

# **Geoscience data curation and interpretation for Offshore Wind at the Canada-Nova Scotia Offshore Petroleum Board**

**M. Niccoli, M. Deptuck, K. Kendell, and B. Altheim  
(Resources and Rights group)**

# What do we do?

- ▶ Regulate oil and gas exploration and development activities that take place in the Canada-Nova Scotia offshore area

Our main responsibilities include:

- Health and safety of offshore workers
- Protection of the environment
- Management and conservation of petroleum resources
- Canada-Nova Scotia employment and industrial benefits
- Issuance of licences for exploration and development
- Hydrocarbon resource evaluation, data collection, curation and distribution

# What do the amendments to the Accord Acts mean for the CNSOPB?

- ▶ Petroleum related regulatory responsibilities remain
- ▶ Expansion of our mandate to include the regulation of offshore renewable energy development in the Canada-Nova Scotia offshore area
- ▶ Our name will change to the Canada-Nova Scotia Offshore Energy Regulator
- ▶ Anticipate the mandate expansion to occur in early 2025

# Overview of Geotechnical & Geophysical Data Sets

- ▶ There are many geotechnical and geophysical data sets we curate that may support ORE, including:
  - 2D & 3D seismic data
  - Geotechnical & shallow hazard surveys
  - Jack-up rig foundation analysis
  - Pipeline surveys etc.
- ▶ These data sets include some, or all, of the following:
  - Piston cores (soil stability, geological descriptions etc.)
  - Grab samples (grain size analysis etc.)
  - Shallow geotechnical boreholes
  - Seafloor photos and ROV videos
  - High resolution geophysical data etc.



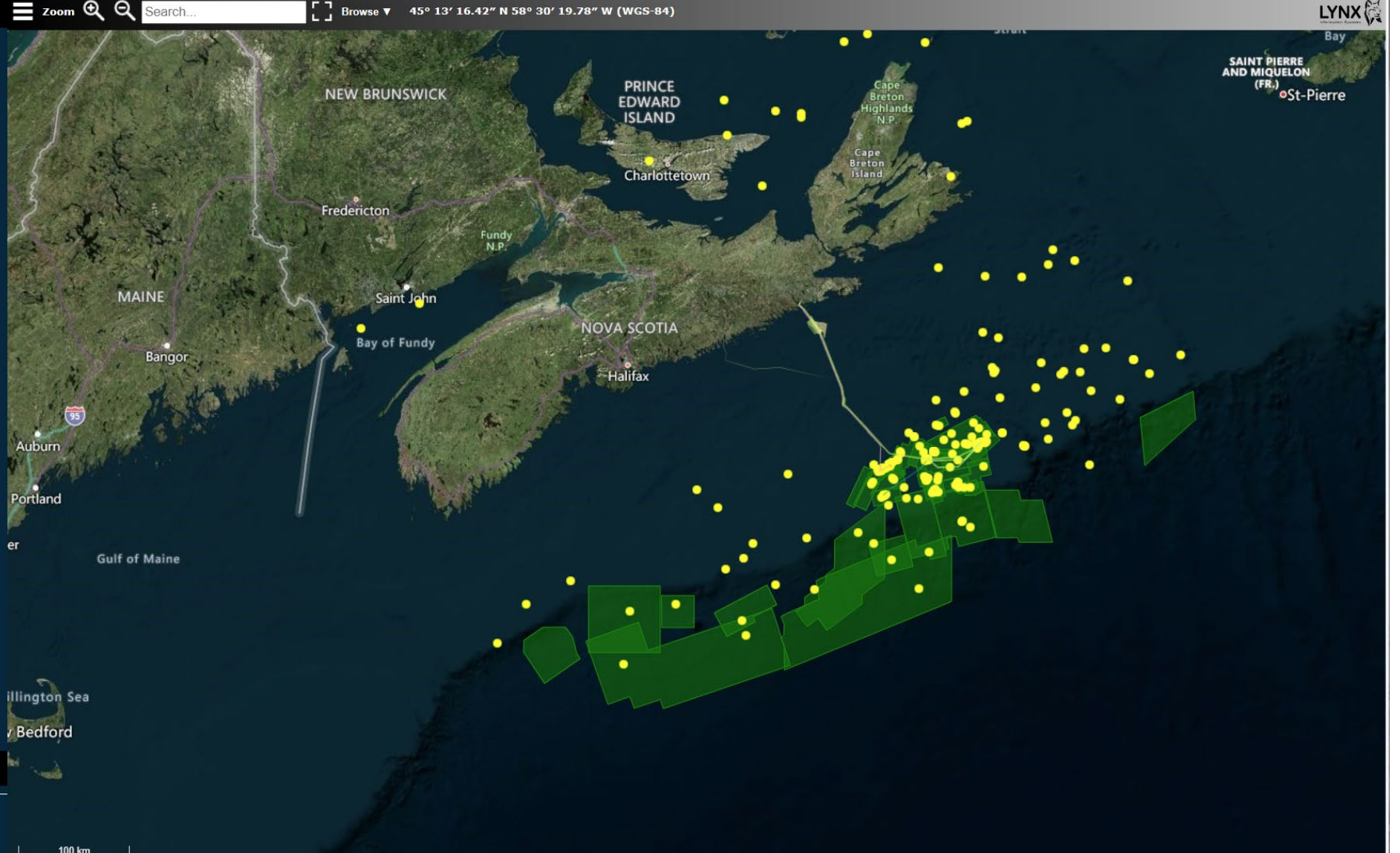
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LAYERS

- ☒ PIPELINE SURVEY REPORTS
  - ☒ Pipeline Survey Areas
    - 8645-M003-006E
    - NS26-E043-001E
    - NS26-L023-001E
    - NS26-M003-010E
    - NS26-M003-006E
- ☐ WELL/SITE/GEOTECHNICAL/SALLOW SEISMIC SURVEYS
  - ☐ Wellsite Survey Areas
- ☐ ENVIRONMENTAL SURVEY REPORTS
- ☒ BOREHOLE DATA, 2D & 3D SEISMIC PROGRAMS
  - ☒ Boreholes
  - ☐ 2D Seismic Programs
  - ☒ 3D Seismic Programs
- ☐ CULTURAL LAYERS
  - ☐ Oil pipeline
  - ☐ Call for Bids - NS22-1 Parcels
  - ☐ Exploration licences
  - ☐ Production licences
  - ☐ Nova Scotia jurisdictional boundaries
  - ☐ Saint Pierre and Miquelon jurisdictional boundary
  - ☐ Georges Bank Exclusion Zone
  - ☐ The Gully Marine Protected Area

BASEMAP





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## LAYERS

☒ PIPELINE SURVEY REPORTS

☒ Pipeline Survey Areas

8645-M003-006E

NS26-E043-001E

NS26-L023-001E

NS26-M003-010E

NS26-M003-006E

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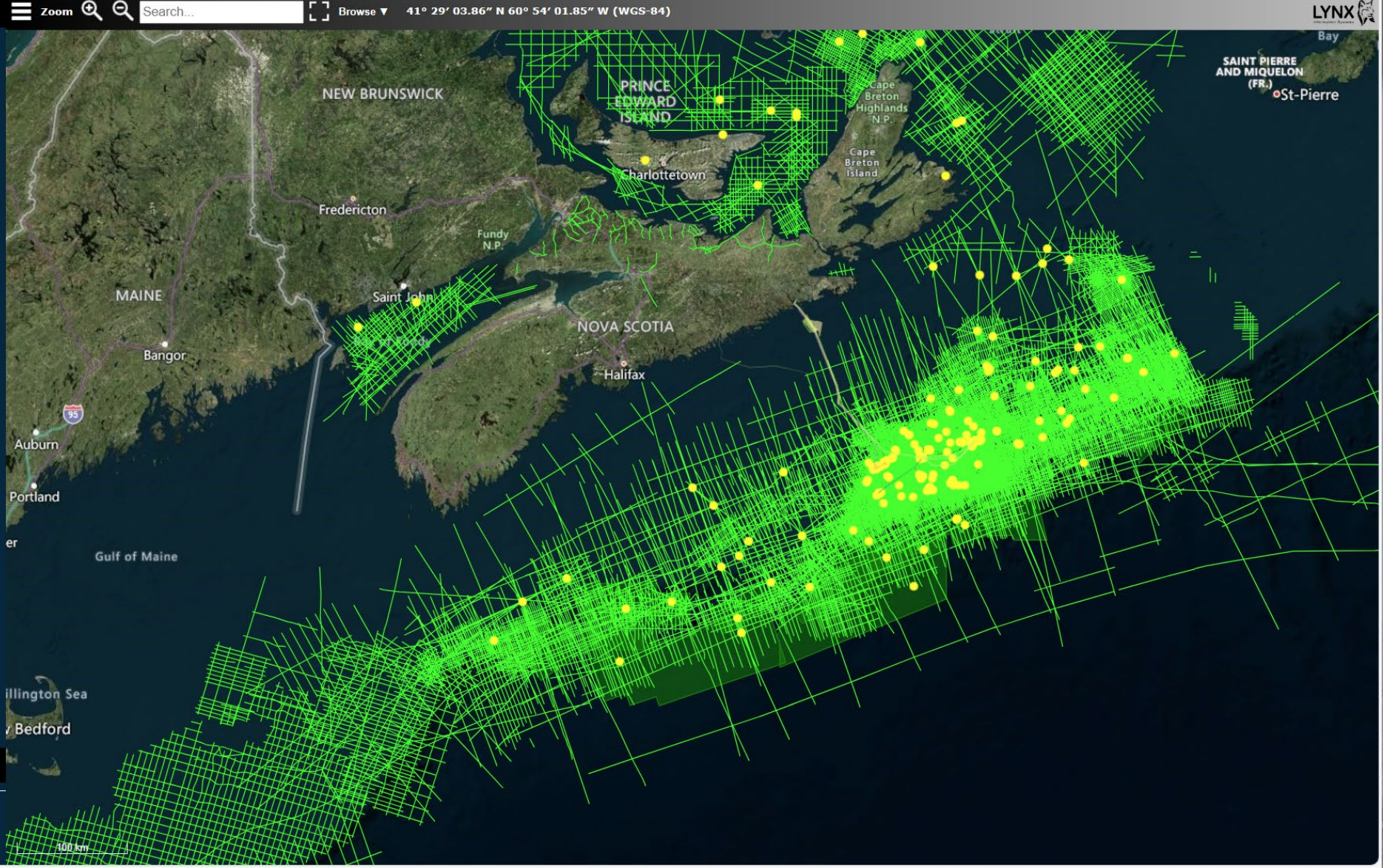
☐ The Gully Marine Protected Area

