

# National Facility for Seismological Investigations

Director:

**Mladen Nedimović** (Dalhousie)

<https://www.nfsi.ca>

Personnel:

**Graeme Cairns**, Facility Manager

**Katie Bosman**, Marine Data Technologist

**Jonathan Thibodeau**, Marine instrument Technologist

Executive Council:

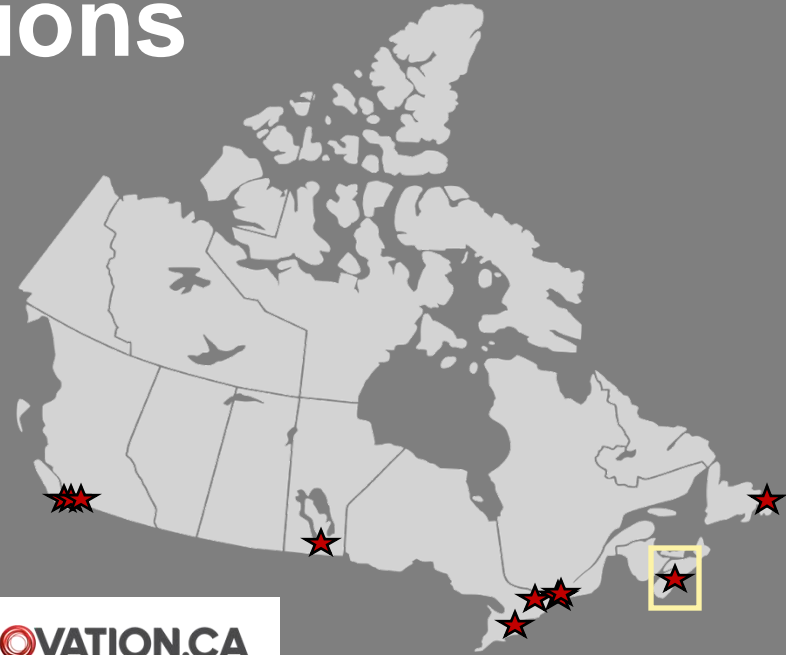
**Pascal Audet** (uOttawa) – **Michael Bostock** (UBC)

