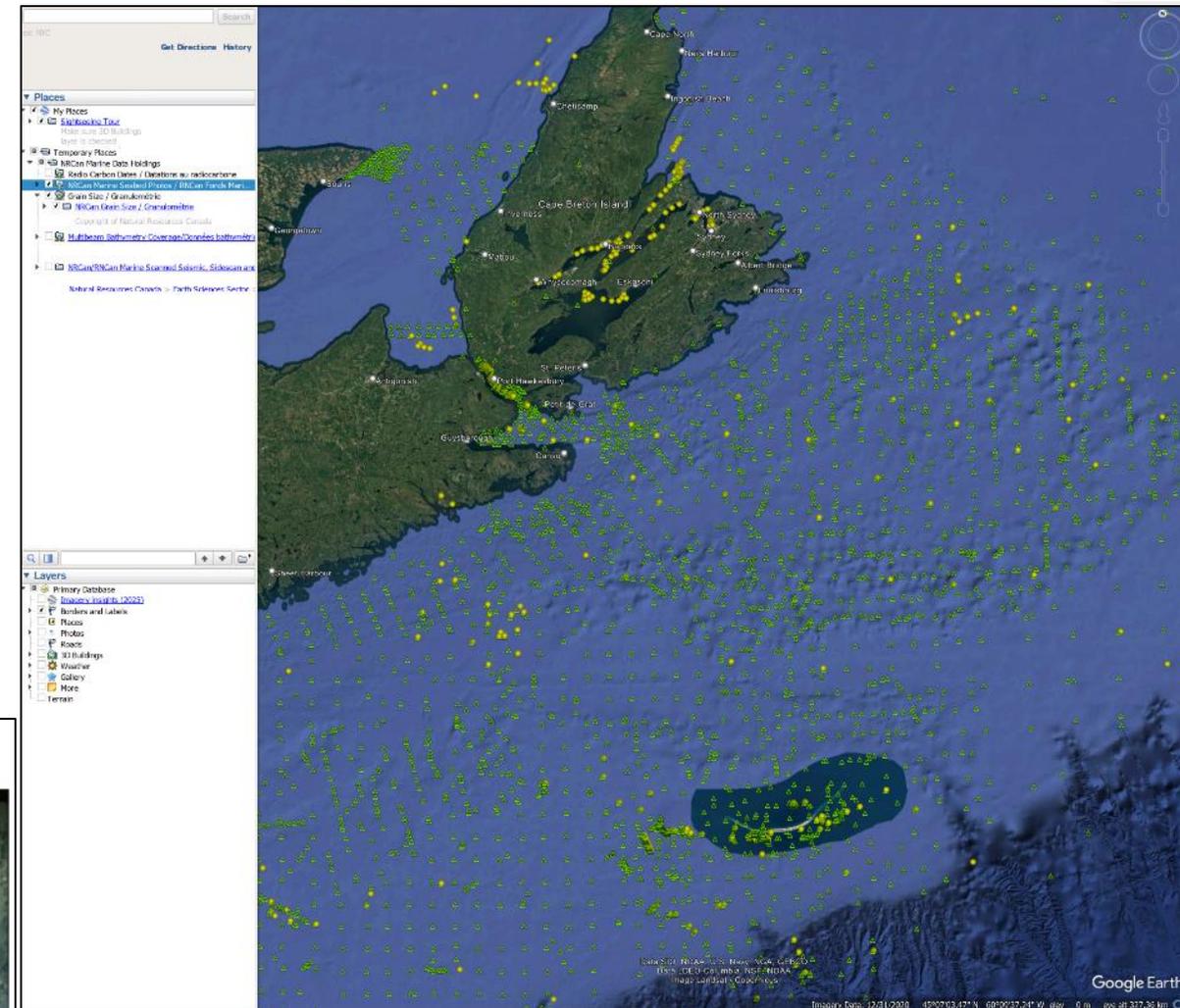
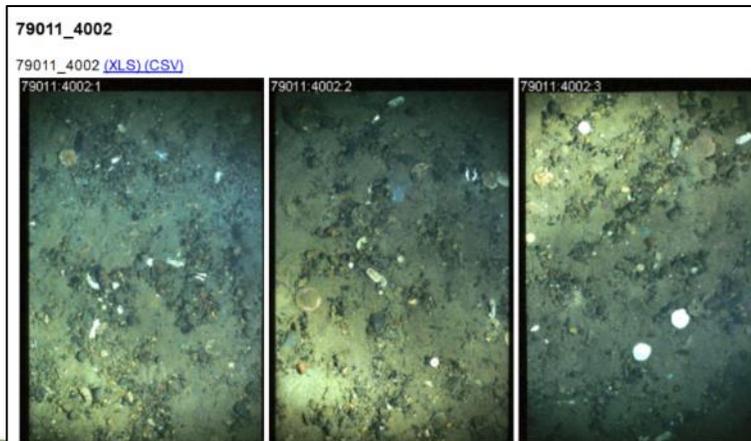
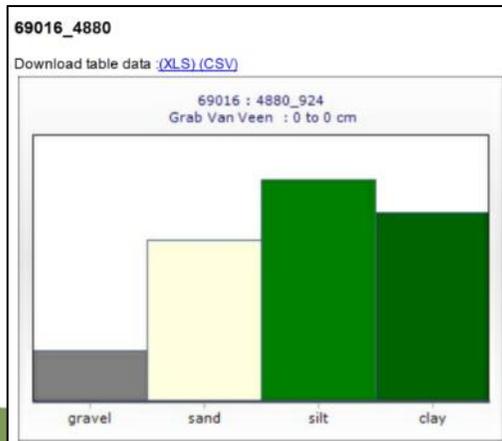
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| tools WIndows 7/ | 1970-01-01 00:00 | - | |

https://ftp.maps.canada.ca/pub/nrcan_rncan/raster/marine_geoscience/NRCAN%20Windows%2010%20Software/



Desktop studies

- To investigation seabed conditions in 2020, turn to existing databases:
 - Bathymetry – Nonna10, CHS, GSCA
 - Seismics – GSCA seismic data archive
 - Ground truth – GSCA Expedition Database



https://ftp.maps.canada.ca/pub/nrcan_nrcan/raster/marine_geoscience/NRCAN%20Windows%2010%20Software/



Desktop studies

- To investigation seabed conditions in 2020, turn to existing databases:
 - Bathymetry – Nonna10, CHS, GSCA
 - Seismics – GSCA seismic data archive
 - Ground truth – GSCA Expedition Database

Expedition Database (ED)

Introduction



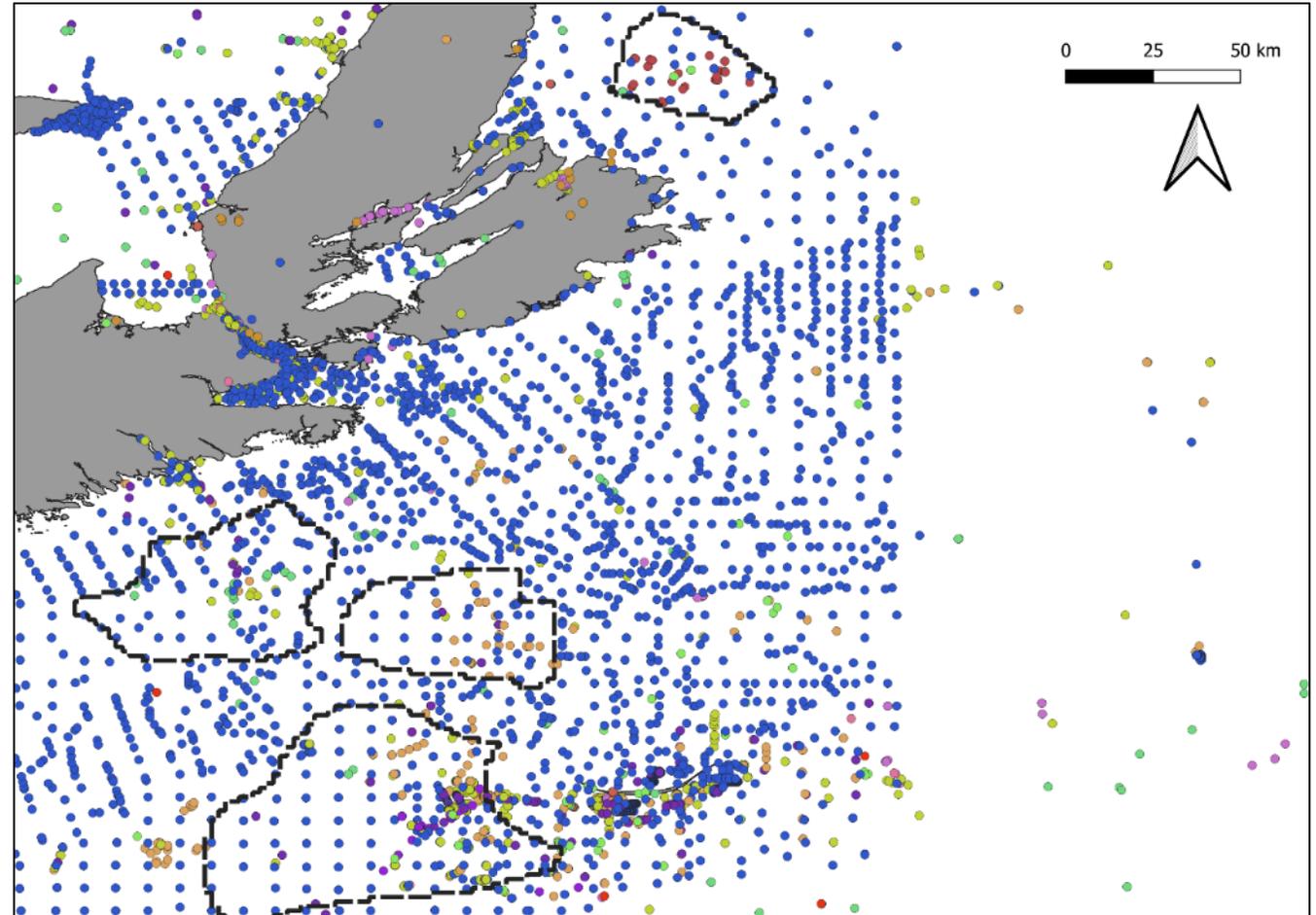
The Expedition Database (ED) contains information (metadata) and data related to marine and coastal field surveys conducted by or on behalf of the Geological Survey of Canada (Atlantic and Pacific). ED is a source of information on "Stations" where geological samples such as piston cores, grab samples, bottom photography were collected. Resulting data such as grain size, radiocarbon dates, and bottom photography can also be accessed through ED. In addition, ED is a source of trackline navigation for marine geophysical (seismic, sidescan, multibeam) profiles collected by the GSC.