## BASEMAP

CNSOPB



CANADA-NOVA SCOTIA  
OFFSHORE PETROLEUM BOARD



LYNX

SAINT PIERRE  
AND MIQUELON  
(FR.)  
St-Pierre



LAYERS

☒ PIPELINE SURVEY REPORTS

☒ Pipeline Survey Areas

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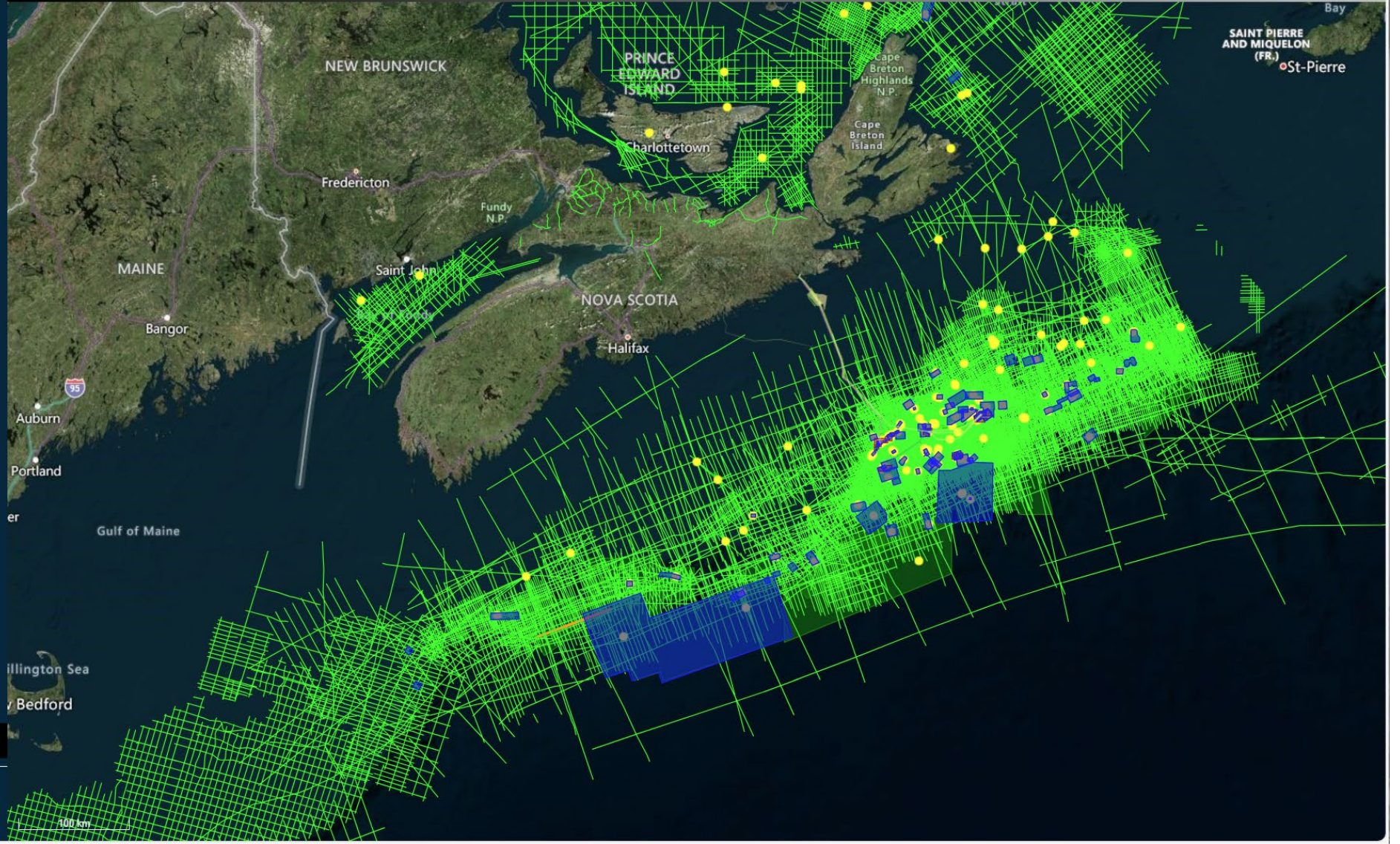
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BASEMAP