**Andrew Calvert** (SFU) – **Fiona Darbyshire** (UQAM)

**Stan Dosso** (Victoria) – **Andrew Frederiksen** (Manitoba)

**Qinya Liu** (Toronto) – **Yajing Liu** (McGill)

**Kim Welford** (Memorial)



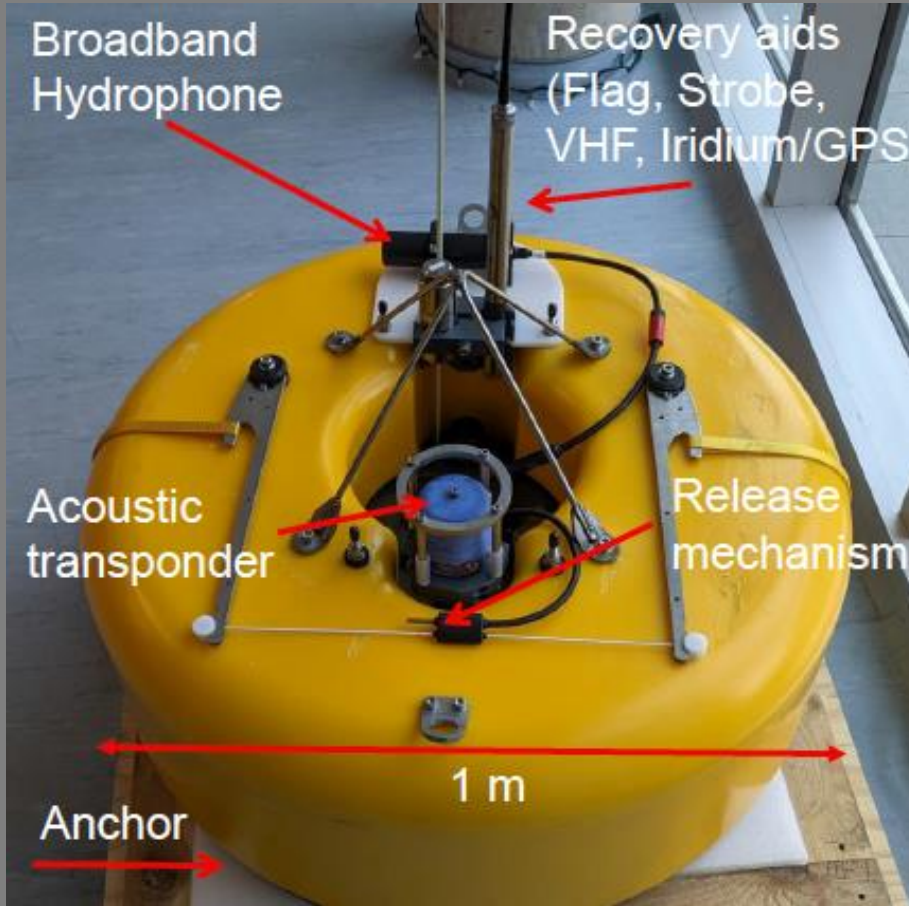
**DALHOUSIE  
UNIVERSITY**

**INNOVATION.CA**

CANADA FOUNDATION  
FOR INNOVATION | FONDATION CANADIENNE  
POUR L'INNOVATION



# BOBS: Güralp Aquarius



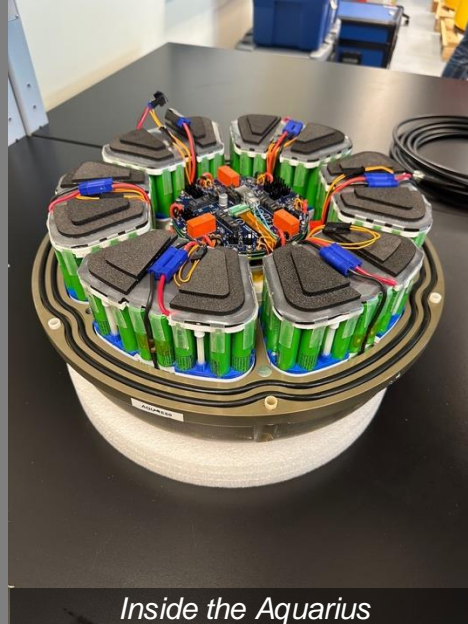
<u>Specifications</u>		<u>Research Impact</u>
number of units	120	High resolution & coverage
clock drift (ms/day)	<0.5	Allows long-term deployments necessary for earthquake monitoring
max deployment (months)	18	
data storage (Gb)	128	
bandwidth (Hz)	120 s – 100 Hz	Joint use for earthquake process and structure imaging studies
dynamic range (bit)	24	
pressure sensor (hydrophone)	100 s – 8 kHz	Acoustic monitoring and compliance
Communication	Acoustic modem	Real-time data to surface from SF instruments
Buoyancy	Syntactic foam	Unsinkable once anchor is released

## Additional NFSI infrastructure:

- Instrumentation lab and offices at Dalhousie (Halifax)
- Portable deck units for charging and communications
- Storage space at COVE facility for Marine Technology (Dartmouth, NS)



*Deck computers*



*Inside the Aquarius*



*NFSI lab space on the Steele Ocean Sciences Building 4<sup>th</sup> floor. Instrumentation lab and two Data Analysis rooms.*

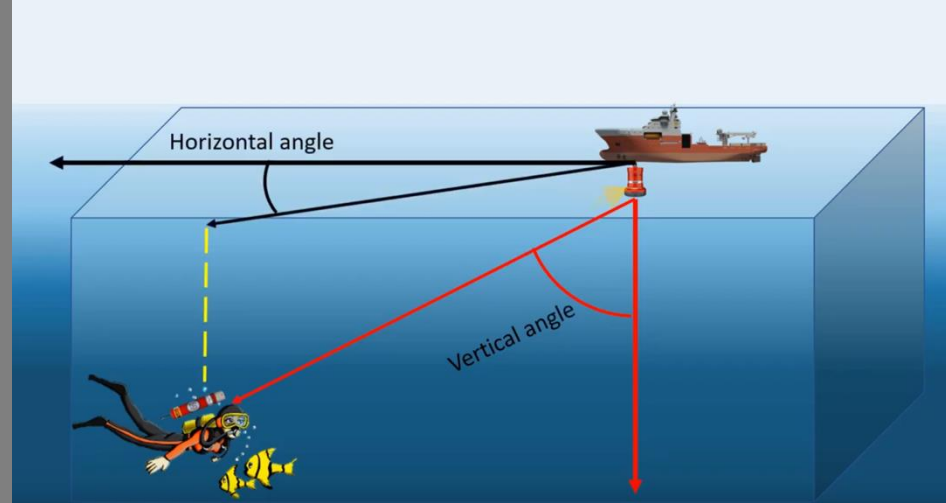


*COVE facility for Marine Technology*



# Ancillary Equipment: Sonardyne Ranger 2 LMF Gyro-USBL

- Provides communication and directional ranging to seafloor instruments for rapid positioning
- Integrated gyro & accelerometer provide compensation for heave, pitch and roll
- Can be mounted on vessels of opportunity without significant calibration
- LMF frequencies for deep water operations. Used successfully in 4700 m to date