<https://ed.marine-geo.canada.ca/>



Desktop studies

- To investigation seabed conditions in 2020, turn to existing databases:
 - Bathymetry – Nonna10, CHS, GSCA
 - Seismics – GSCA seismic data archive
 - Ground truth – GSCA Expedition Database



<https://ed.marine-geo.canada.ca/>



Desktop studies

<https://ostrnrcan-dostrncan.canada.ca/home>

- Products:

- Geological model of parameters relevant for offshore wind-energy infrastructure in Atlantic Canada – Philibert et al. 2025 - <https://doi.org/10.4095/pv67z56149>
- Characterization of near-surface bedrock occurrences along the Scotian Shelf: a framework for offshore wind development – Dafoe et al. 2025 - <https://ostrnrcan-dostrncan.canada.ca/handle/1845/347128>
- Geomorphology and sediment mobility on sand banks: a study of Dogfish Bank, Hecate Strait, Northeast Pacific Ocean – Boggild et al. 2024 - <https://doi.org/10.1002/esp.5925>
- The science questions underpinning the potential for offshore wind turbines on Atlantic Canada's continental shelves – Eamer et al. 2023 - <https://doi.org/10.4095/331697>
- Geotechnical engineering properties spatial database – Ingham et al. 2023 – available on request
- Geotechnical parameters important for offshore wind energy in Atlantic Canada – Eamer et al. 2022 - <https://doi.org/10.4095/329688>
- The inner shelf geology of Atlantic Canada compared with the North Sea and Atlantic United States: insights for Atlantic Canadian offshore wind energy – Eamer et al. 2020 - <https://doi.org/10.1016/j.csr.2020.104297>
- Seabed conditions on the inner shelves of Atlantic Canada – Eamer et al. 2020 - <https://doi.org/10.4095/326514>



Desktop studies <https://ostrnrcan-dostrncan.canada.ca/home>

- Products (MGMSp):
 - Bathymetric compilation for Scotian Shelf and Newfoundland-Labrador Shelves bioregions, offshore Atlantic Canada - Patton and Kostylev 2023 - <https://doi.org/10.4095/332197>
 - Intensity and frequency of seabed shear stress and sediment mobilization on the Canadian Atlantic Shelf — A modelling study – Li et al. 2024 - <https://doi.org/10.1016/j.csr.2024.105181>
 - Modelling seabed disturbance and sediment mobility for the Scotian Shelf bioregion, offshore Nova Scotia – Li et al. 2023 - <https://doi.org/10.4095/331499>
 - Seabed disturbance and sediment mobility due to tidal current and waves on the continental shelves of Canada – Li et al. 2021 - <https://doi.org/10.1139/cjes-2020-0139>
 - Updated surficial geology compilation of the Scotian Shelf bioregion, offshore Nova Scotia and New Brunswick, Canada – Philibert et al. 2024 - <https://doi.org/10.4095/332375>

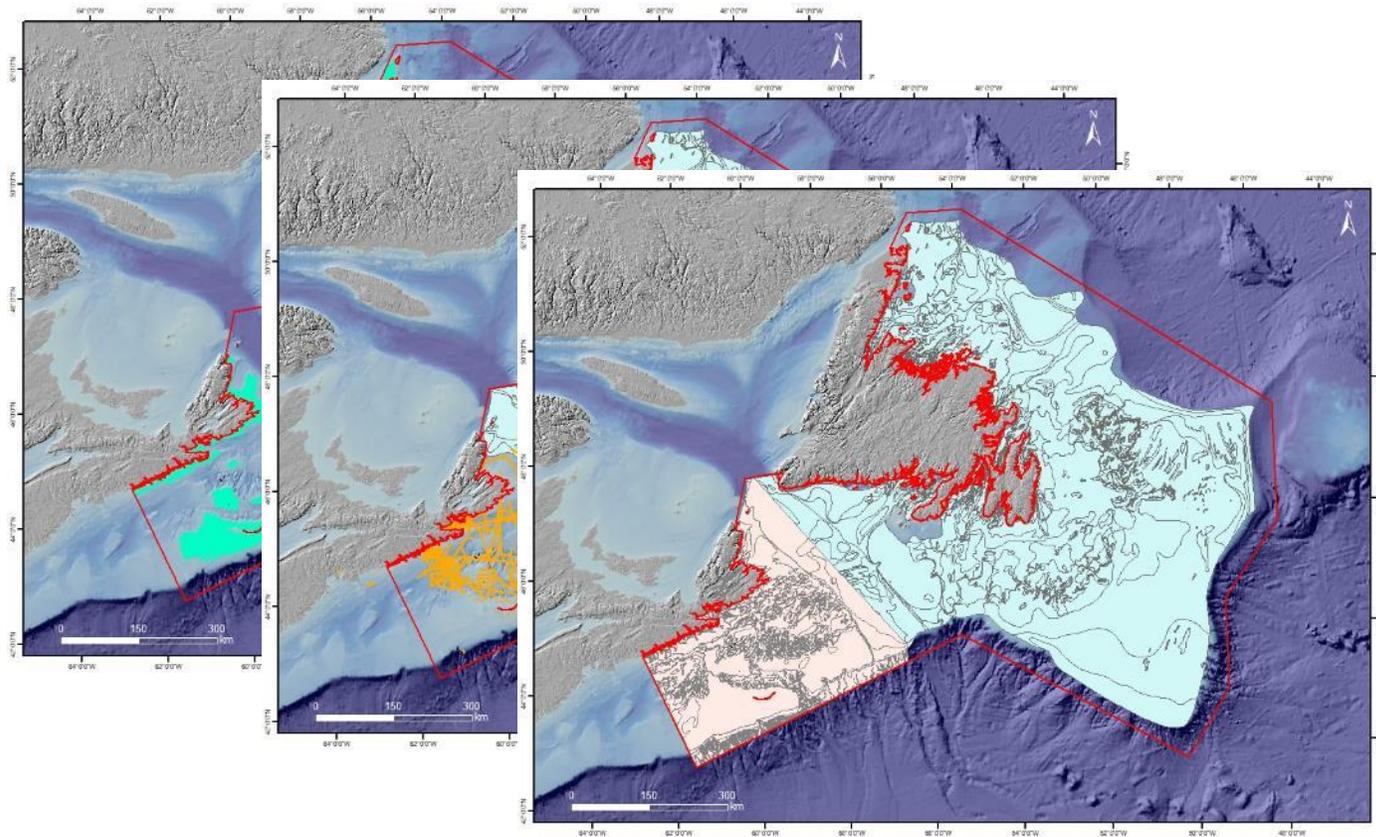


And contributions to:

- CanmetENERGY Ottawa
 - Preliminary considerations analysis of offshore wind energy in Atlantic Canada – Kilpatrick et al. 2023 - <https://doi.org/10.4095/331855>
 - Offshore wind technology scan, a review of offshore wind technologies and considerations in the context of Atlantic Canada – Tang and Kilpatrick 2021 - <https://doi.org/10.4095/329349>
 - Jurisdictional Scan of Suitable Area Definition for Offshore Wind Development – 2020 - https://publications.gc.ca/collections/collection_2022/rncan-nrcan/M154-136-2020-eng.pdf
- DFO - Application of Marxan with Zones as a marine spatial planning decision-support tool: a case study for offshore wind planning in Nova Scotia - Nagel et al. 2024 - https://publications.gc.ca/collections/collection_2024/mpo-dfo/Fs97-6-3601-eng.pdf
- RA committee – 2025 - <https://iaac-aeic.gc.ca/050/evaluations/document/160802?culture=en-CA>
- WEA working group – 2025 - <https://cnsoer.ca/renewable-energy/lands-management/governments-designated-offshore-wind-energy-areas>



Geological model - Philibert et al. 2025



Parameters included:

- Water depth (GBF, piles, caissons), filtered to minimum OWF size
- Surficial geology (ranked 1-3)
- Sediment thickness (from 2d seismic)
- Slopes (<math><5^\circ</math>)
- Sediment mobility index
- Salt diapir distribution
- Paleo-lowstand
- Gas charged sediments
- Paleochannels

Parameters not included:

- Any classifications deeper than 70 m
- Geomorphology
- Engineering properties
- Extensive seismic coverage
- Many geohazards (e.g., liquefaction, landslides)



Gravity

3. Sable Island Bank

Area within suitable depth range (0 - 30 m) : 1700 km²

Surface Geology : Post-glacial sand and gravel

Surface Geology Rank : 3 (100%)

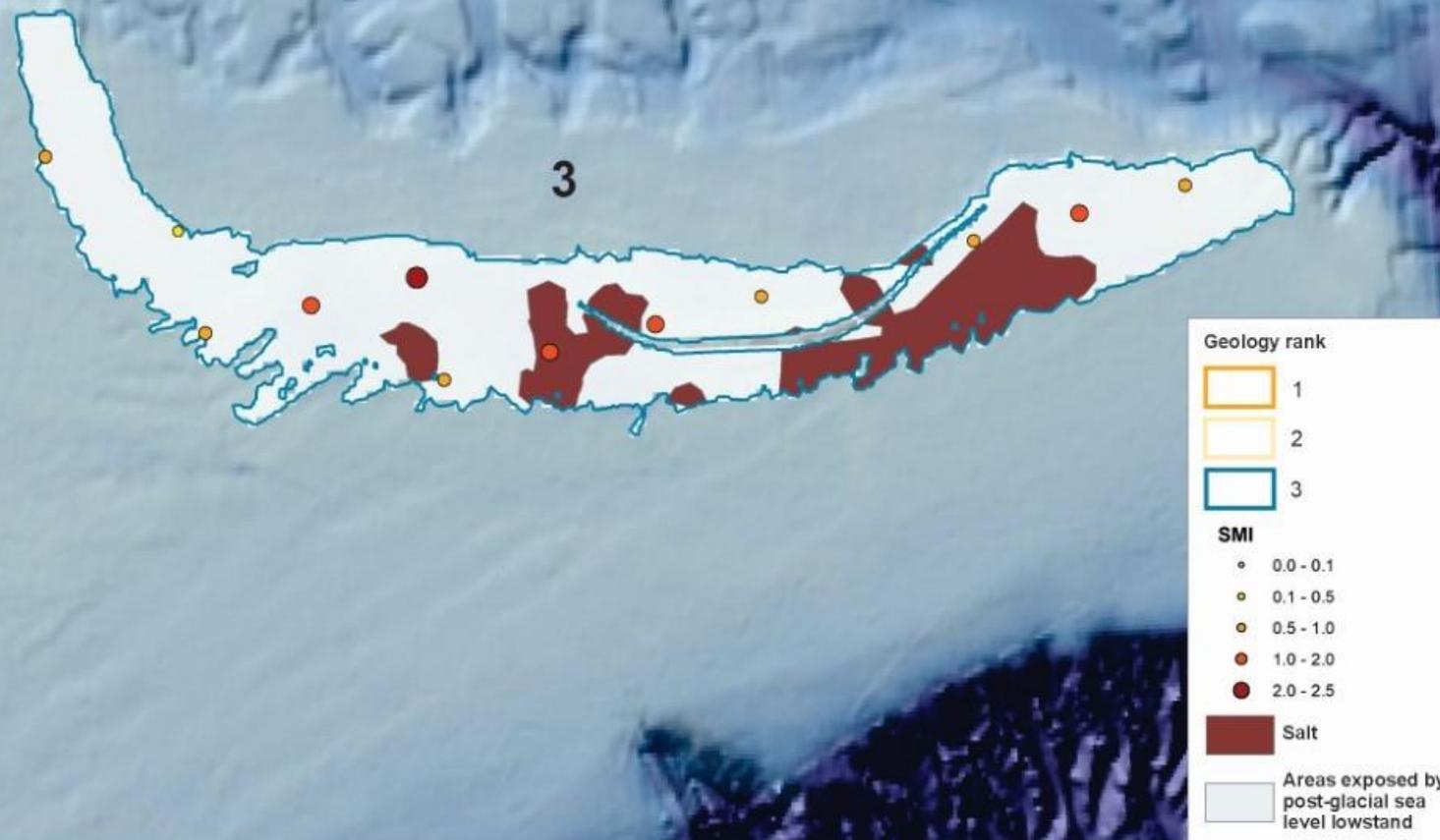
Sediment thickness: Does not impact gravity base foundation