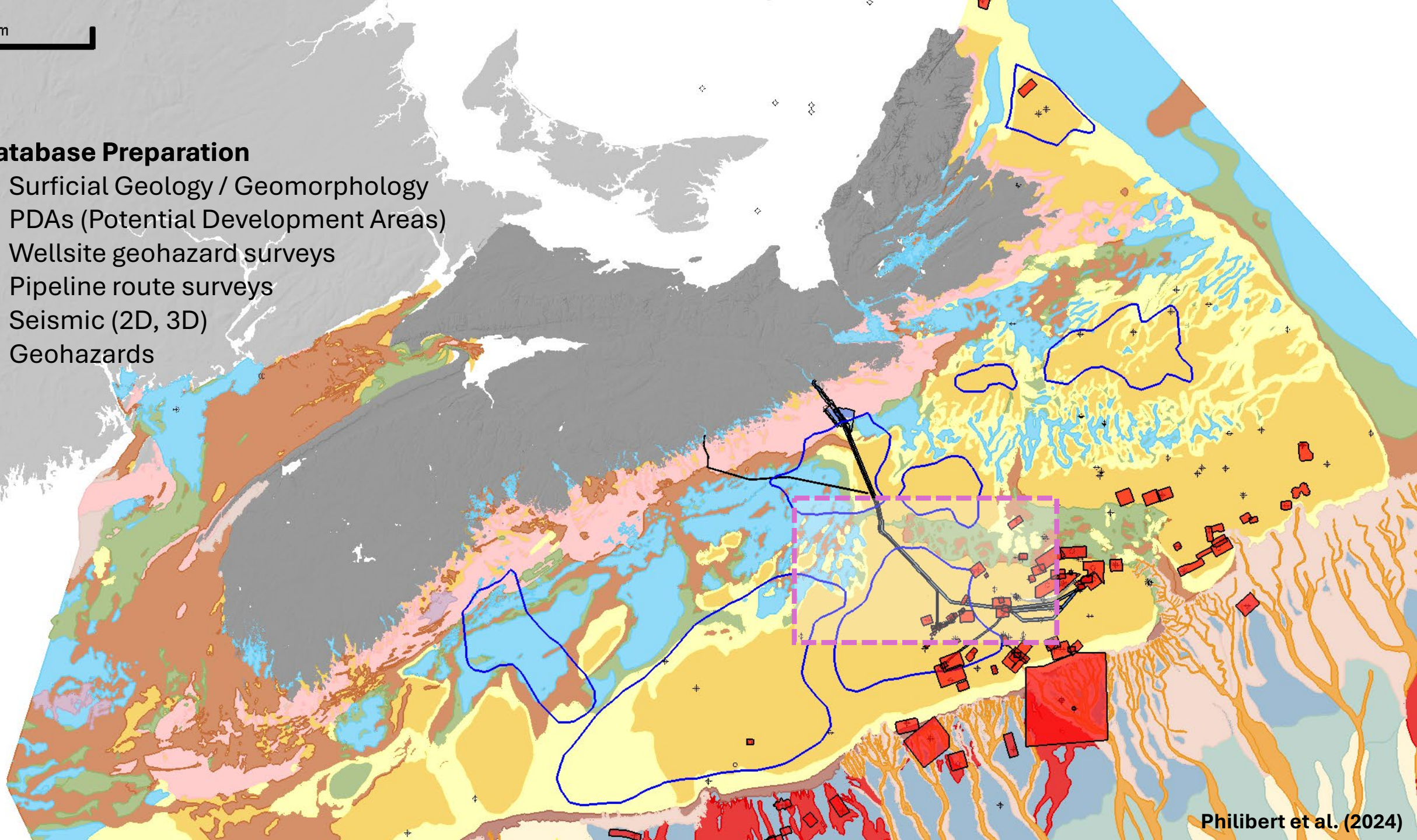




100000m

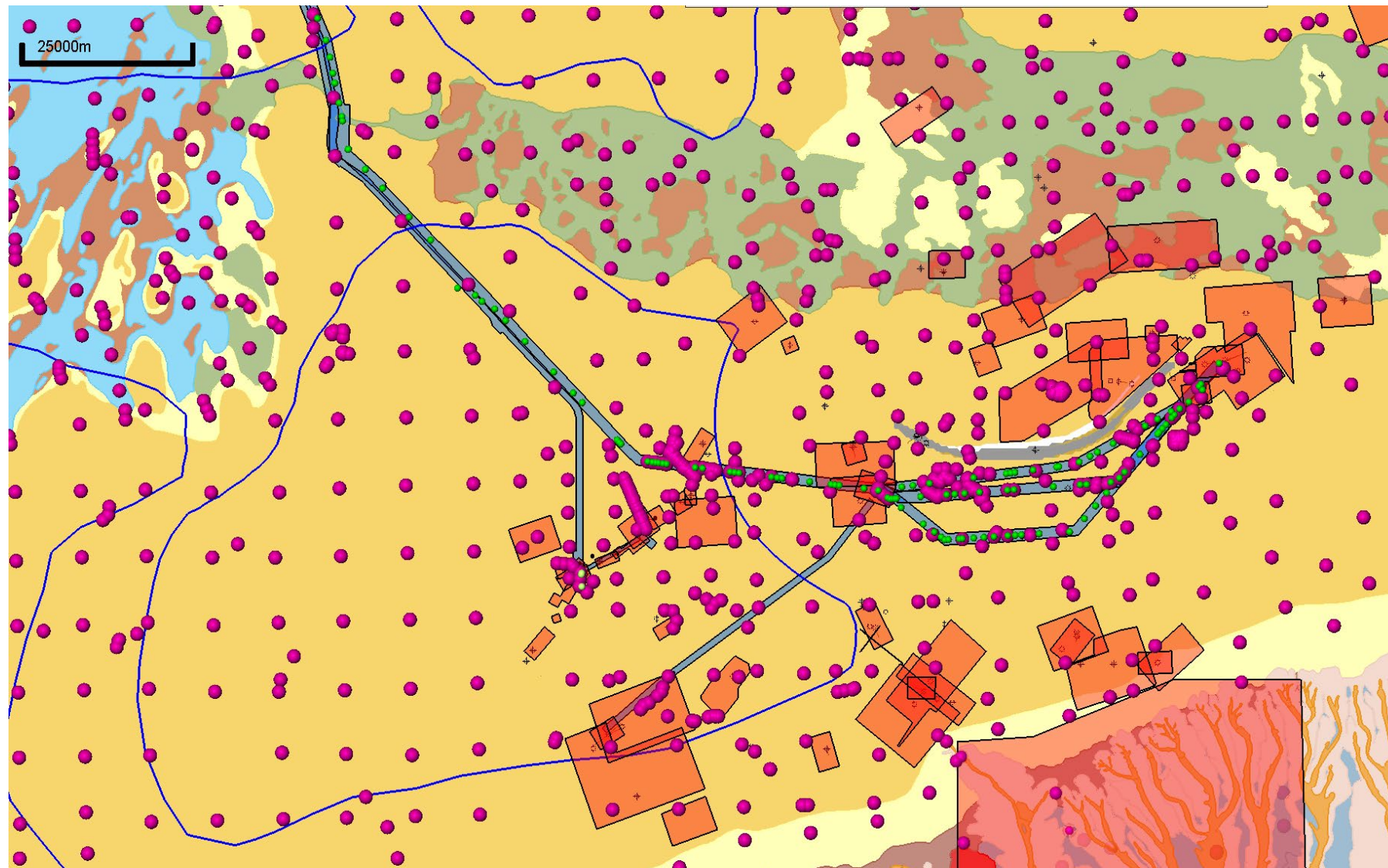
## Database Preparation

- Surficial Geology / Geomorphology
- PDAs (Potential Development Areas)
- Wellsite geohazard surveys
- Pipeline route surveys
- Seismic (2D, 3D)
- Geohazards



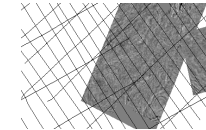


# Curated Petrel Project

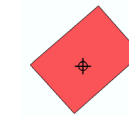


## GSC Geology

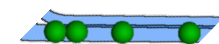
- 01 Converted sg\_bedrock
- 02 Converted sg\_glacial\_diamict
- 03 Converted sg\_glacial\_marine\_mud
- 04 Converted sg\_hemipelagic\_mud
- 05 Converted sg\_interbedded\_sand\_and\_mud
- 06 Converted sg\_interbedded\_silt\_and\_mud
- 07 Converted sg\_late\_glacial\_sublittoral\_sand
- 08 Converted sg\_mass\_transport\_deposit
- 09 Converted sg\_overconsolidated\_diamict
- 10 Converted sg\_overconsolidated\_mud\_to\_diamict
- 11 Converted sg\_post-glacial\_marine\_mud
- 12 Converted sg\_post-glacial\_sand\_and\_gravel
- 13 Converted sg\_pro-glacial\_sand
- 14 Converted sg\_pro-glacial\_sand\_and\_gravel
- 15 Converted sg\_undifferentiated\_bedrock\_or\_glacial\_diamict
- 16 Converted sg\_undifferentiated\_post-glacial\_sediments