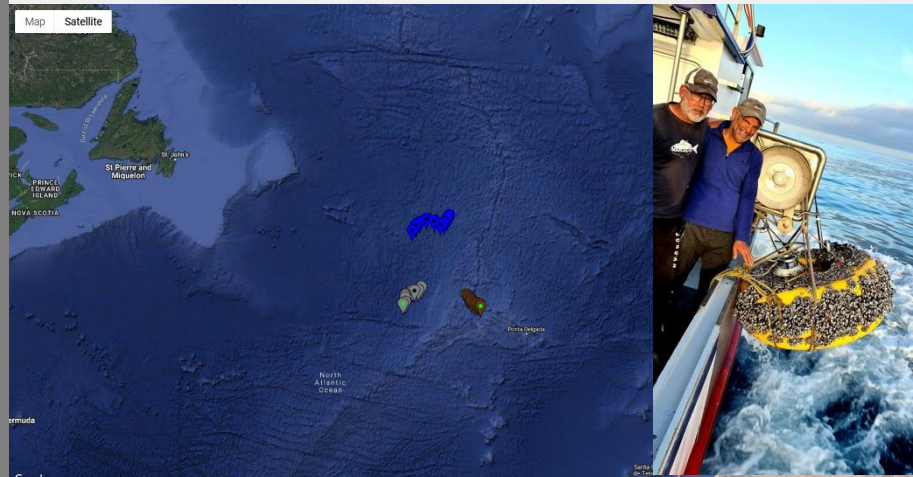
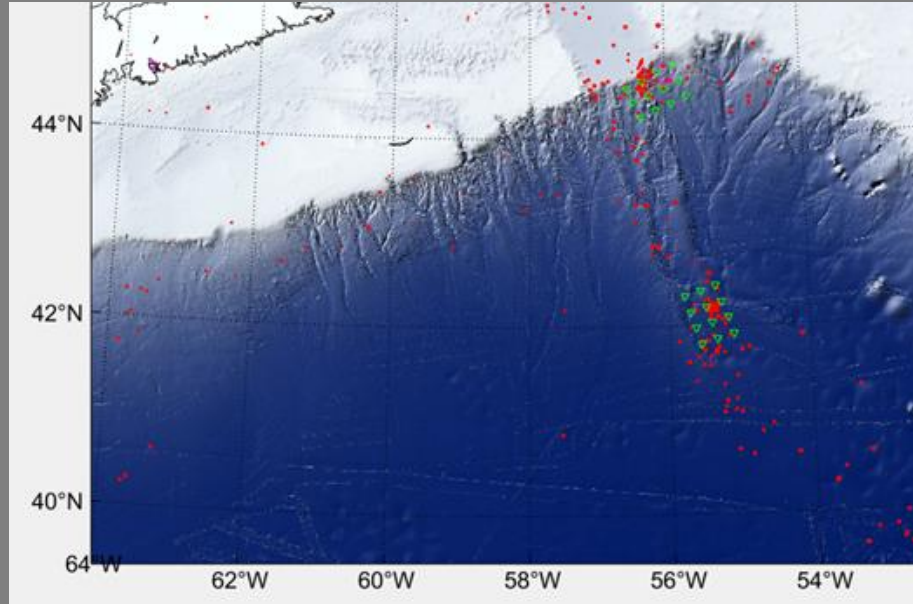
# Ancillary Equipment: Sonardyne Modem 6 LMF Mini-dunkers (Directional and Omni-Directional)

- For communication and ranging to instruments for positioning on the seafloor
- Does not provide direction like gyroUSBL. Need to move vessel overhead to triangulate.
- Easy to hang over side from any vessel
- Directional sensitivity blocks out overhead ship noise and surface acoustic bounces
- Used successfully in 3000 m of water to date



# Laurentian Fan sea trials: Nov 2021 – Dec 2022

- Pis: M. Nedimović (Dalhousie); Collaborator: A. Plourde
- 12 BOBS deployed November 2021 with 8 instruments recovered in August 2022
- 3 surfaced prematurely, tracked across Atlantic, 1 recovered. No response from one instrument
- Data corrupted after 3 months due to software bug
- **S41H-3405: The First Broadband Ocean-Bottom Seismometer Deployment in Eastern Canada: A Case Study on the Lower Laurentian Fan Seismic Zone**