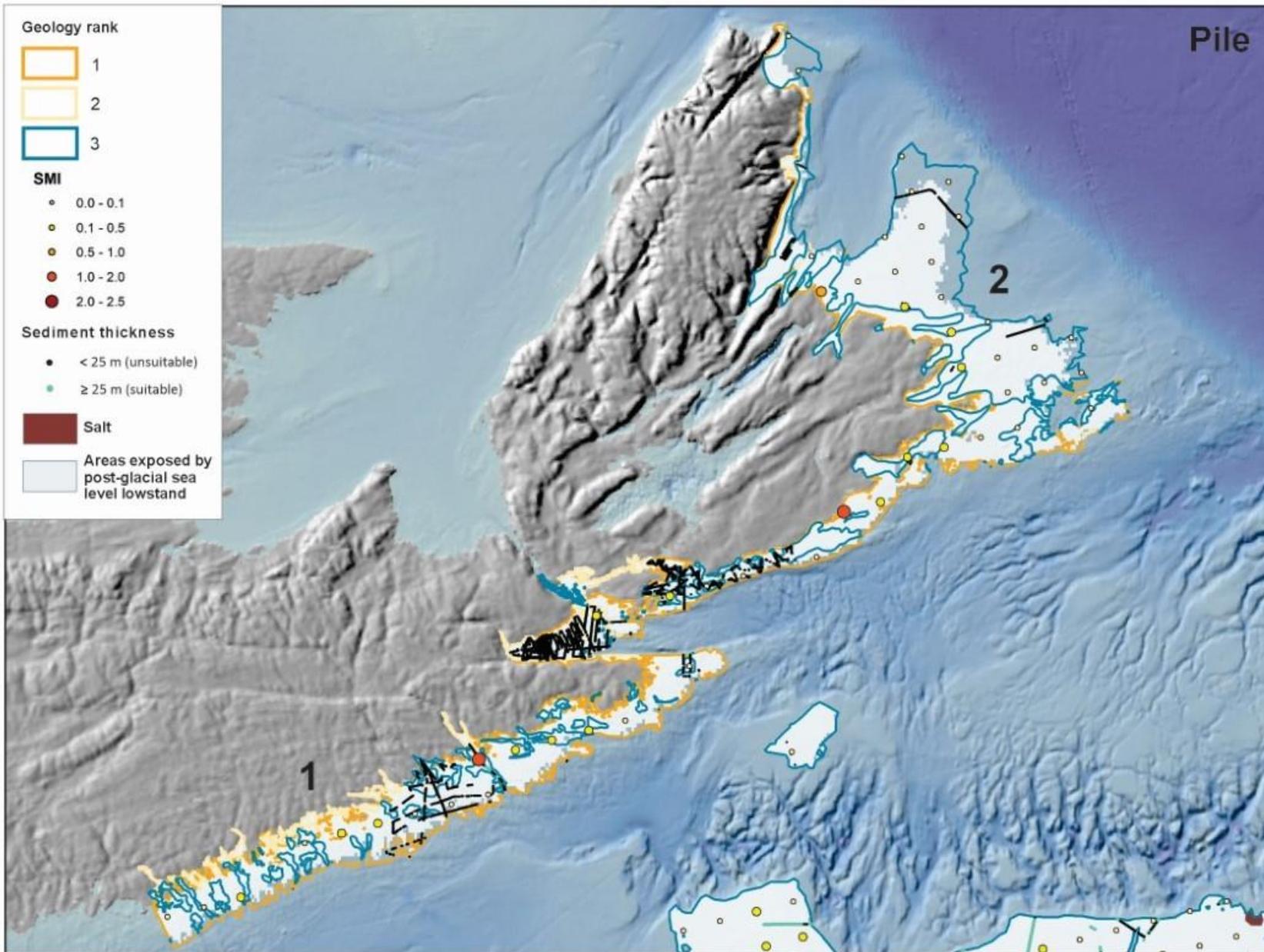
SMI : Moderate to very high

Slopes : Suitable

Areas exposed by post-glacial sea level : 100 %

Salt : 20 %



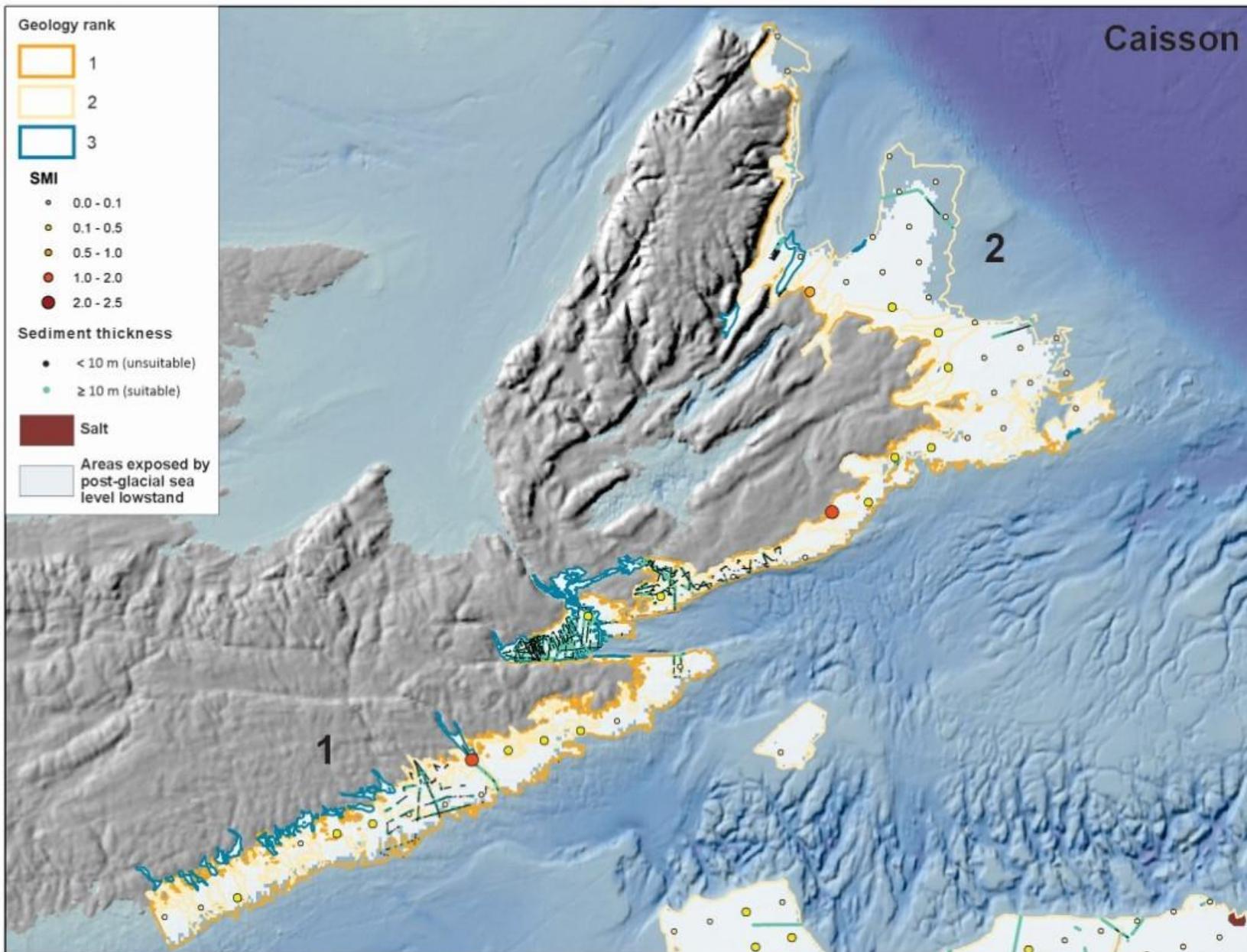


1. Eastern Shore of Nova Scotia

Area within suitable depth range (0 - 70 m) : 3000 km²
Surface Geology : Bedrock, post-glacial sand and gravel and post-glacial marine mud
Surface Geology Rank : 1 (70%), 2 (15%), 3 (15%).
Sediment thickness data range : 0 to 85 m
Sediment thickness data coverage : Insufficient
SMI : Low to high
Slopes : Suitable
Areas exposed by post-glacial sea level lowstand : 95%
Salt : NA

2. Cape Breton Island

Area within suitable depth range (0 - 70 m) : 5000 km²
Surface Geology : Bedrock and post-glacial sand and gravel
Surface Geology Rank : 1 (38%), 2 (2%), 3 (60%).
Sediment thickness data range : 0 to 50 m
Sediment thickness data coverage : Insufficient
SMI : Low to high
Slopes : Suitable
Areas exposed by post-glacial sea level lowstand : 90%
Salt : NA



1. Eastern Shore of Nova Scotia

Area within suitable depth range (20 - 70 m) : 3000 km²
Surface Geology : Bedrock, post-glacial sand and gravel and post-glacial marine mud
Surface Geology Rank : 1 (70%), 2 (15%), 3 (15%).
Sediment thickness data range : 0 to 85 m
Sediment thickness data coverage : Insufficient
SMI : Low to high
Slopes : Suitable
Areas exposed by post-glacial sea level lowstand : 95 %
Salt : NA

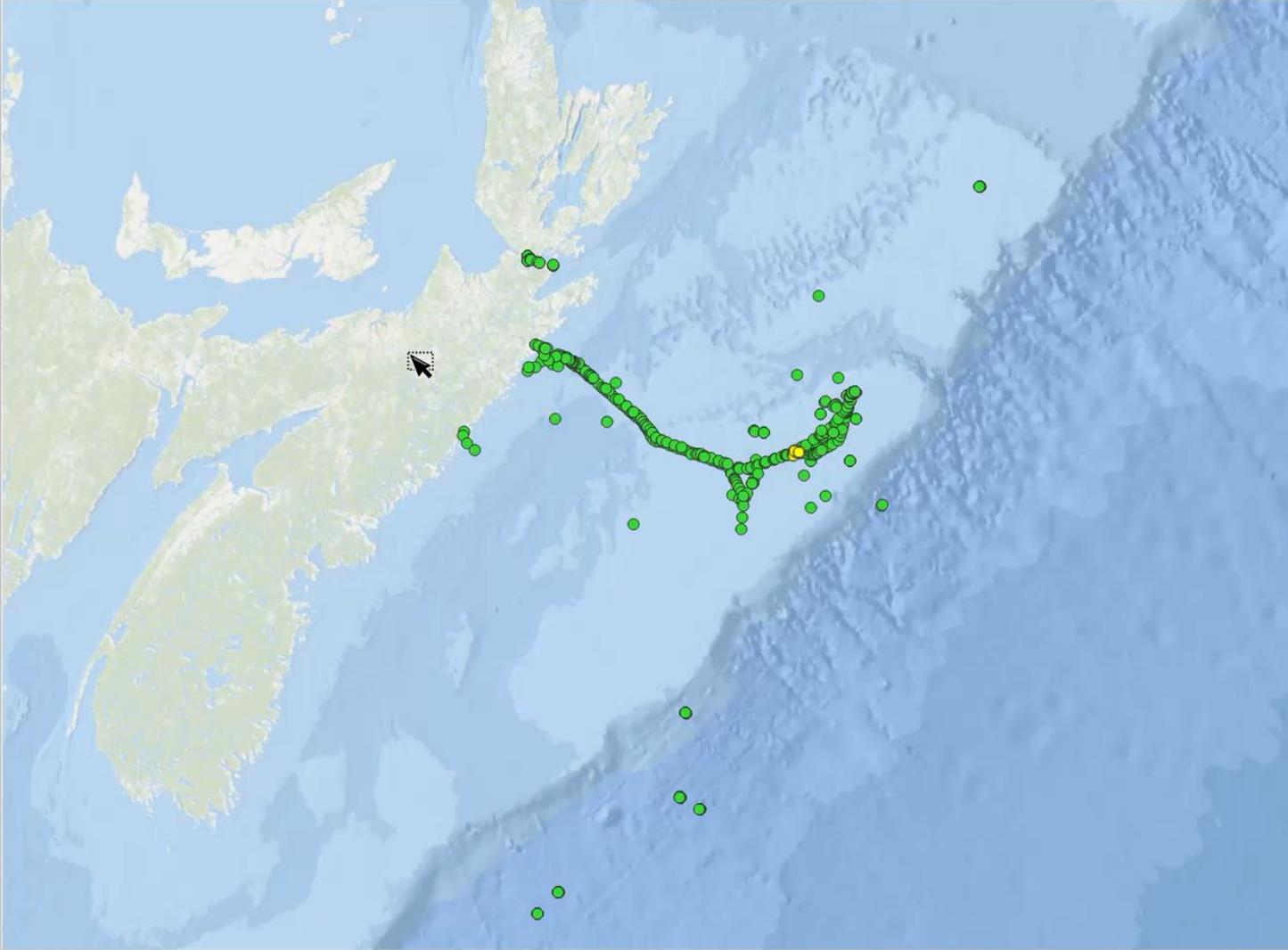
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Salt : NA



Layers

- core inv 2 10
- group3
- Pages from Brown Geotechnical Propertie
- group2
- shelf map for reference NS26-S006-001E
- banks_modified
- openstreetmap
- ESRI Ocean