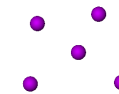
2D and 3D seismic



Wellsite surveys



Pipeline CPT Locations

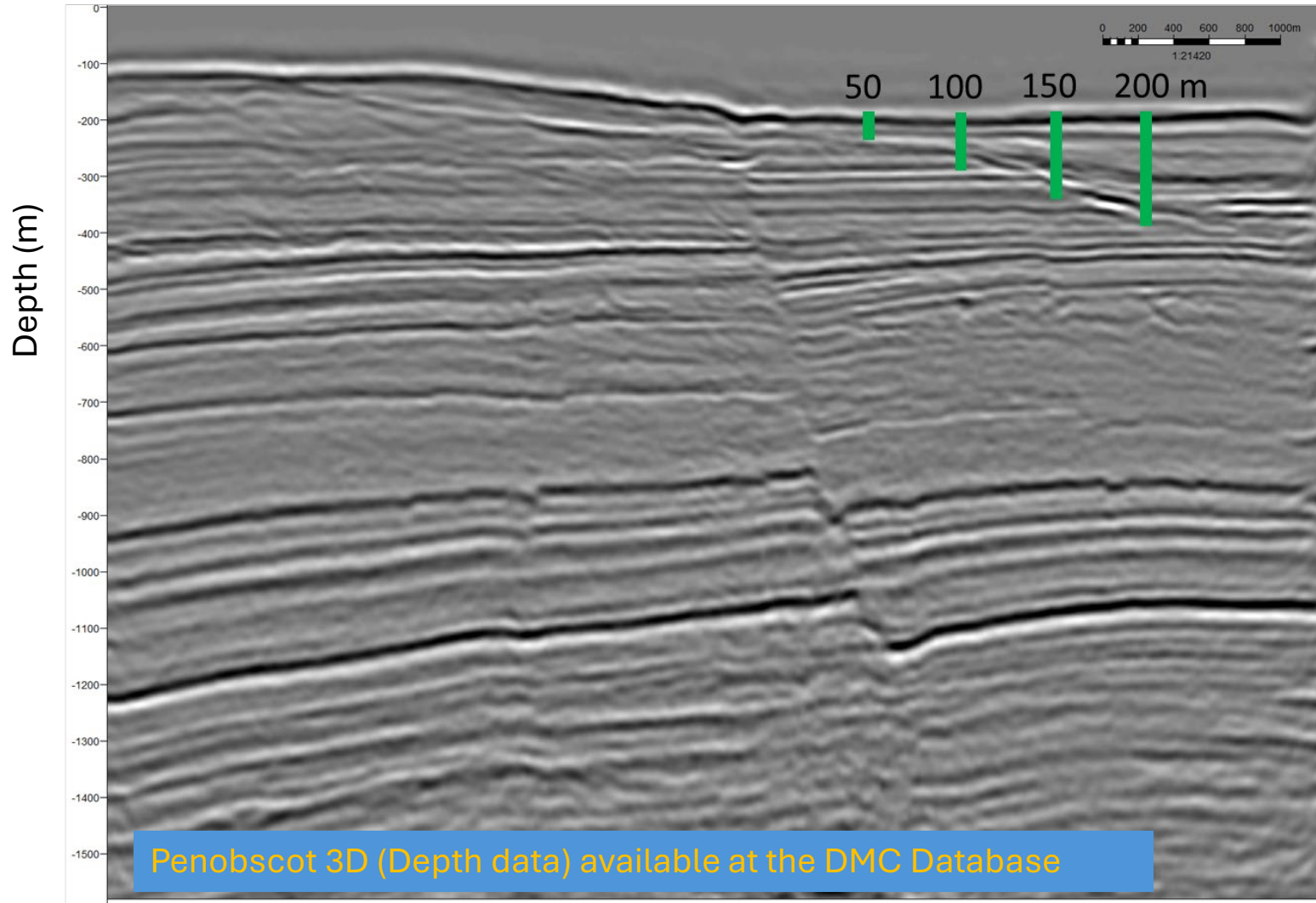


NRC Grain Size data



PDA outlines

# Legacy, conventional 3D seismic

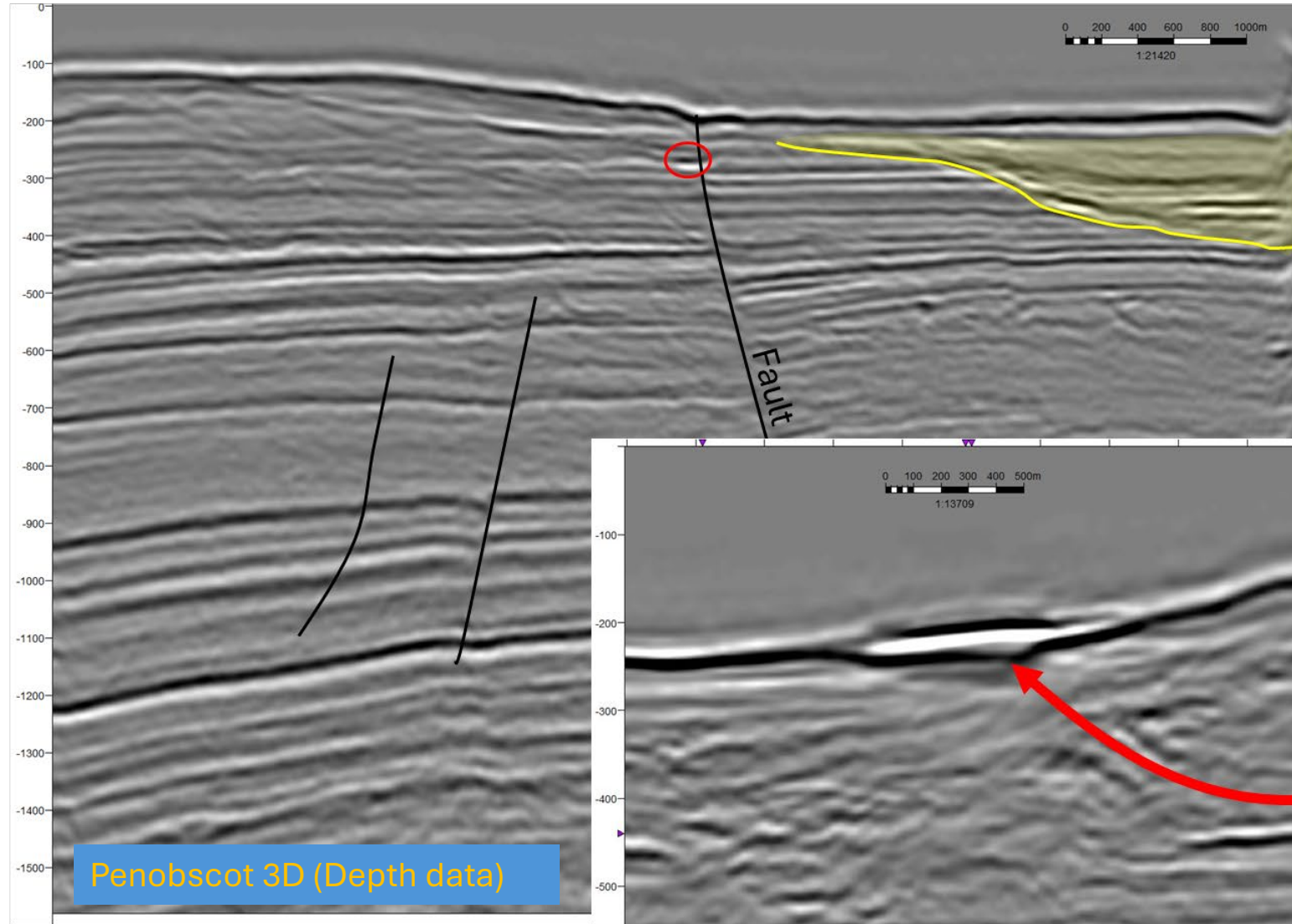


Legacy conventional seismic data provides imaging of the deeper subsurface that may enhance seabed and shallow geotechnical & geophysical interpretations/studies for the shallower 100-200 m

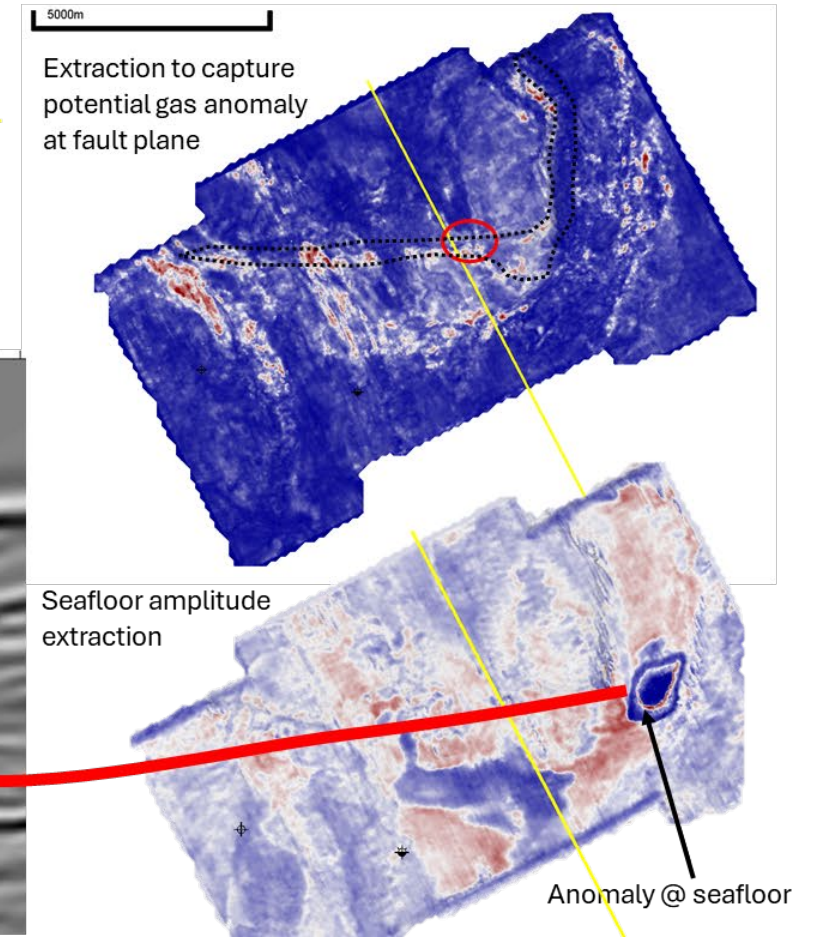


# Legacy, conventional 3D seismic

Depth  
(meters)

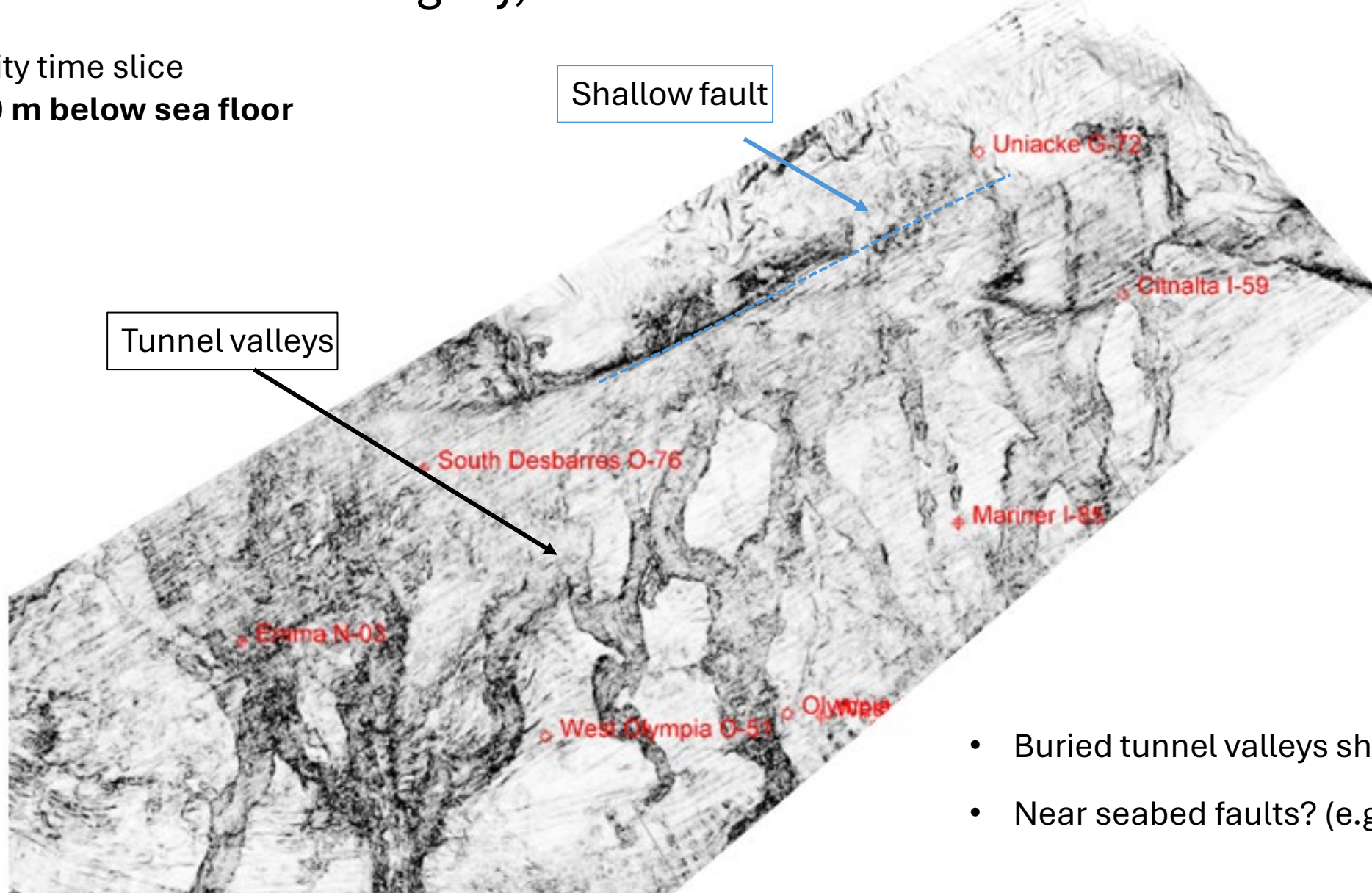


Our database of curated seismic data can be used to map near-surface faults, canyons, channels, shallow gas etc. and to create amplitude extractions to highlight shallow anomalies.