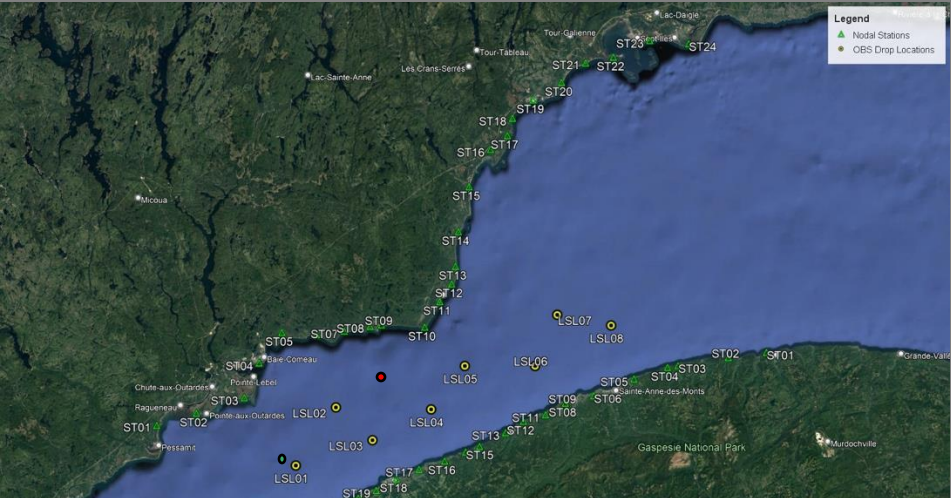




# Lower St-Lawrence Seaway: Deployments (Sept. 2023 & Nov. 2024), Recoveries (May 2024):

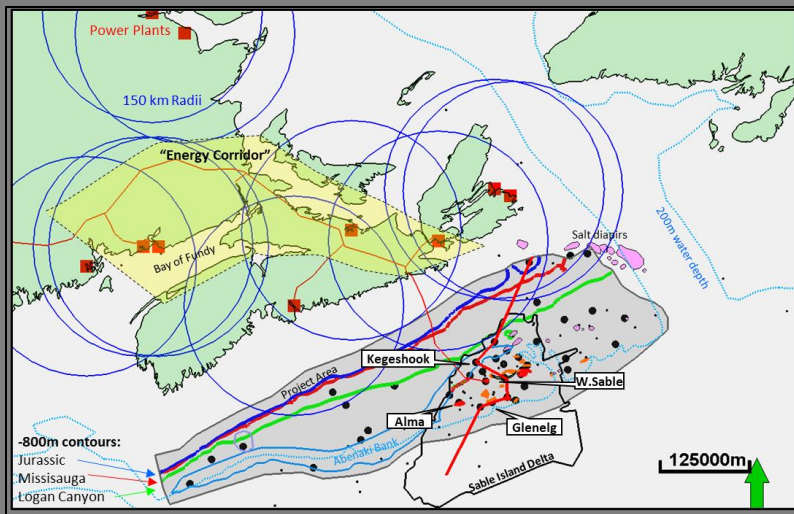
PIs: Y. Liu (McGill), M. Nedimović & M. Zhang (Dal);  
Collab: A. Plourde (GSC)

- Track whales & collect seismic data; However, no hydrophone replacements on time
- 8 BOBS deployed/recovered with small fishing vessels
- Deployment of land stations along both banks



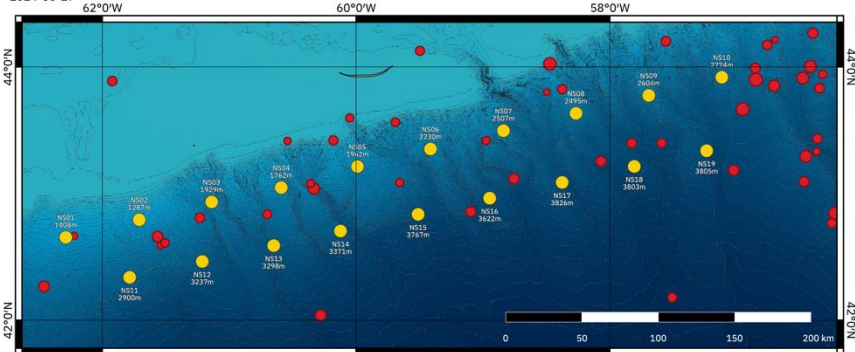
# Seismic Evaluation of the Scotian Margin for Long-term Carbon Storage

(Deployments: June 2024) PIs: M. Zhang (Dalhousie), M.n Nedimović (Dalhousie)