Processing Toolbox

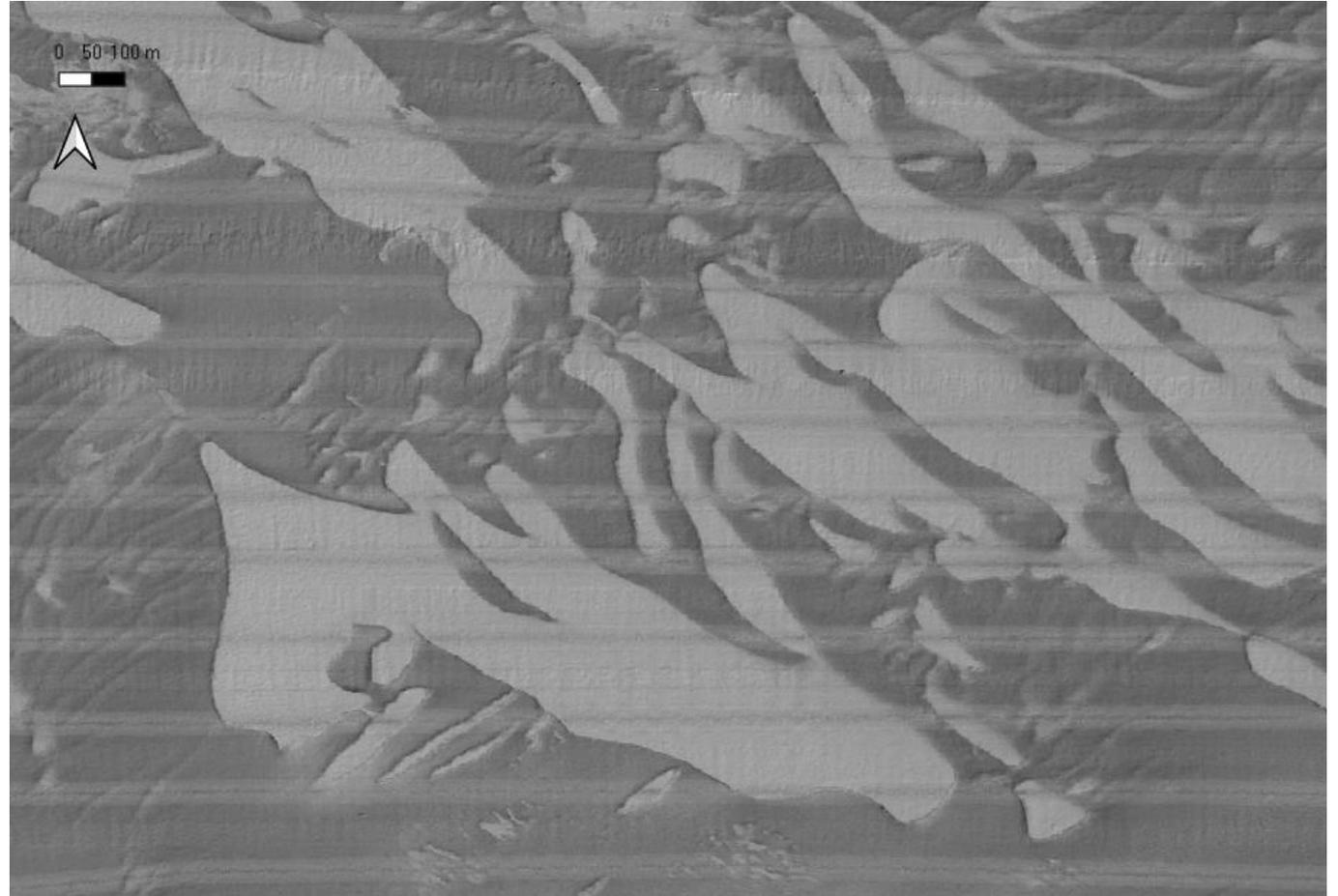
- Search...
- ▶ Recently used
 - ▶ 3D Tiles
 - ▶ Cartography
 - ▶ Database
 - ▶ File tools
 - ▶ GPS
 - ▶ Interpolation
 - ▶ Layer tools
 - ▶ Mesh
 - ▶ Network analysis
 - ▶ Plots
 - ▶ Point cloud conversion
 - ▶ Point cloud data management
 - ▶ Point cloud extraction
 - ▶ Raster analysis
 - ▶ Raster creation
 - ▶ Raster terrain analysis
 - ▶ Raster tools
 - ▶ Vector analysis
 - ▶ Vector creation
 - ▶ Vector general
 - ▶ Vector geometry
 - ▶ Vector overlay
 - ▶ Vector selection
 - ▶ Vector table
 - ▶ Vector tiles
 - ▶ GDAL
 - ▶ Lat Lon tools

Zoom to Coordinate

Enter 'Latitude, Longitude'

Offshore wind science questions in Atlantic Canada

1. What is the surficial geology of the banks?
2. How thick are sediments under the banks?
3. What are the engineering properties of our offshore sediments (and bedrock)?
4. What is the risk of mobile sediments in shallow areas?
5. What other geohazards can we expect?
Landslides? Glauconite?
6. What are we going to find when we map it?



Backscatter mapping data from Middle Bank, Scotian Shelf (2024001)



Offshore Wind Predevelopment Program



Atlantic Canada Offshore Wind Integration & Transmission Study

Evaluate market pathways, investments and strategies to reliably and efficiently integrate Atlantic Canada offshore wind into the region, including hydrogen and exports



Atlantic Canada Offshore Wind Marine Data Collection Campaigns

Collect and publish project agnostic geoscience, metocean and marine wildlife & habitat data, to help de-risk offshore wind development off the coasts of Nova Scotia and Newfoundland and Labrador.



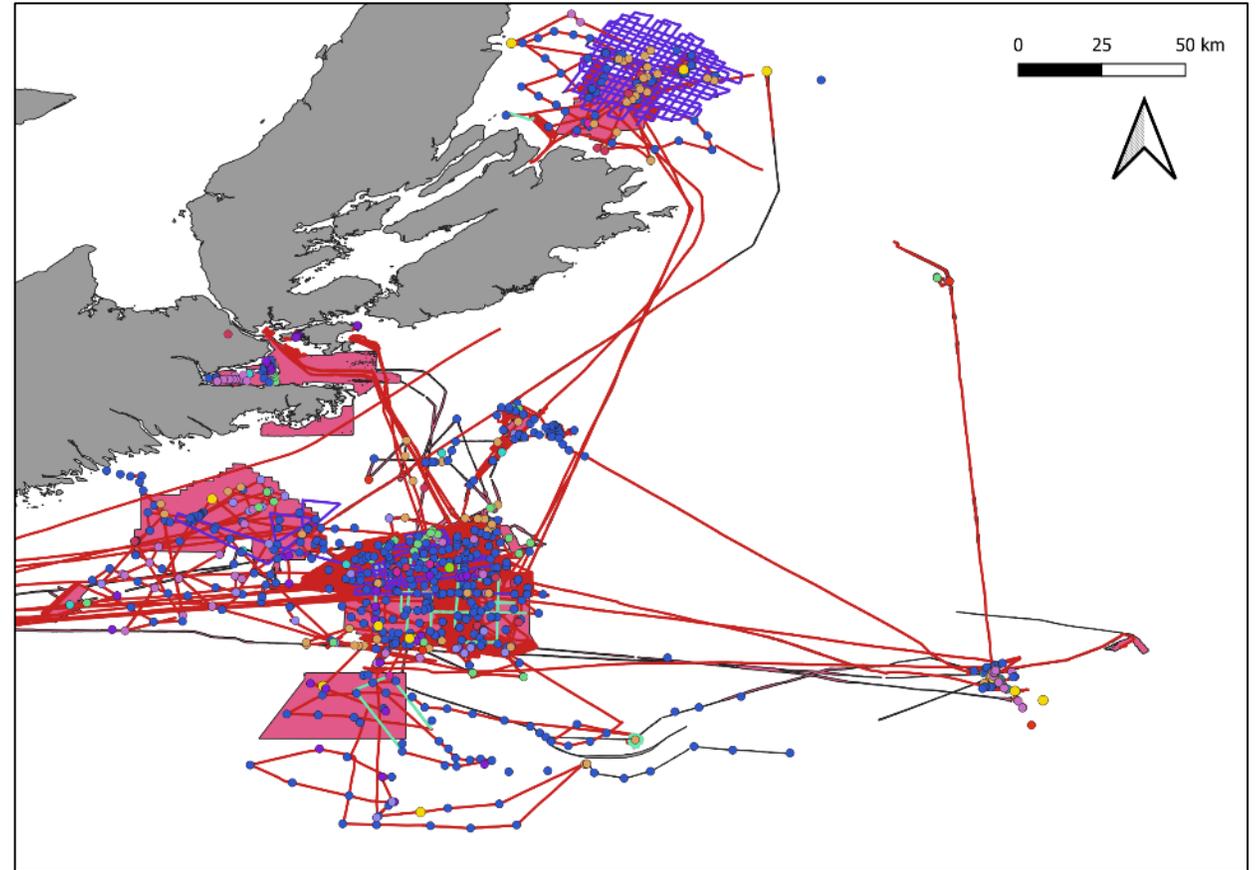
Offshore Wind Indigenous and Coastal Communities Grant

Assist Indigenous and coastal communities' in accessing technical support to carry out engagement activities



Active data collection

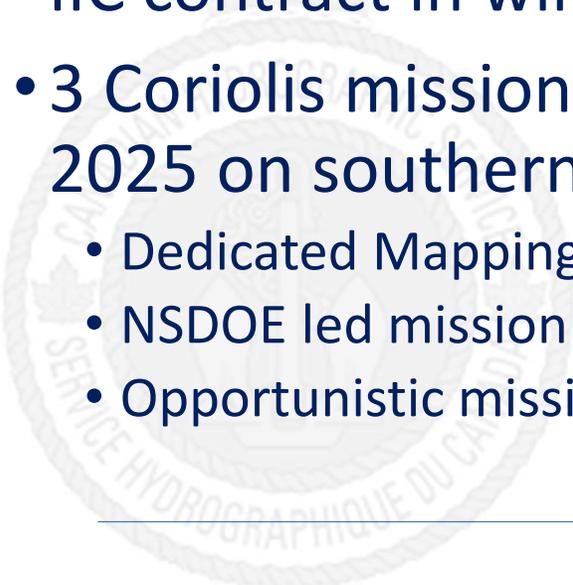
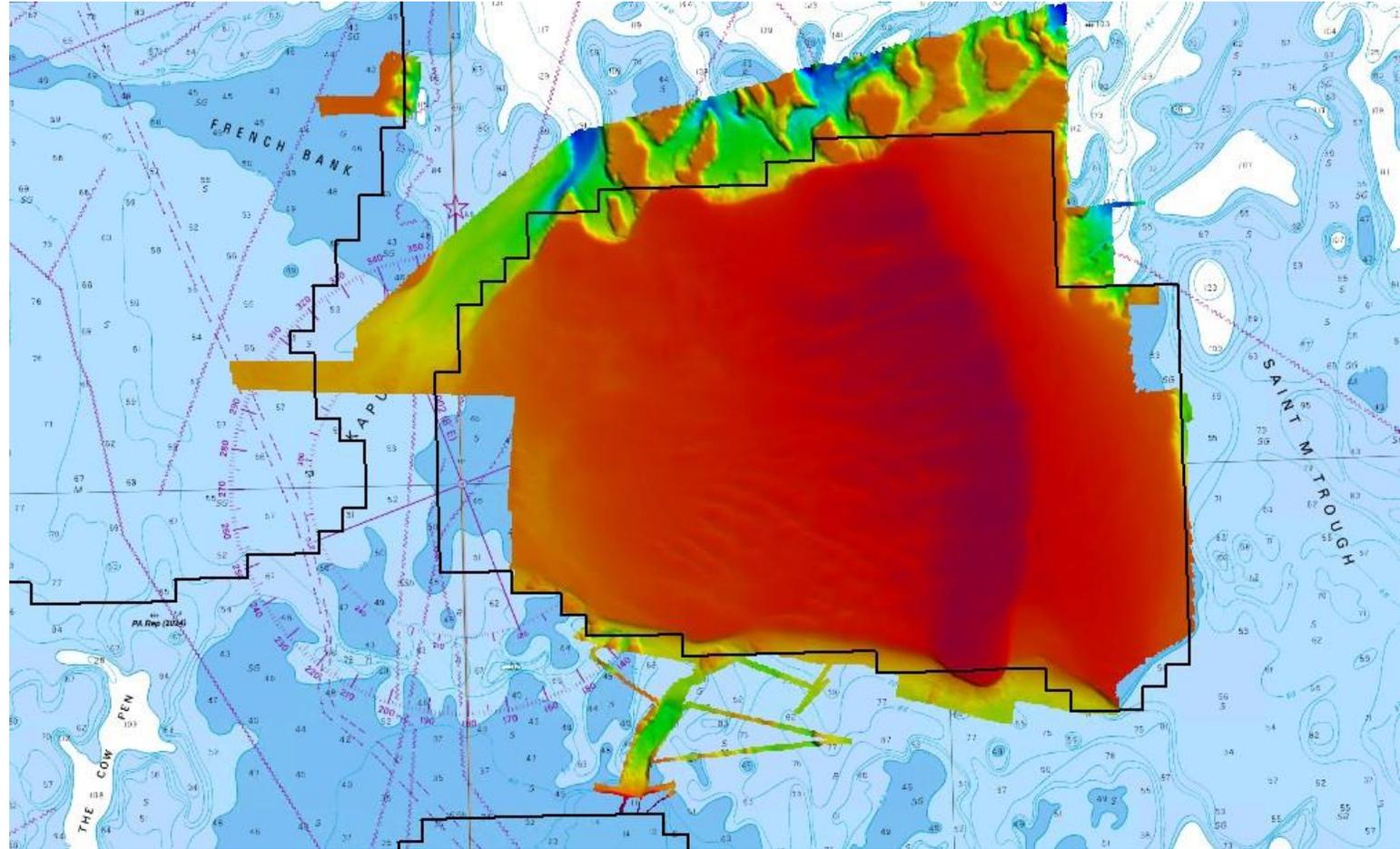
- 12 expeditions since mid-2023
- Hundreds of stations (samples, photos, moorings, etc)
- Tens of thousands of km of subbottom data
- Hundreds of thousands of hectares of new mapping
- Also - Observations of bats, birds, and marine mammals, including mooring and lander deployments