# Legacy, conventional 3D seismic

3D discontinuity time slice  
**220 ms  $\approx$  120 m below sea floor**

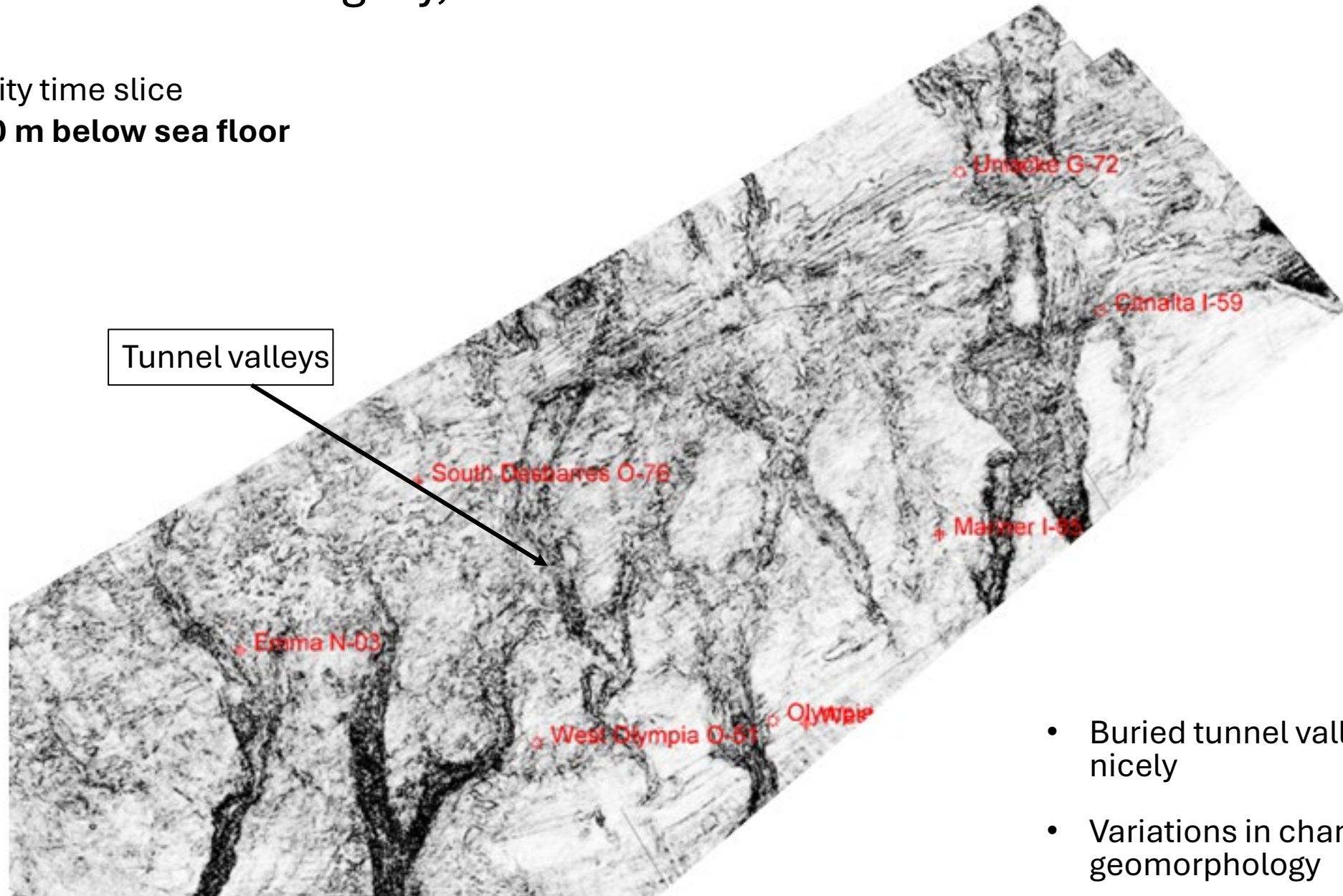


- Buried tunnel valleys show up nicely
- Near seabed faults? (e.g. near Citnalta)



# Legacy, conventional 3D seismic

3D discontinuity time slice  
**340 ms  $\approx$  370 m below sea floor**



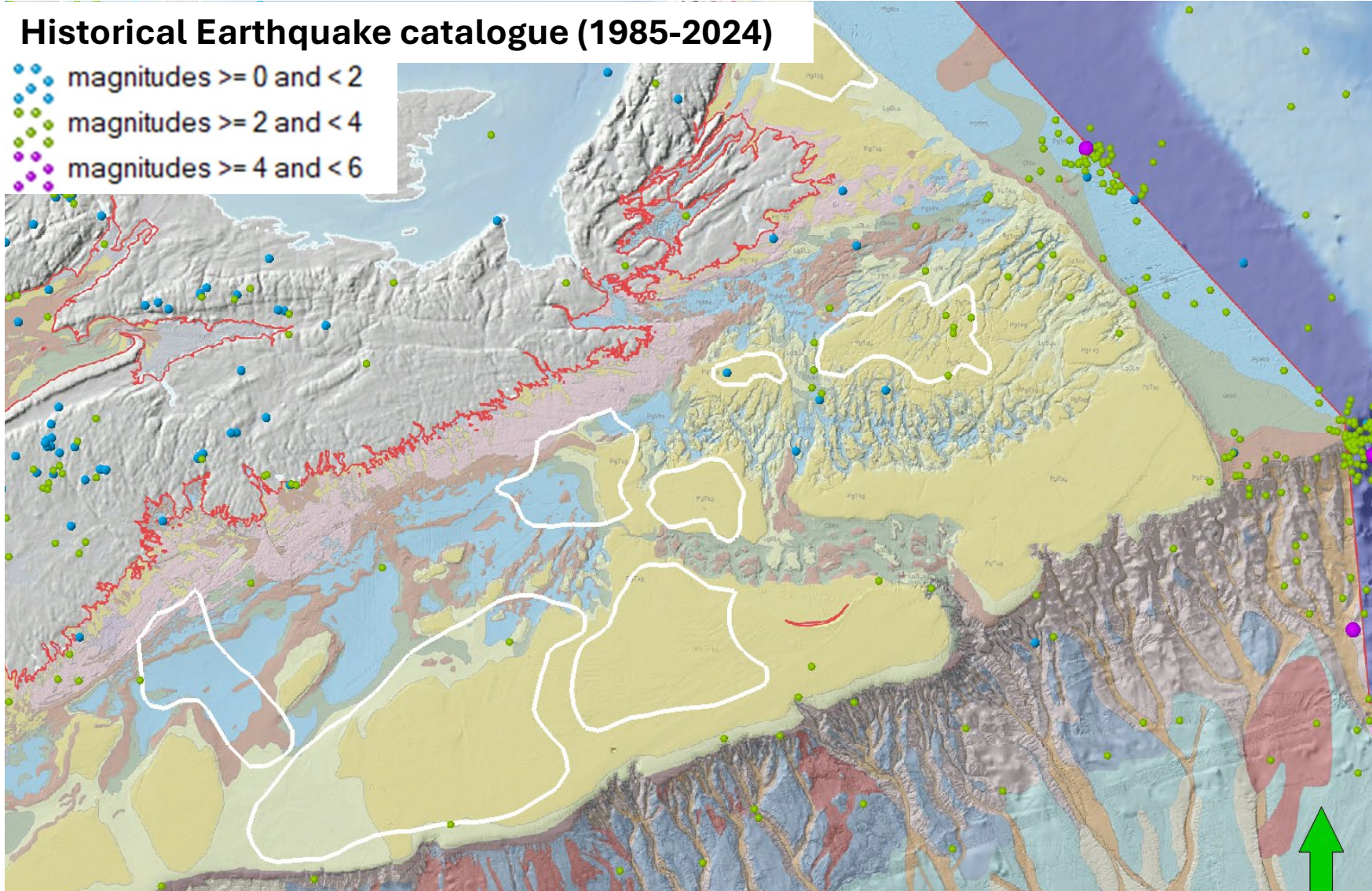
- Buried tunnel valleys show up nicely
- Variations in channel geomorphology



# Geohazards

## Historical Earthquake catalogue (1985-2024)

- magnitudes  $\geq 0$  and  $< 2$
- magnitudes  $\geq 2$  and  $< 4$
- magnitudes  $\geq 4$  and  $< 6$



## Also available

**Submarine cables (active / inactive)**

**Waste-disposal sites**

**Military exercise zones**

## In progress

Predicted earthquake rates

Global maps of storm at fixed return periods of 10/20/50 years

Maps of historical lightning strikes



# Grain size distribution by fraction

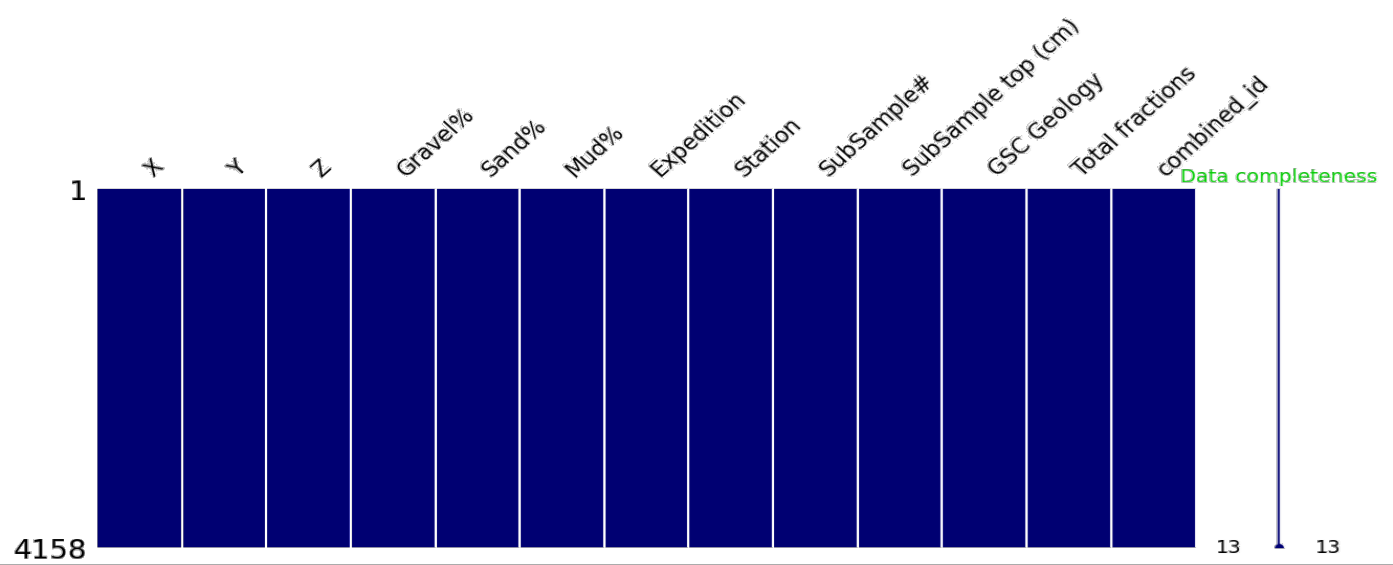
Tidy Data table (Wickman, 2014) derived from the Expedition Database Grain Size Analyses, Geological Survey of Canada