## Seismic Investigation of the Scotian Margin (SeISM) - Surveyed Locations

2024-06-27



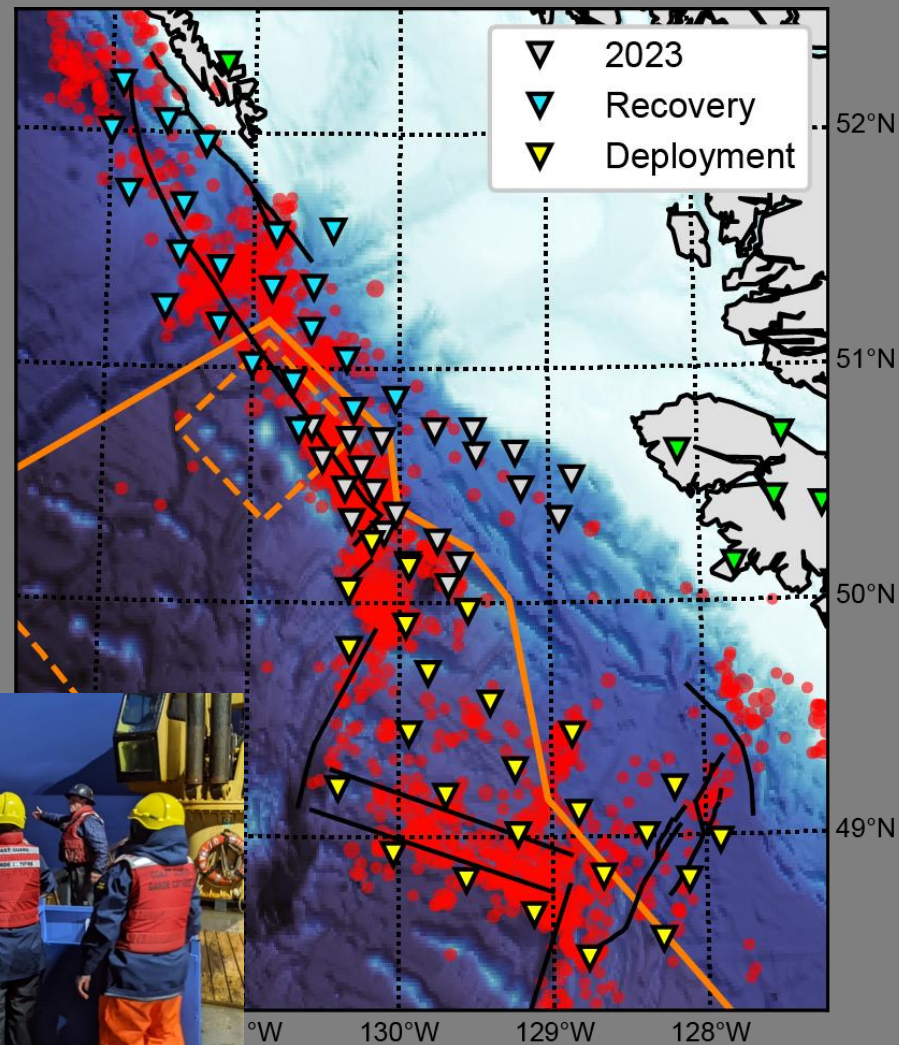
- The Scotian margin has been qualitatively identified by the IPCC as one of the premier global locations for carbon storage
- There is a need for evaluation of seismic risks and tectonic structures that could impact long-term storage
- We deployed 19 BOBS in early June 2024 and will recover them in late May 2025



# Deployment: QCF (Oct. 2023)

## Recovery & Redeployment (July 2024)

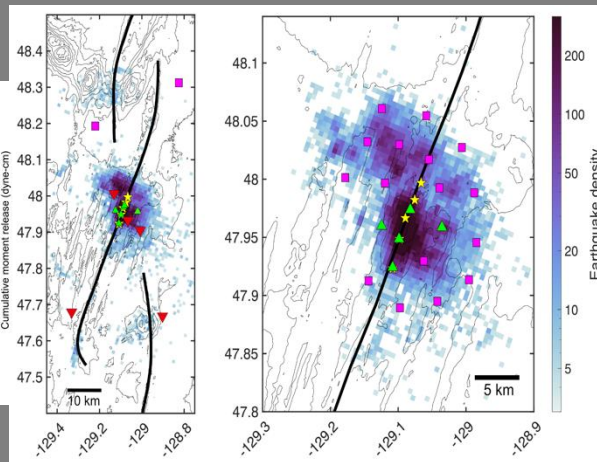
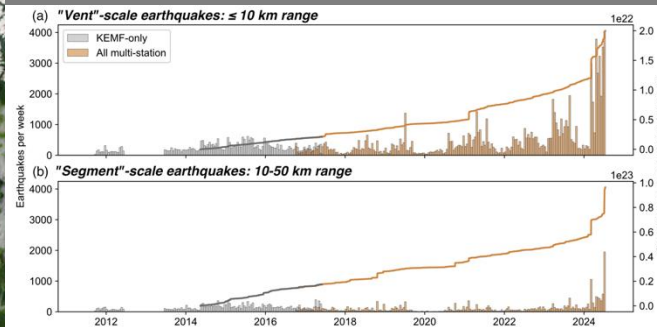
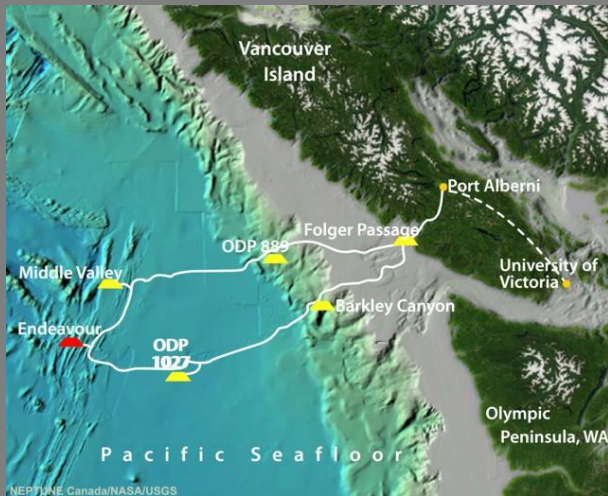
- Pis: M. Bostock (UBC), M. Nedimović (Dalhousie), S. Peacock (UBC), E. Nissen (uVic), M. Zhang (Dalhousie); Collab: A. Schaeffer, T. Sun et al. (GSC)
- 28 BOBS deployed from R/V Tully in 2023; 8 were positioned; 3 surfaced early, 2 recovered
- M~5 earthquake within days of first deployments
- 25 BOBS recovered (inver. gray triangles) and 24 redeployed (inver. blue triangles); 3 surfaced/recovered
- T53A-3195: PACSAFE: Preliminary results from the Leg 1 deployment of Ocean Bottom Seismometers off Canada's west coast