Middle Bank

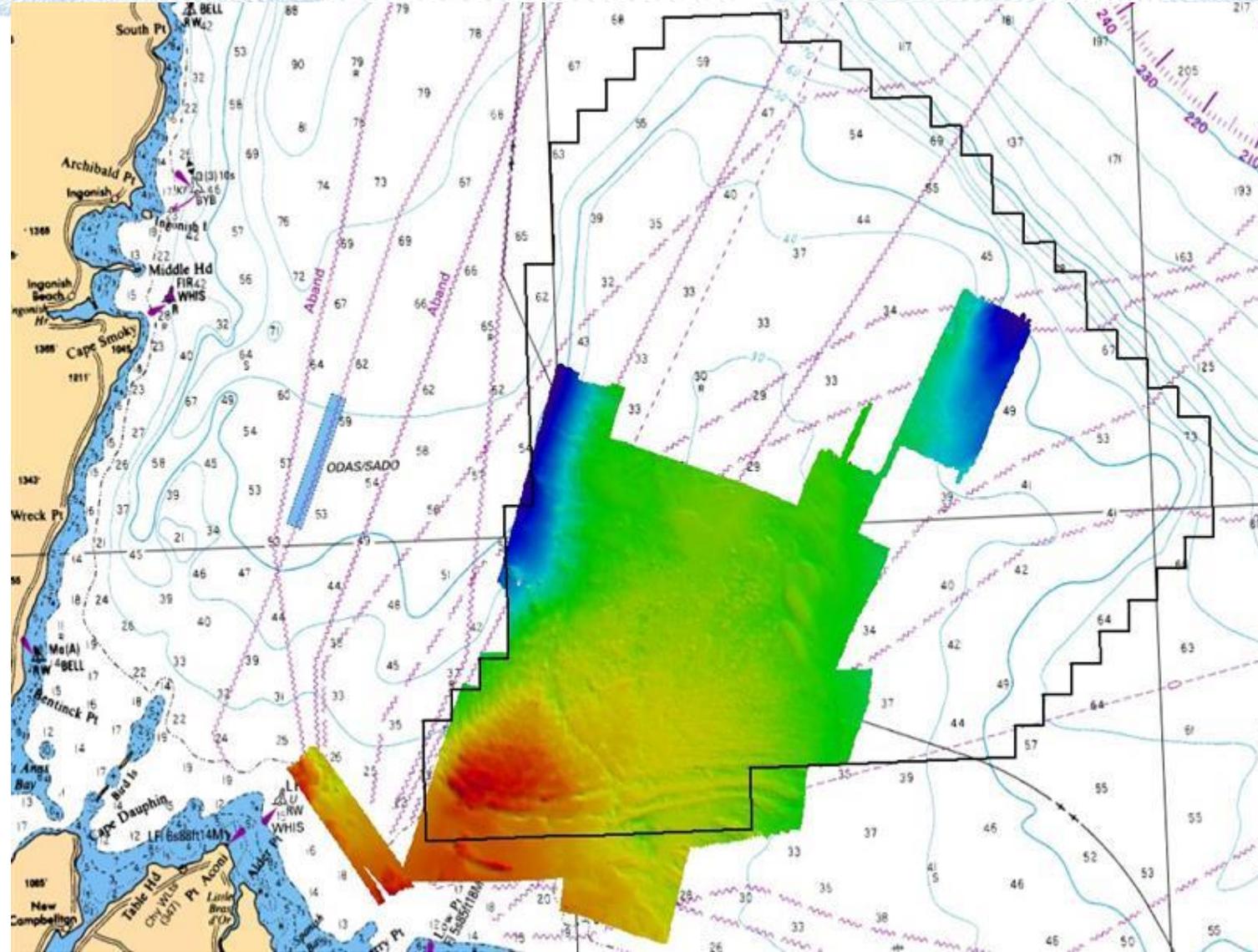
- Mostly completed
- Large portion of Northern section completed in 2024
- IIC contract in winter 2025
- 3 Coriolis missions summer 2025 on southern portions
 - Dedicated Mapping mission
 - NSDOE led mission
 - Opportunistic mission





Sydney Bight

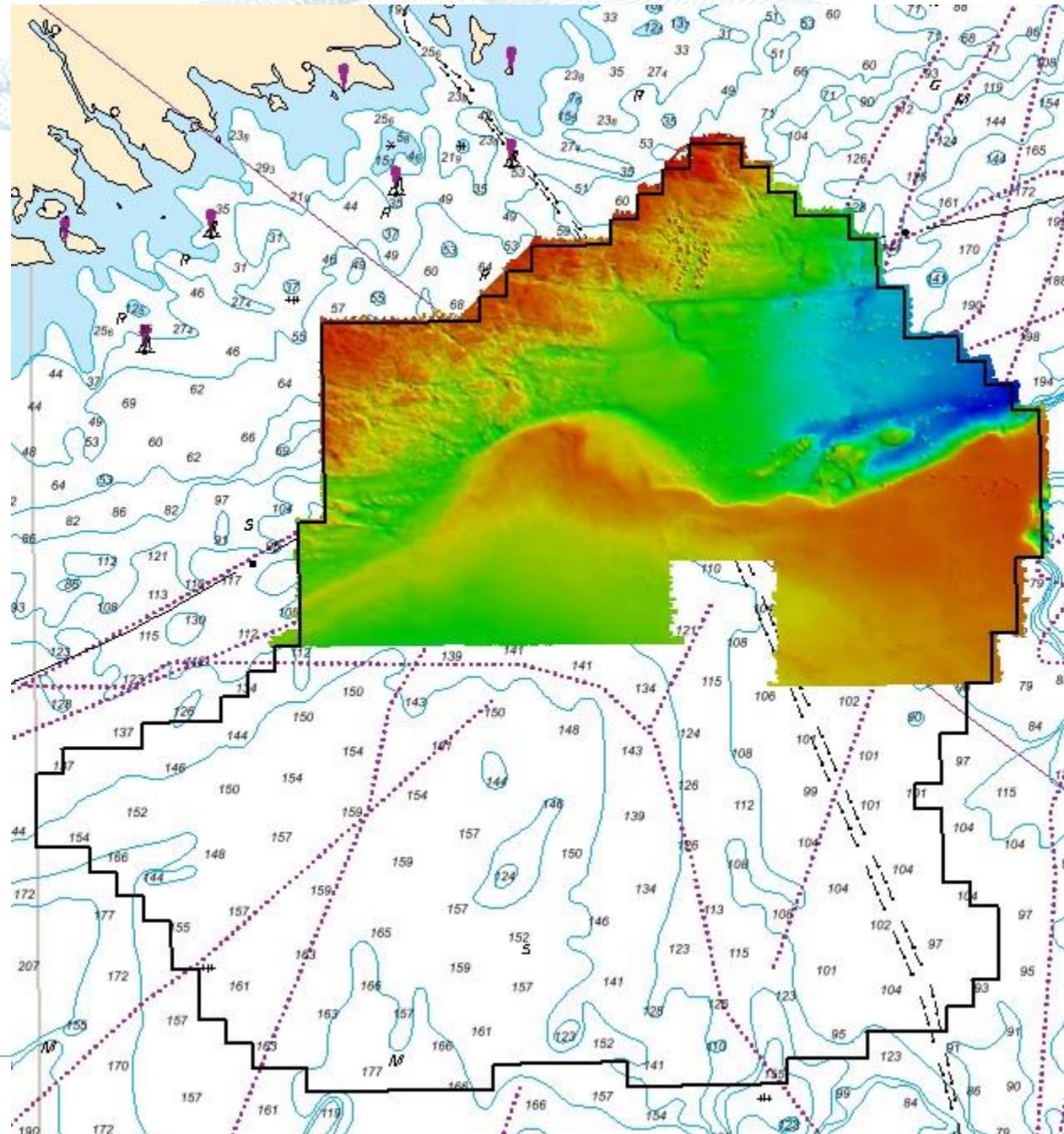
- In progress
- Southern portion surveyed with NOVUS in Oct 2024
- Northern portion surveyed with NOVUS in May 2025
- Opportunistic survey onboard the Coriolis in summer 2025.