	X	Y	Z	Expedition	Station	SubSample#	SubSample top (cm)	combined_id	Total fractions	GSC Geology	Fraction	Percentage
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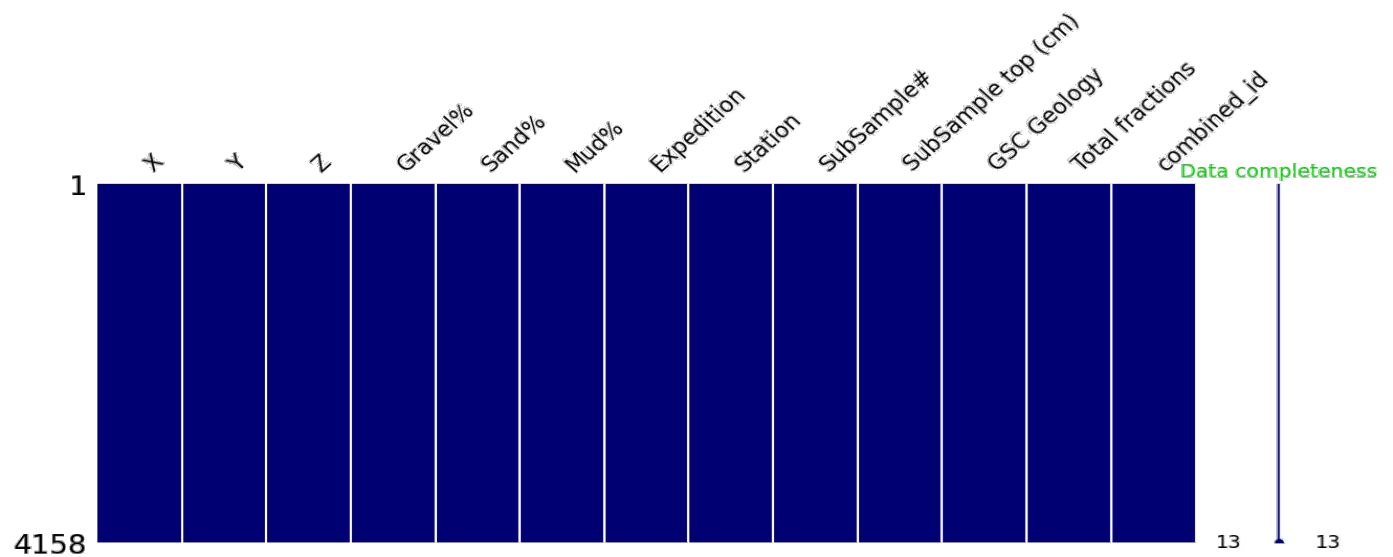


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Pac-man chart distribution

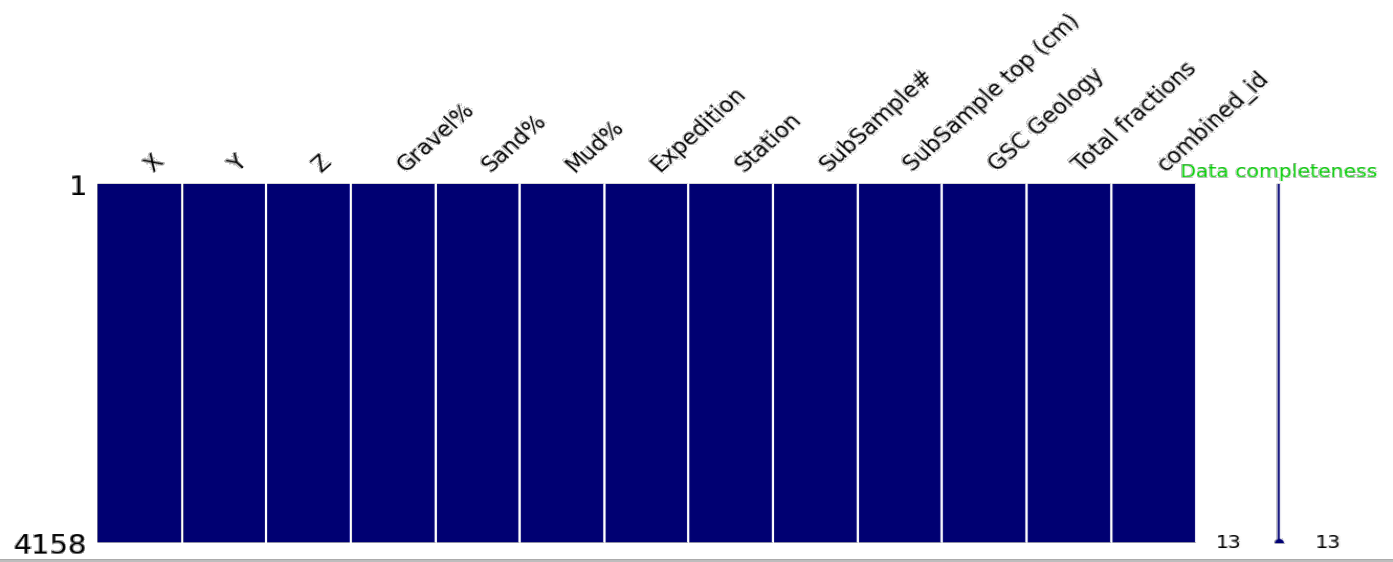
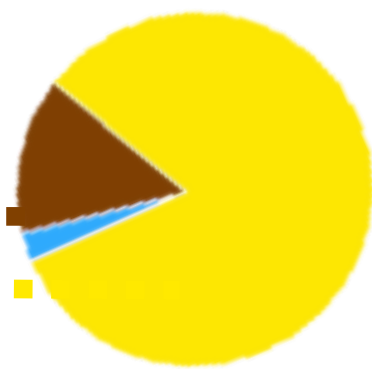


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Pac-man chart distribution



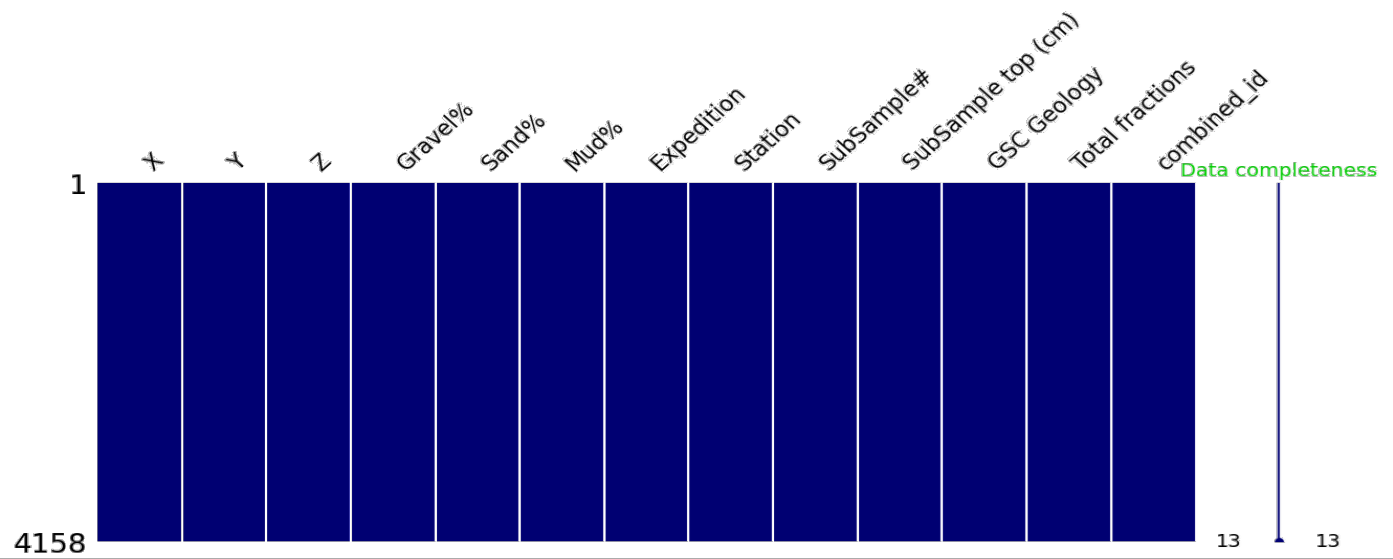
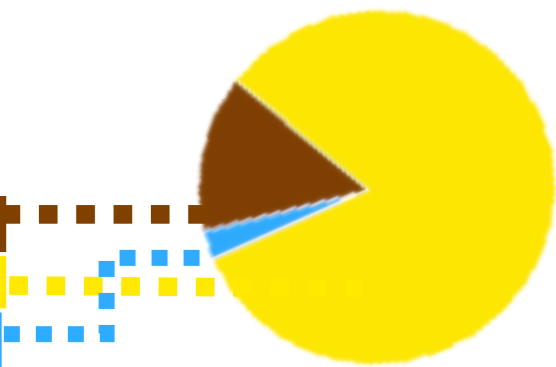