# Submarine Volcano Eruption Monitoring at the Endeavour Segment Offshore BC

PIs: M. Zhang (Dalhousie), W. Wilcock (UofW), M. Nedimović (Dalhousie), M. Denolle (UofW)

Collaborators: A. Plourde (GSC), M. Heesemann (ONC)



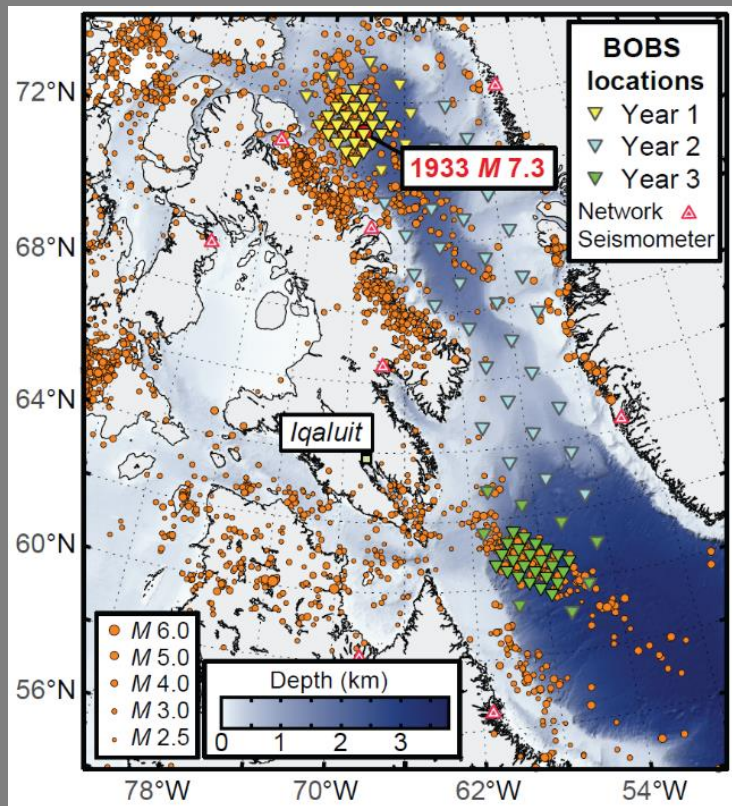
- Endeavour segment is highly likely to erupt in the coming months/years
- 5 BOBS were deployed by ONC and Dalhousie during the summer of 2024
- Dal was funded by NSERC to deploy 20 BOBS in summer of 2025
- UofW was funded by NSF to recover 20 BOBS in the summer of 2026





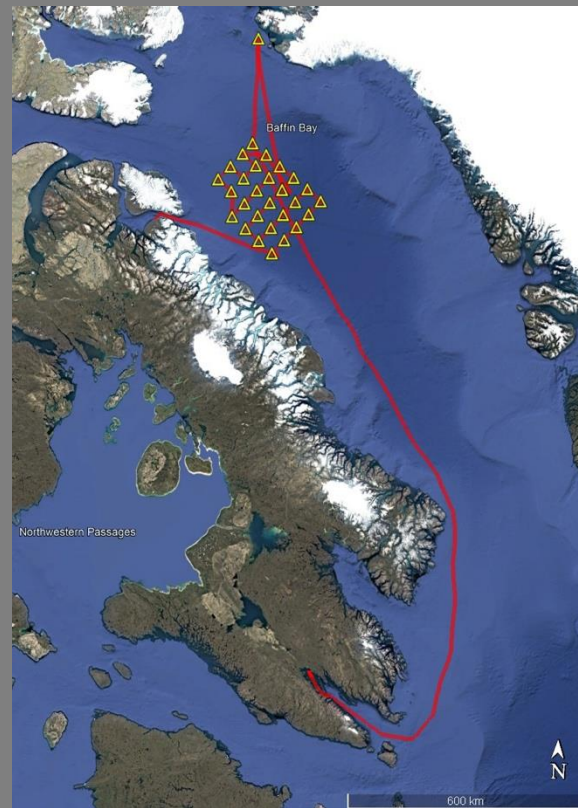
# ICE-OBS: Investigating Canada's Eastern Offshore with Broadband Seismology