French Bank

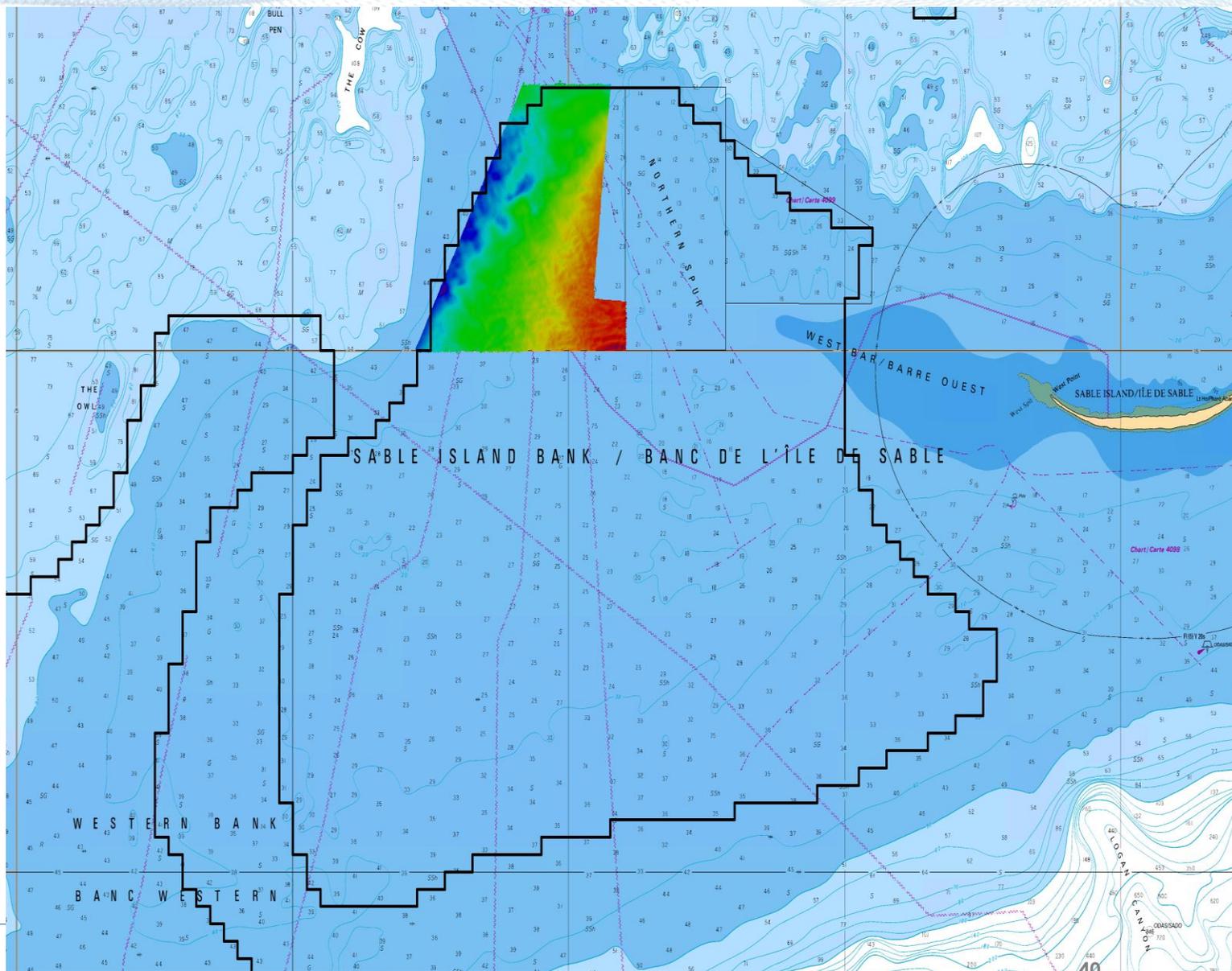
- In progress
- Part of the \$3M contract with NRCan funding.
- Contract awarded to IIC/Leeway.
- Mandatory area completed as of Sept 2025.





Sable Bank

- In progress
- Part of the \$3M contract with NRCan funding.
- Contract awarded to IIC/Leeway
- Optional area E completed
- Working on optional area D, but weather over the last weeks/month has caused delays in progress.