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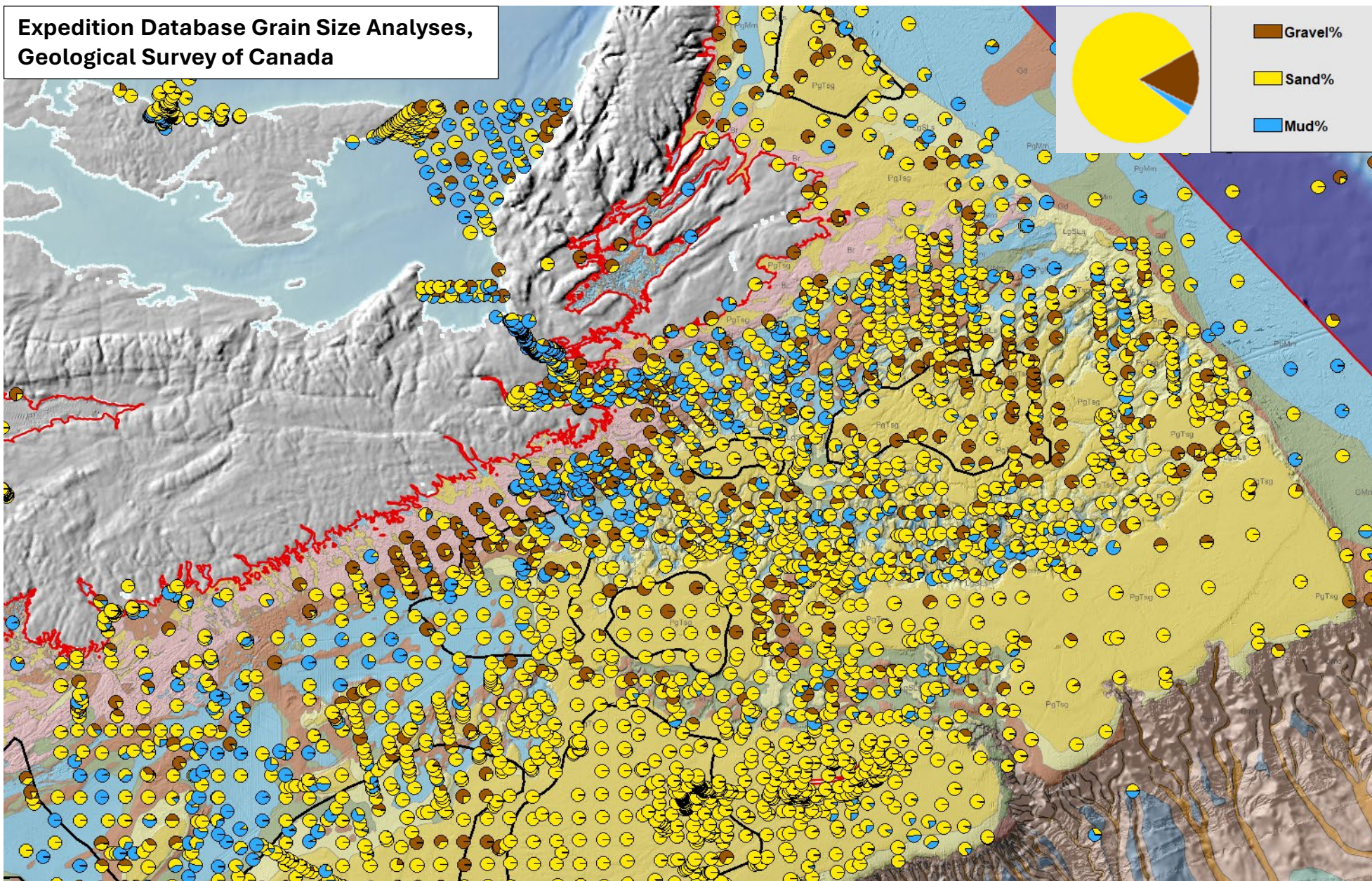
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Pac-man chart distribution





# Grain size distribution by fraction

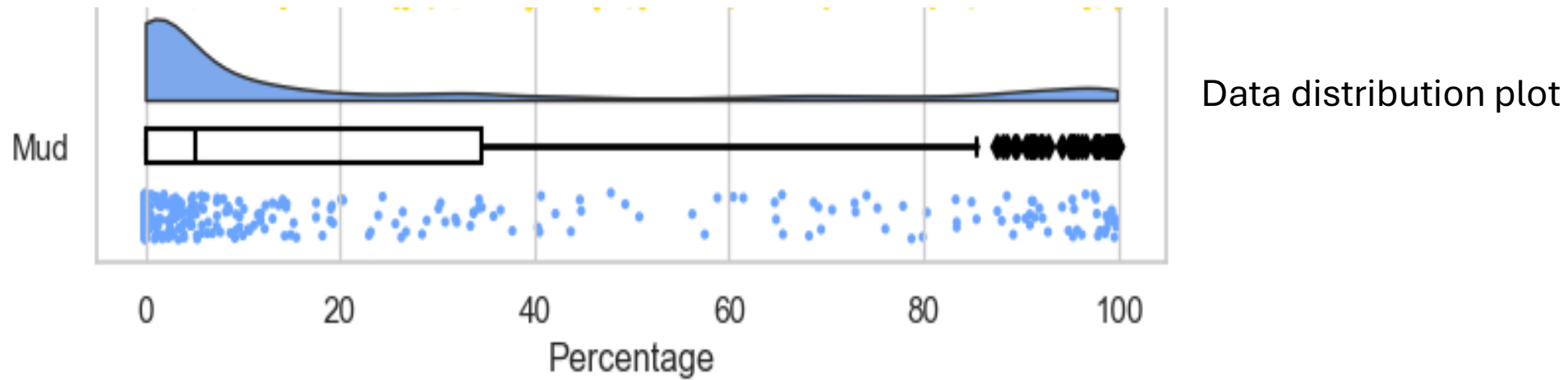


The overall pattern of Pac-man charts agrees with the coarse distribution of geologic units as mapped

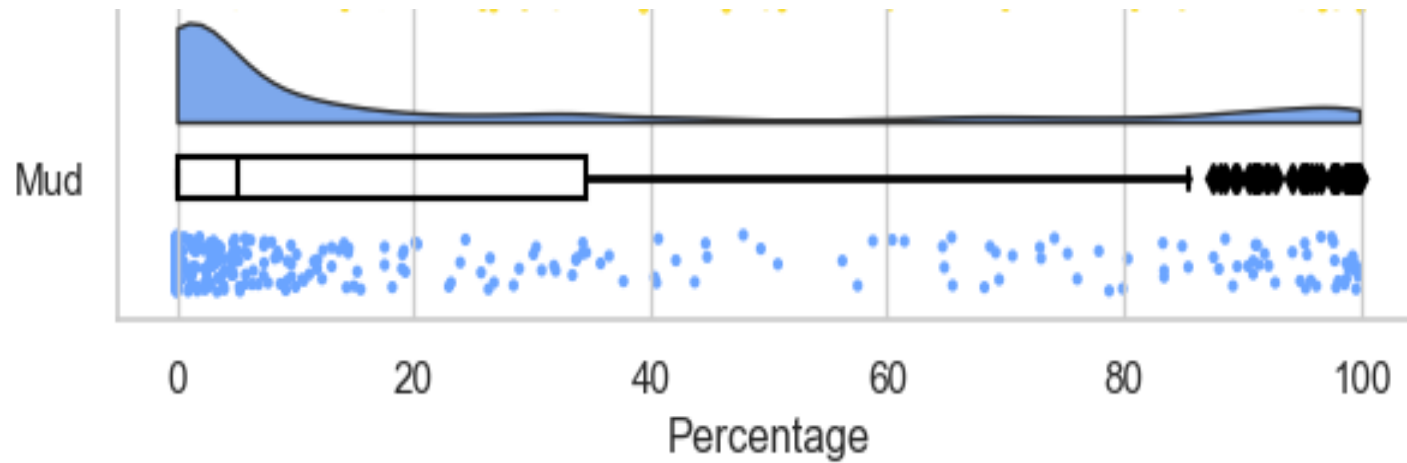
Additionally showing some variability within individual geologic unit



# Statistics of grain size fractions by GSC geologic unit



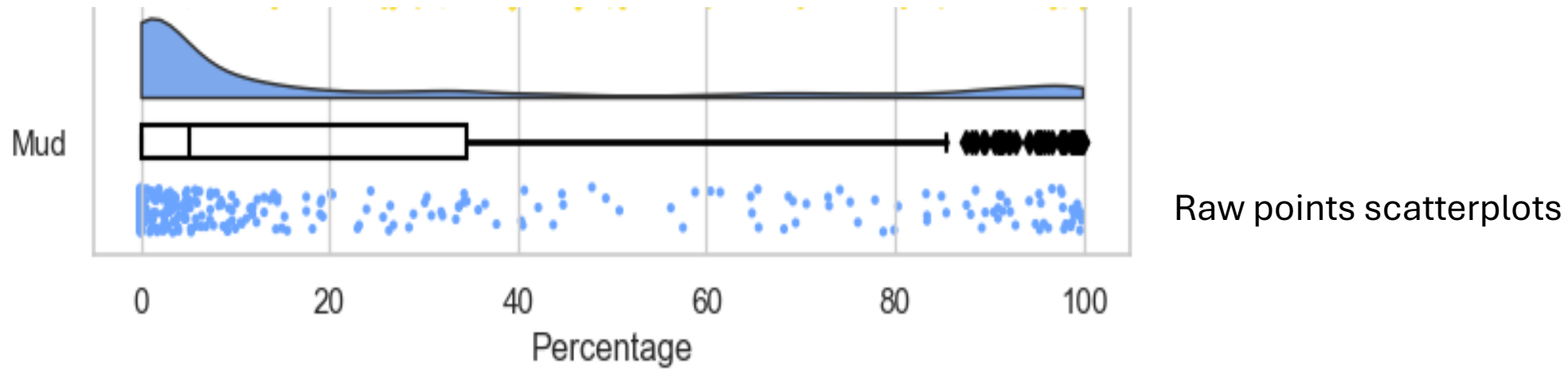
# Statistics of grain size fractions by GSC geologic unit