PIs: M. Nedimović, M. Zhang (Dal) Collaborators: A. Plourde (GSC), Y. Liu (McGill)



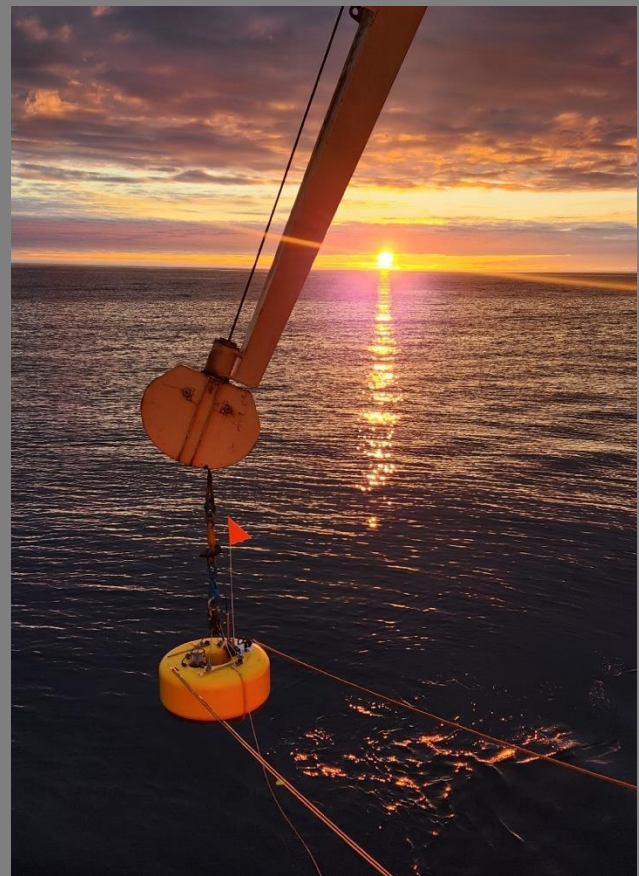
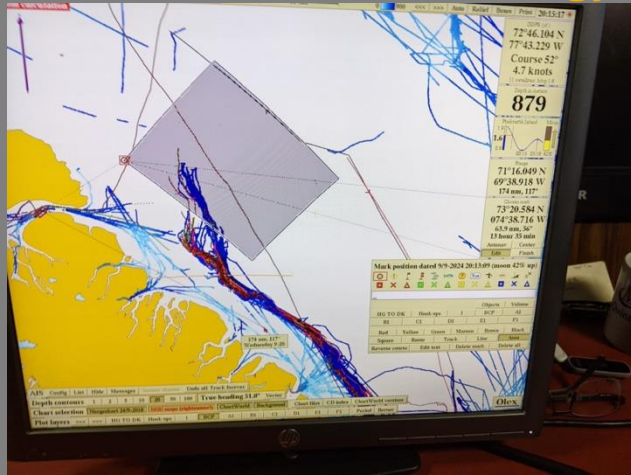
- What are the principal causes of stress leading to earthquakes in the region (tectonic, or associated with glacial isostatic adjustment)?
- What is the distribution of seismogenic faults and the potential to host a M7+ earthquake?
- How does this structure vary along the rift axis from Baffin Bay to the Labrador Sea, and how do the variations correlate with magmatism?
- To what extent does ice cover affect the ocean background ambient noise, and can these effects be modelled?