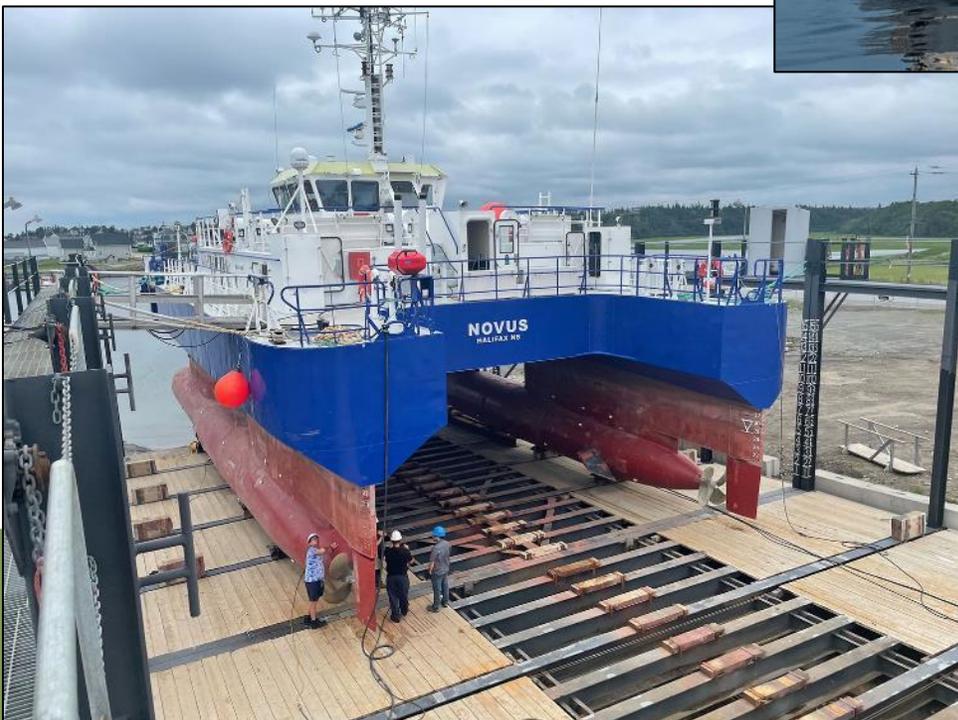
2025004



<https://leewaymarine.ca/vessels>



<https://reformar.ca/en/coriolis-2-2/>



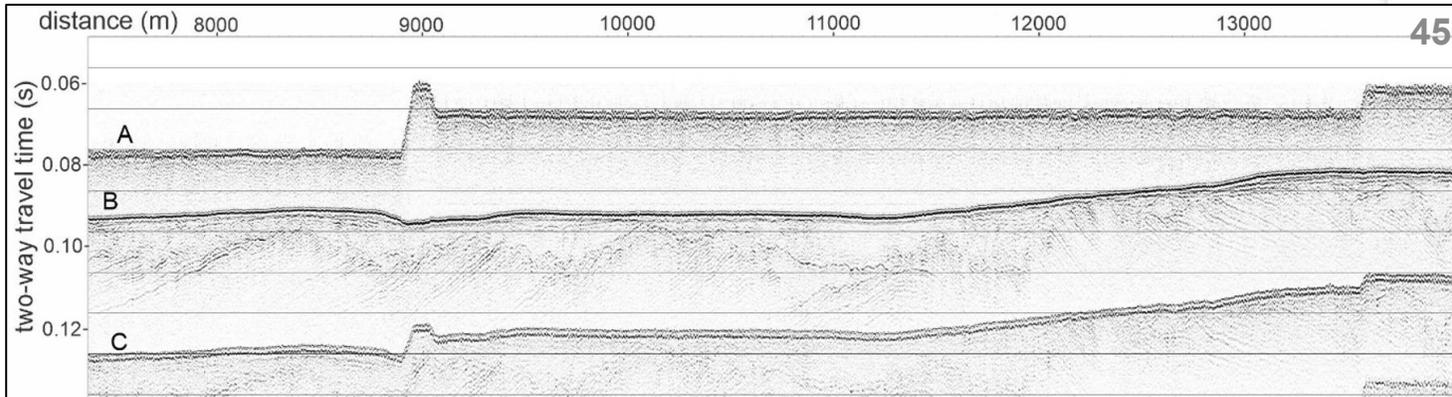
Eastern Shore - 2025303



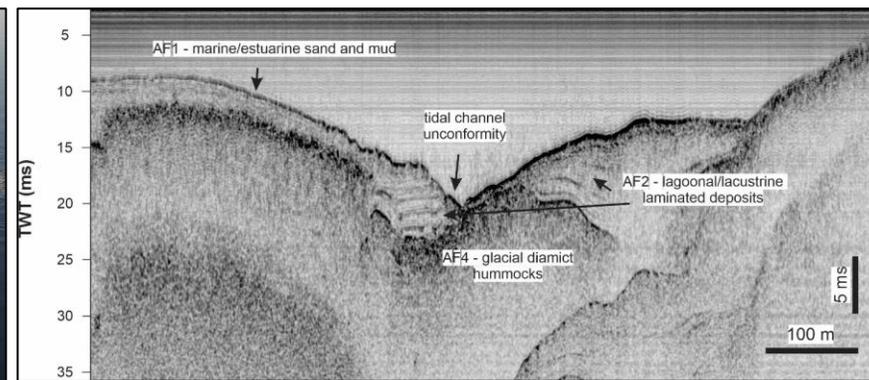
Eastern Shore - 2023004



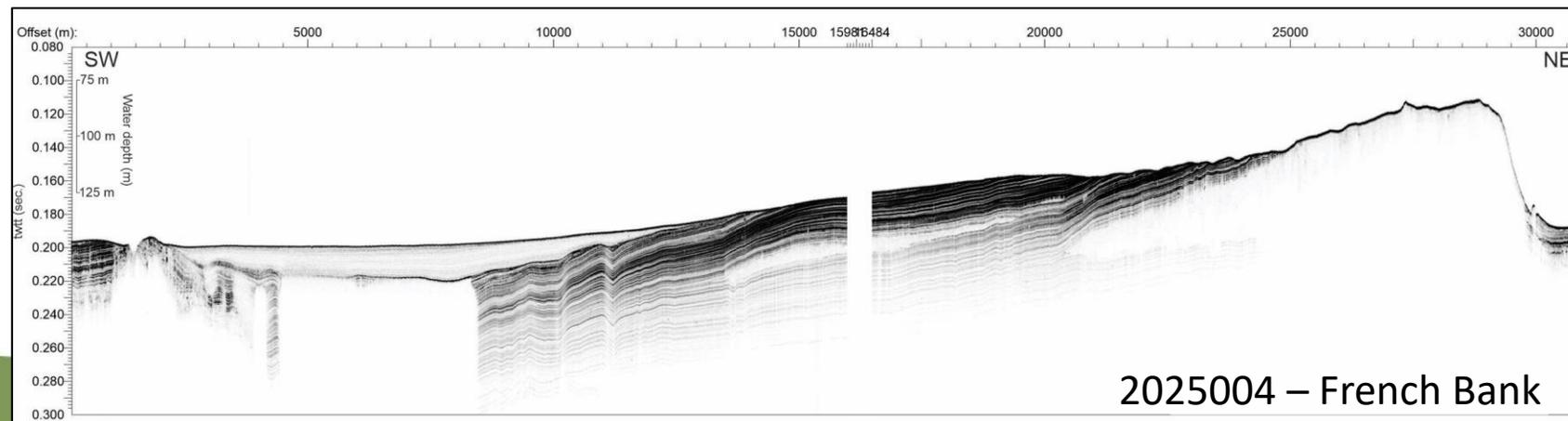
Sydney Bight - 2024003



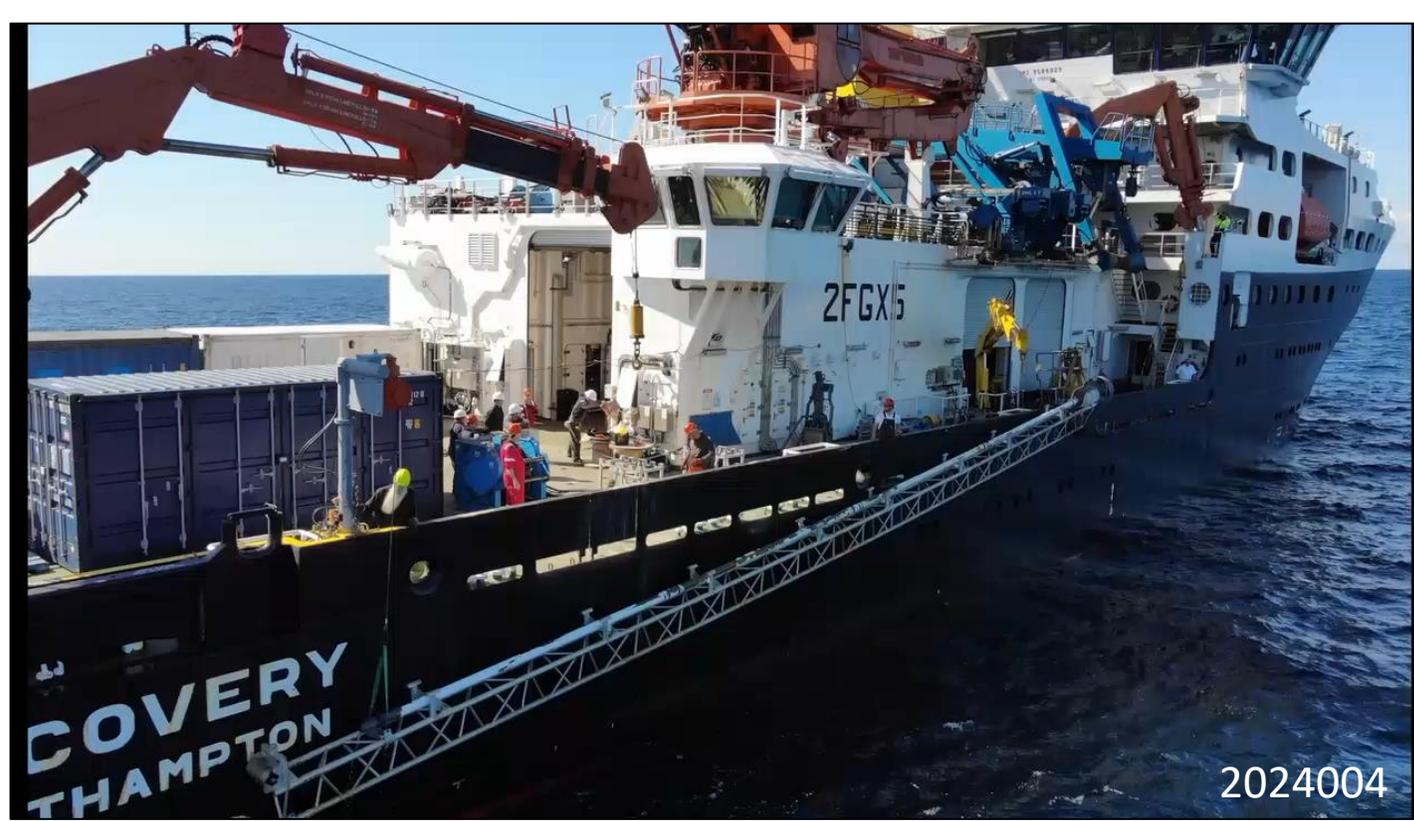
Eastern Shore - 2025303



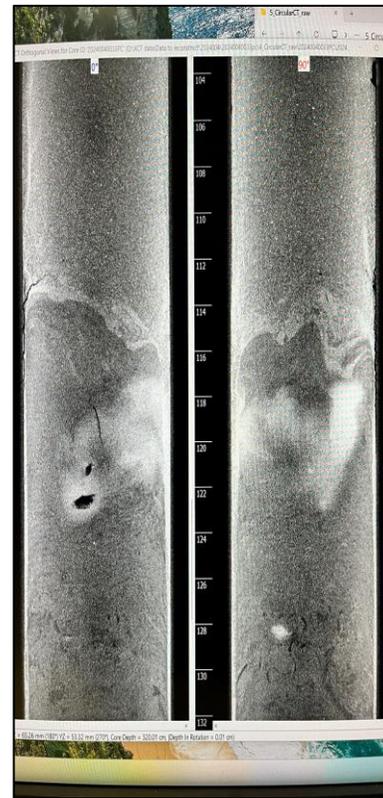
2024004



2025004 – French Bank



2024004



Eastern shore - 2024004



Middle Bank
- 2025004

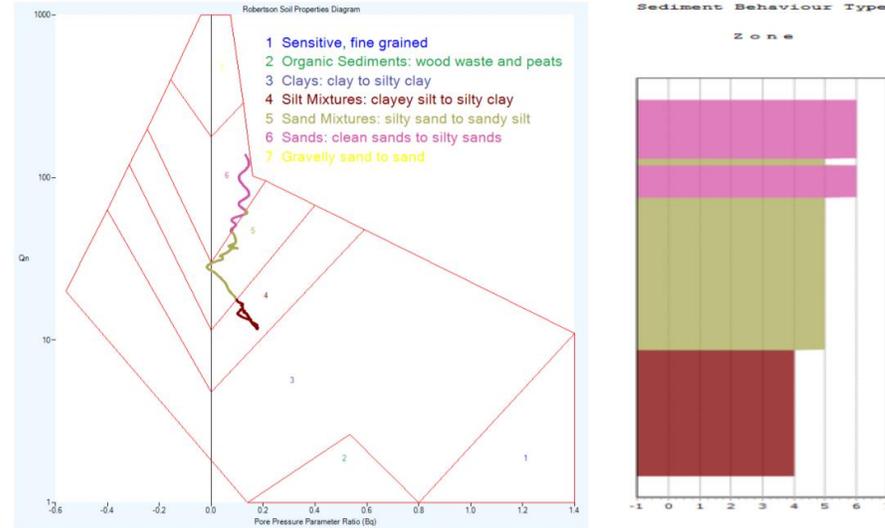


2025004

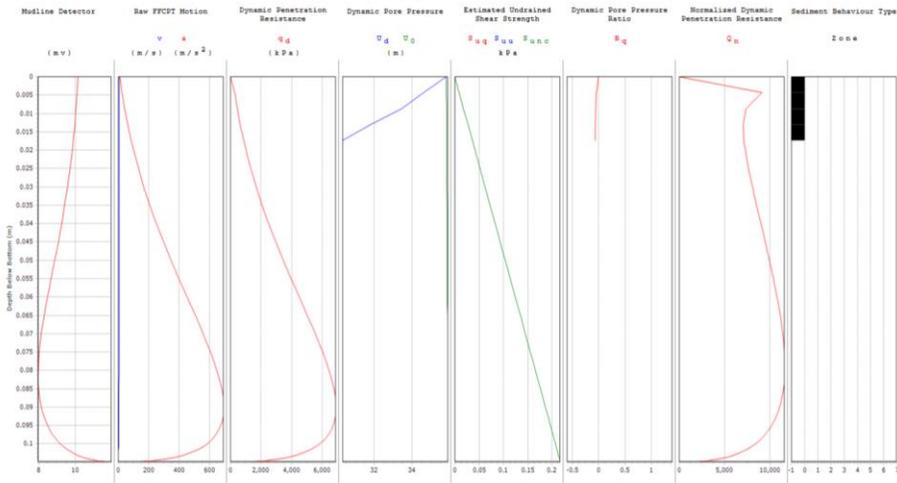


2025004

FFCPT Project 2025004FFCPT
 Client
 Report for Drop 00750000
 Drop Time September 11, 2025 16:26:37
 Plot Created on September 11, 2025 14:25:22
 FFCPT serial number SN10414 FFCPT Diameter (mm) 88
 Max Penetration 1.639 (m)



FFCPT Project 2025004FFCPT
 Client
 Report for Drop 00610001
 Drop Time September 10, 2025 15:45:21
 Plot Created on September 10, 2025 14:48:14
 FFCPT serial number SN10414 FFCPT Diameter (mm) 88
 Max Penetration 0.105 (m)



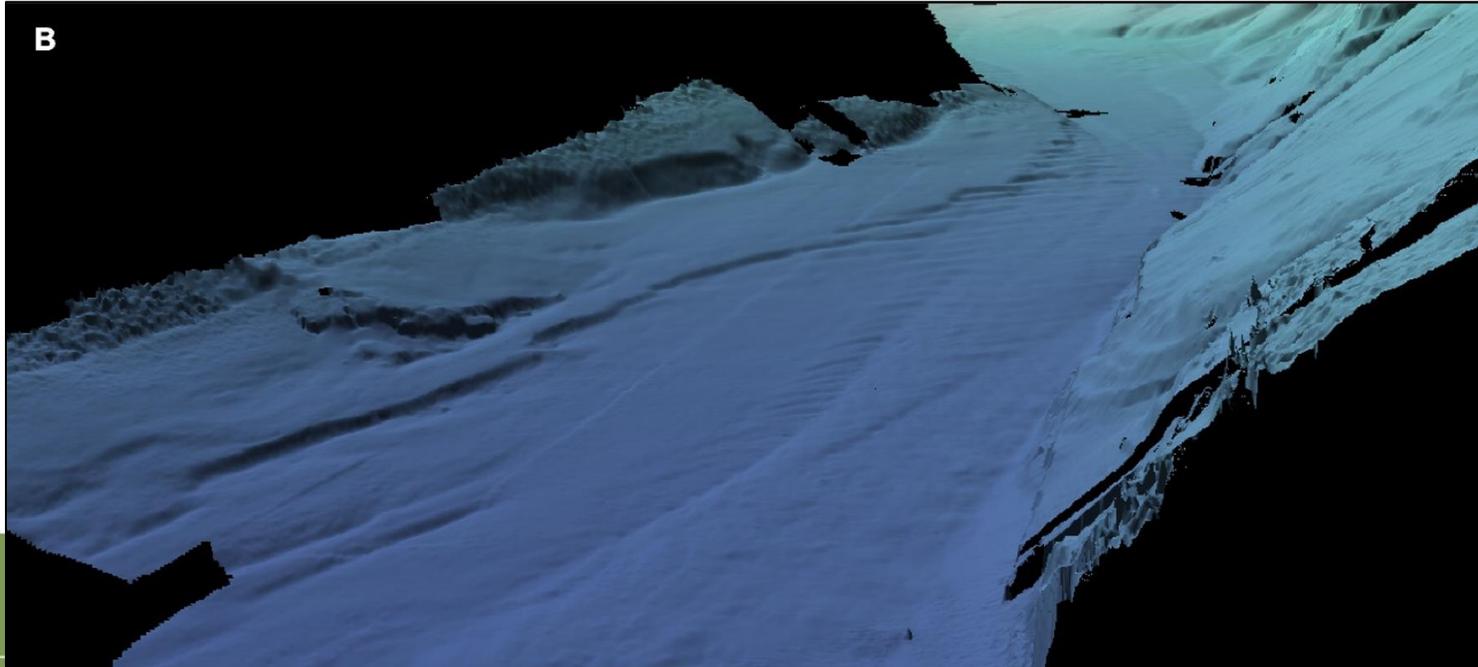
2025004 data – Sable Island Bank (left), Brandall Basin (between Middle and Sable) top



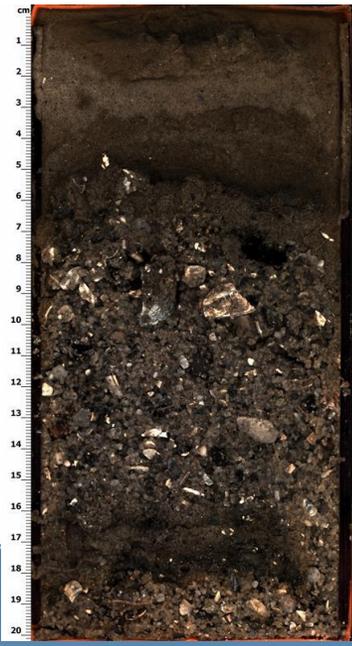
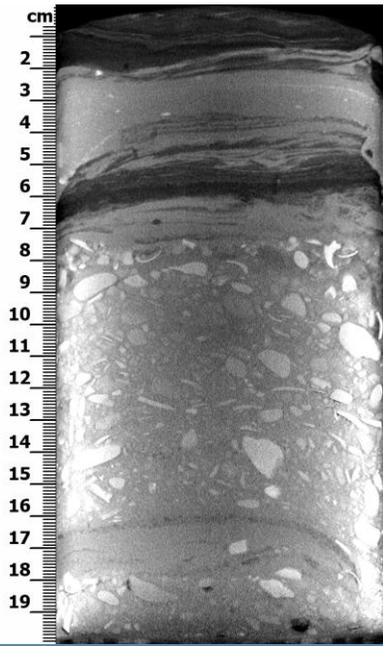
2024004



B







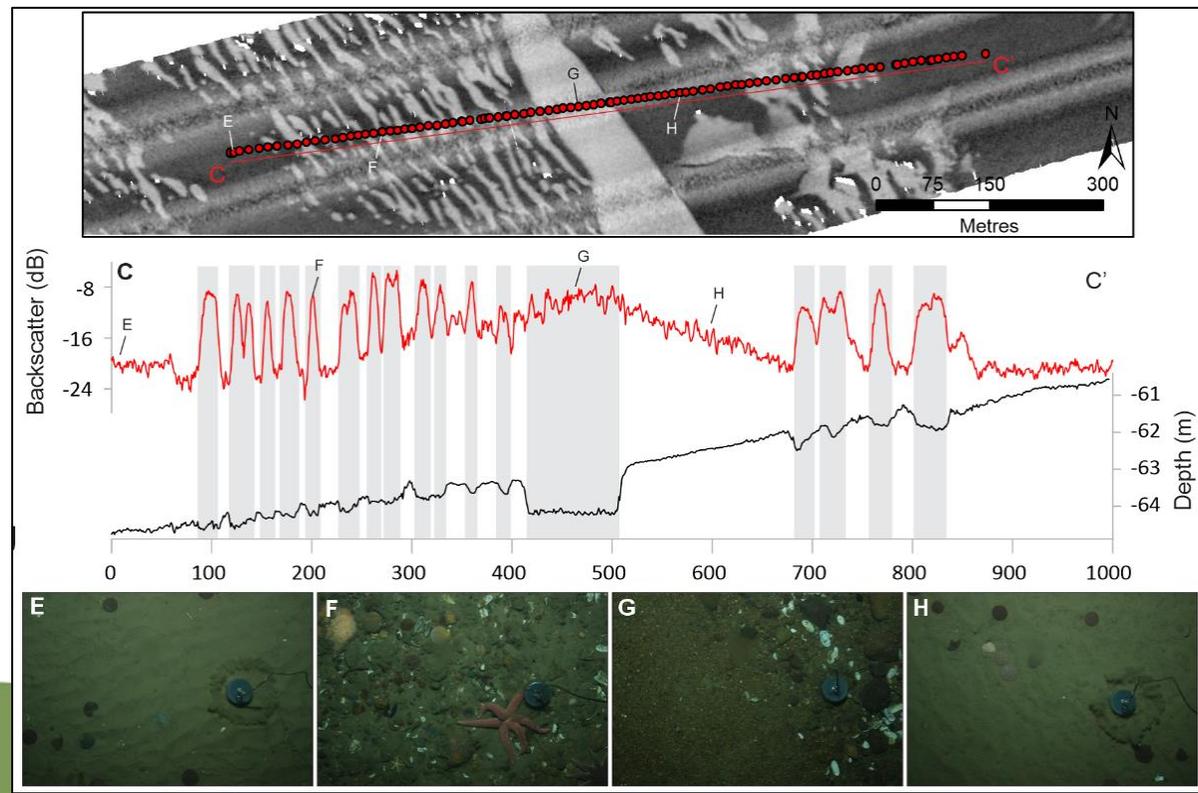
20240040196
push core – off
Banquereau



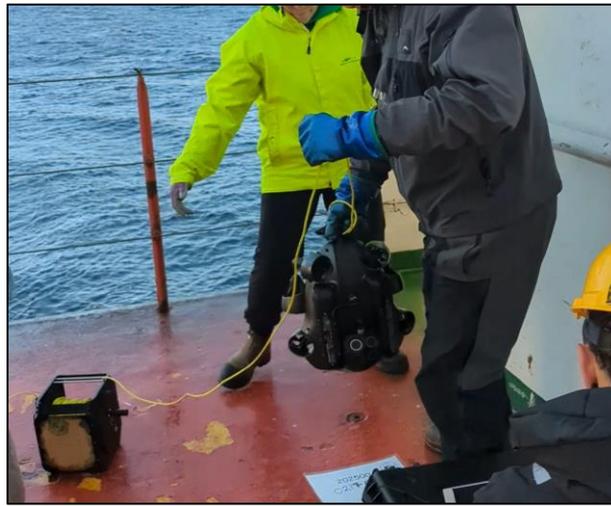
French Bank, Middle Bank, 2024004



GSCA 4K camera



Middle Bank - Campbell et al., 2024

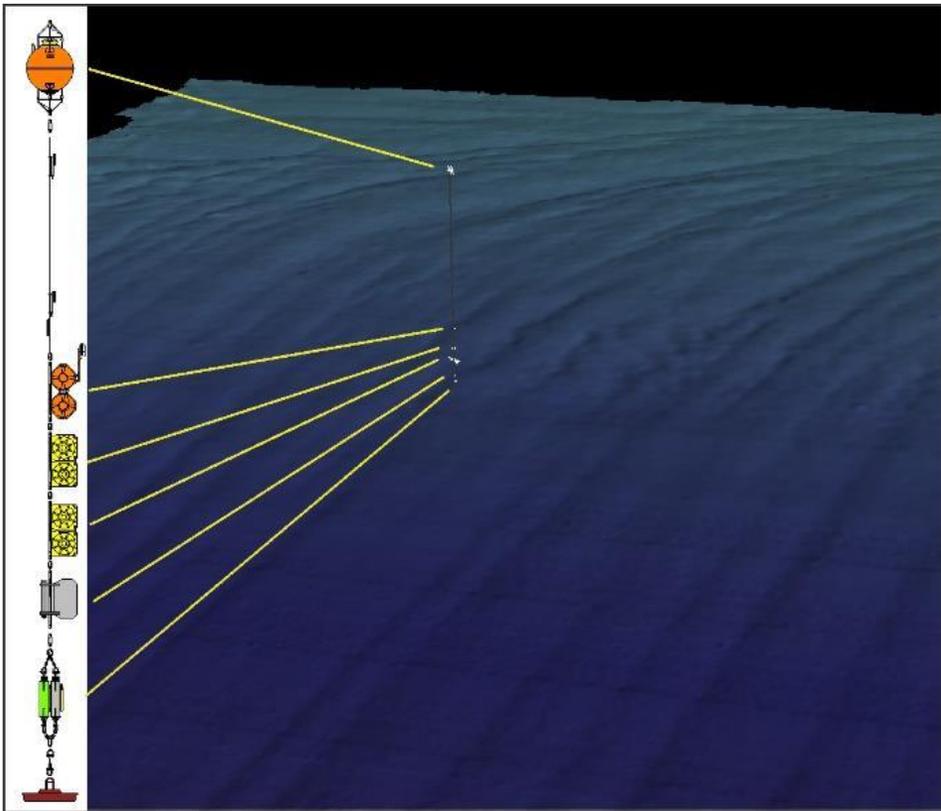


Middle Bank - 2025004



Sydney Bight - 2025004





Middle Bank - 2024004



Canada

Canada



Middle Bank - 2025004

- These moorings have scientific instruments that will measure and record:
 - Water temperature
 - Water salinity
 - Speed and direction of water currents
 - Underwater noise
 - Whale calls

Middle Bank - 2025004



Scientific Moorings in Proposed Wind Energy Areas

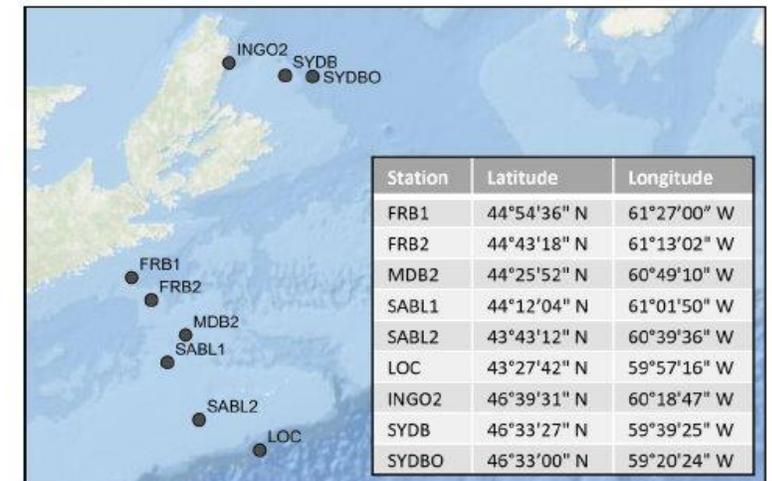
Project Lead: Hilary Moors-Murphy, Research Scientist, Fisheries and Oceans Canada (DFO)

Fisheries and Oceans is placing scientific moorings to listen for whale sounds and measure things like water temperature, salinity and underwater noise from within and around proposed offshore wind energy areas. This will help scientists understand the environment and how building wind farms in the ocean might affect sea life.

Example mooring



- **Nine moorings** to be placed in the ocean in **September or October 2025** using the research ship *RRS James Cook*
- Six moorings will be placed in **French Bank, Middle Bank, Sable Island Bank, and Logan Canyon** on the eastern Scotian Shelf
- Three moorings will be placed in **Sydney Bight area** near eastern Cape Breton
- These moorings will collect data for about two years, from **Fall 2025 to Fall 2027**
- The equipment will sit on the seafloor and reach up to **no less than 20 meters below surface**
- There will be **no markers on the surface** to show where the equipment is
- **Fishers and other mariners should avoid these locations** to protect their gear and the equipment
- NAVWARNs will be shared when the equipment is placed, with the latest location details



For more information contact: hilary.moors-murphy@dfo-mpo.gc.ca



Natural Resources
Canada

Ressources naturelles
Canada



Middle Bank - 2025003



Banquereau - 2024004







Eastern Shore
- 2024303



Eastern Shore
- 2025303

Sable Island
- 2025300



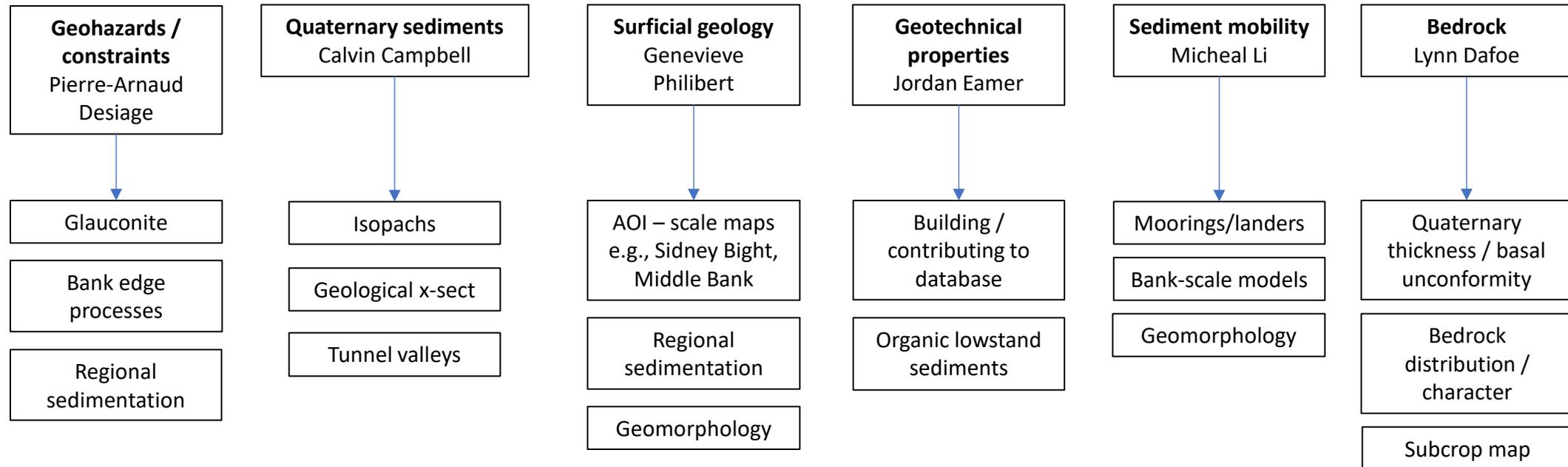
Next steps

- Workshop in March: three 1.5 hour sessions on:
 - Sydney Bight,
 - French Bank,
 - Middle Bank,
 - and a regional component (~10 min) in each
- Mid-program update report – March 2026 - <https://ostrnrcan-dostrncan.canada.ca/home>
 - In addition – many queued cruise reports, papers to come
- Data release – March 2026 – <https://geo.ca/>
- Continued data collection – program runs to March 2028



Workshops

- Following the structure of the program, for each wind energy area one speaker will cover the following activities:



- Plus possible additional topics: multibeam echosounder data processing (CHS), nearshore geology (Edward King), habitat mapping (Vladimir Kostylev), Sable Island Bank (Edward King and others)



Thank you – jordan.eamer@nrcan-rncan.gc.ca