## BIBOS: Baffin Bay Broadband Offshore Seismology Sep. 2024 Deployment



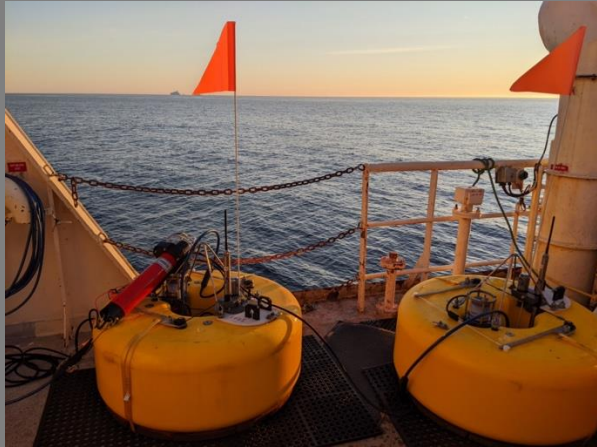


# BIBOS: Baffin Bay Broadband Offshore Seismology – Sep. 2024 Deployments





# BIBOS: Baffin Bay Broadband Offshore Seismology Sep. 2024 Deployments



**Brief summary of the current state of work at the NFSI:**

- **Currently, 102 BOBS deployed across 6 projects**
- **This is every available working BOBS deployed except for 2 stored in BC**
- **13 are in need of repair and 4 lost**

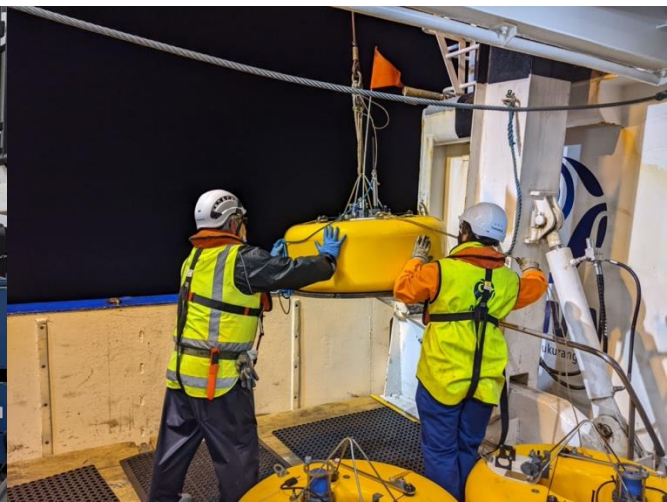
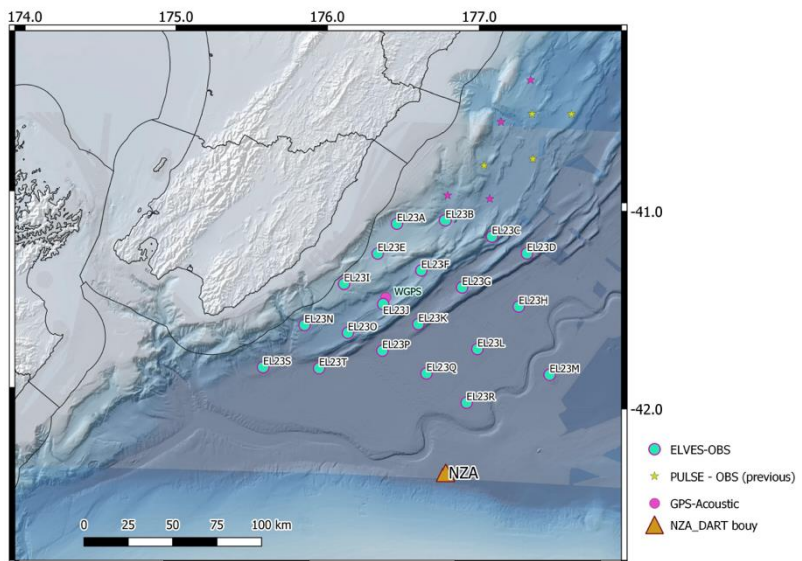


## 2025 Operational Outlook – Even busier...

Jan	Recover 20 BOBS in New Zealand & ship back to Canada Need additional container at COVE to store returning instruments
Apr/May	Recover 8 BOBS in St. Lawrence
May	Recover 20 BOBS offshore Nova Scotia
Jun/Jul	Possibly deploy 20 BOBS on Endeavour and recover 5 BOBS for OTN
Aug	Recover 23 BOBS offshore BC, turn around and redeploy 25+
Sept	Recover 29 BOBS in Baffin Bay, with possible redeployment
Oct/Nov?	Deploy 20 BOBS in Adriatic (probably not until 2026)

## Recoveries: ELVES (Jan, 2025)

- Earthquake and Locking inVEstigation of Subduction
- M. Savage (VUW), E. Warren-Smith & K. Jacobs (GNS), P. Audet (uOttawa), M. Nedimović (Dal)
- 20 instruments to be recovered after 13 months at seafloor; all positioned; none surfaced prematurely



## More information:

- Website: <http://nfsi.ca>
- Email: [nfsi@nfsi.ca](mailto:nfsi@nfsi.ca)
- Mailing list: <http://nfsi.ca/outreach/ mailing/>
- GitHub Organization Page: <https://github.com/nfsi-canada>
- OBS contract announcement: <http://nfsi.ca/outreach/blog/obs-contract-announcement/>
- **Get in touch to inquire about collaboration! *We work on a first-come, first serve basis***