Box plot with median, quartiles and outliers

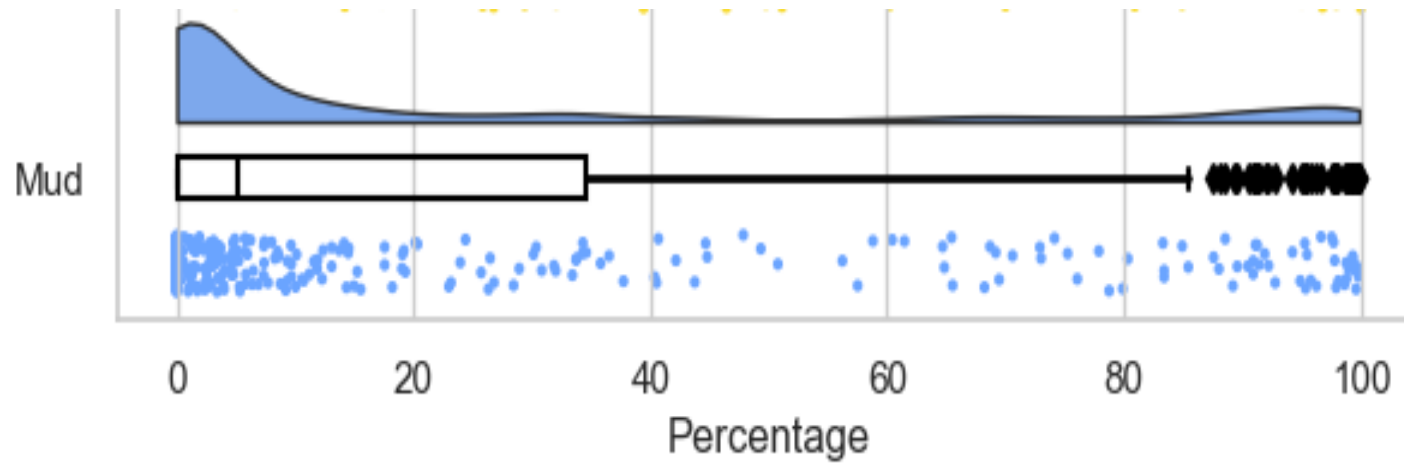


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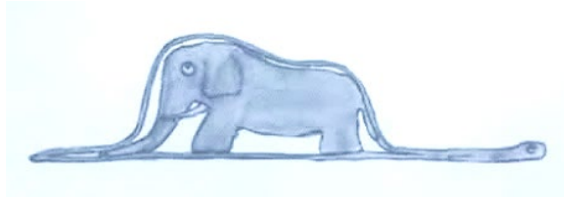
# Statistics of grain size fractions by GSC geologic unit

“Cloud and rain” plot

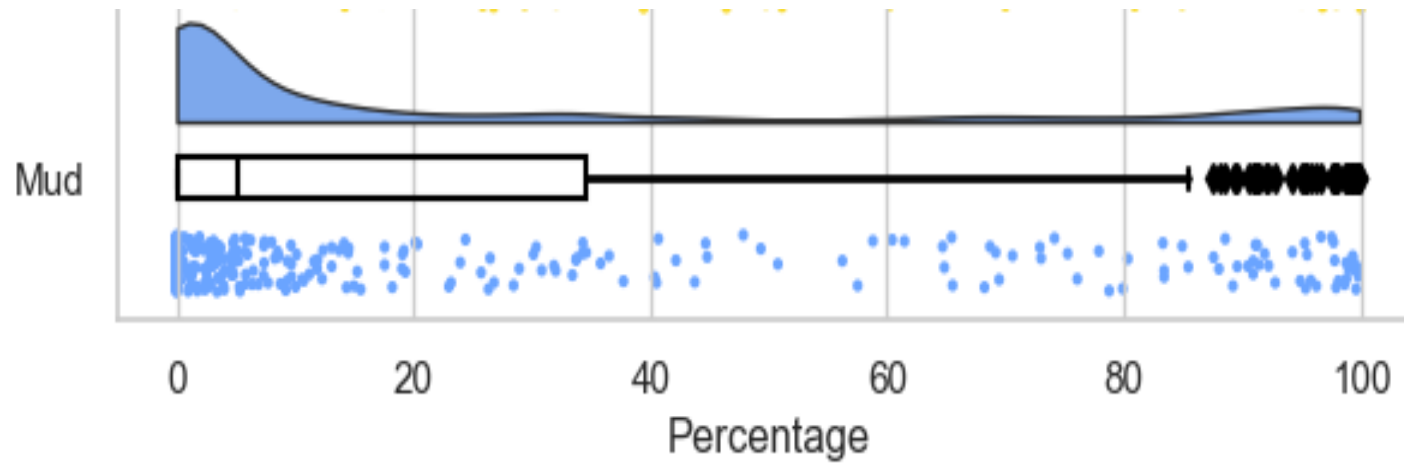




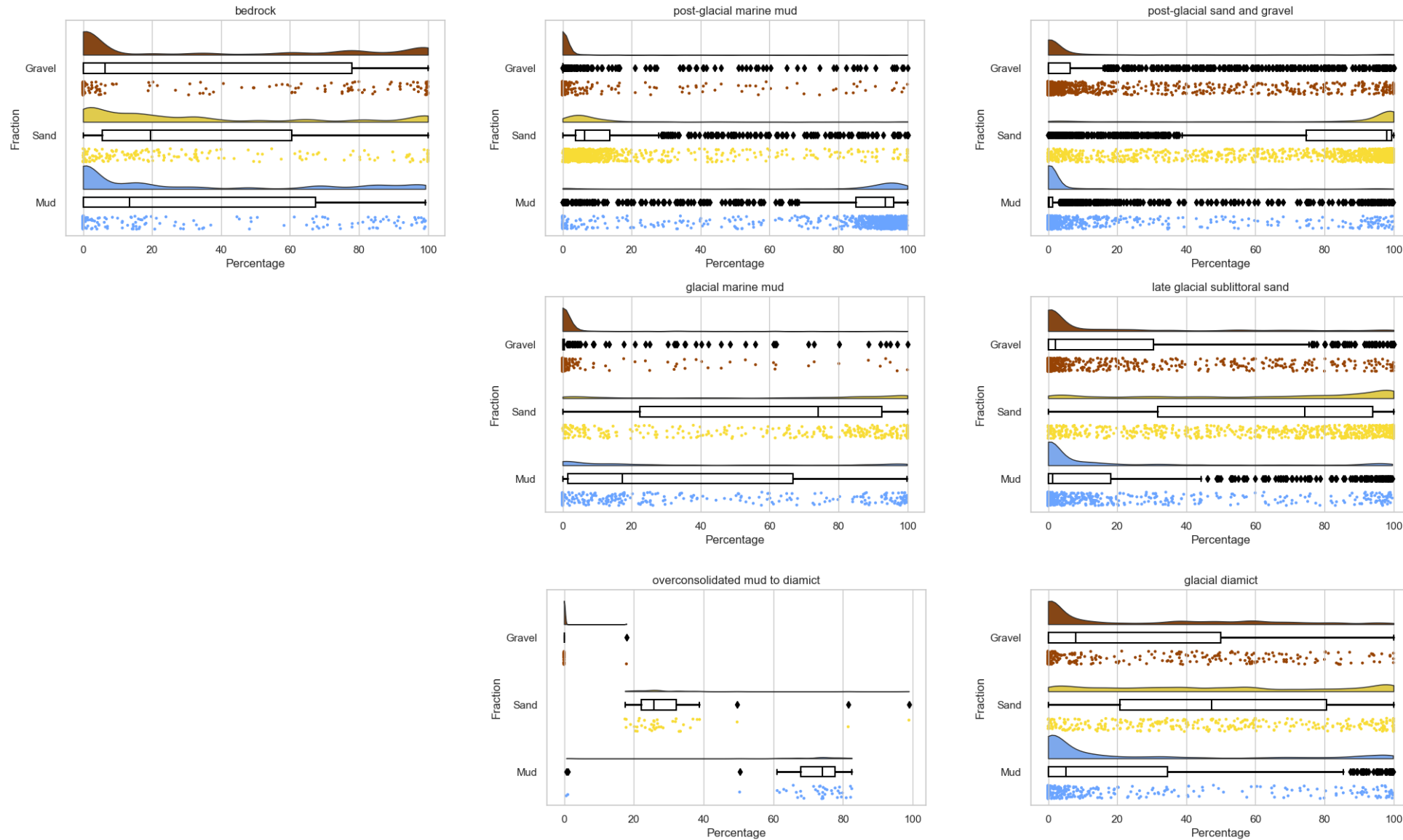
# Statistics of grain size fractions by GSC geologic unit



“Petite Prince” plot



# Statistics of grain size fractions by GSC geologic unit



General observation:

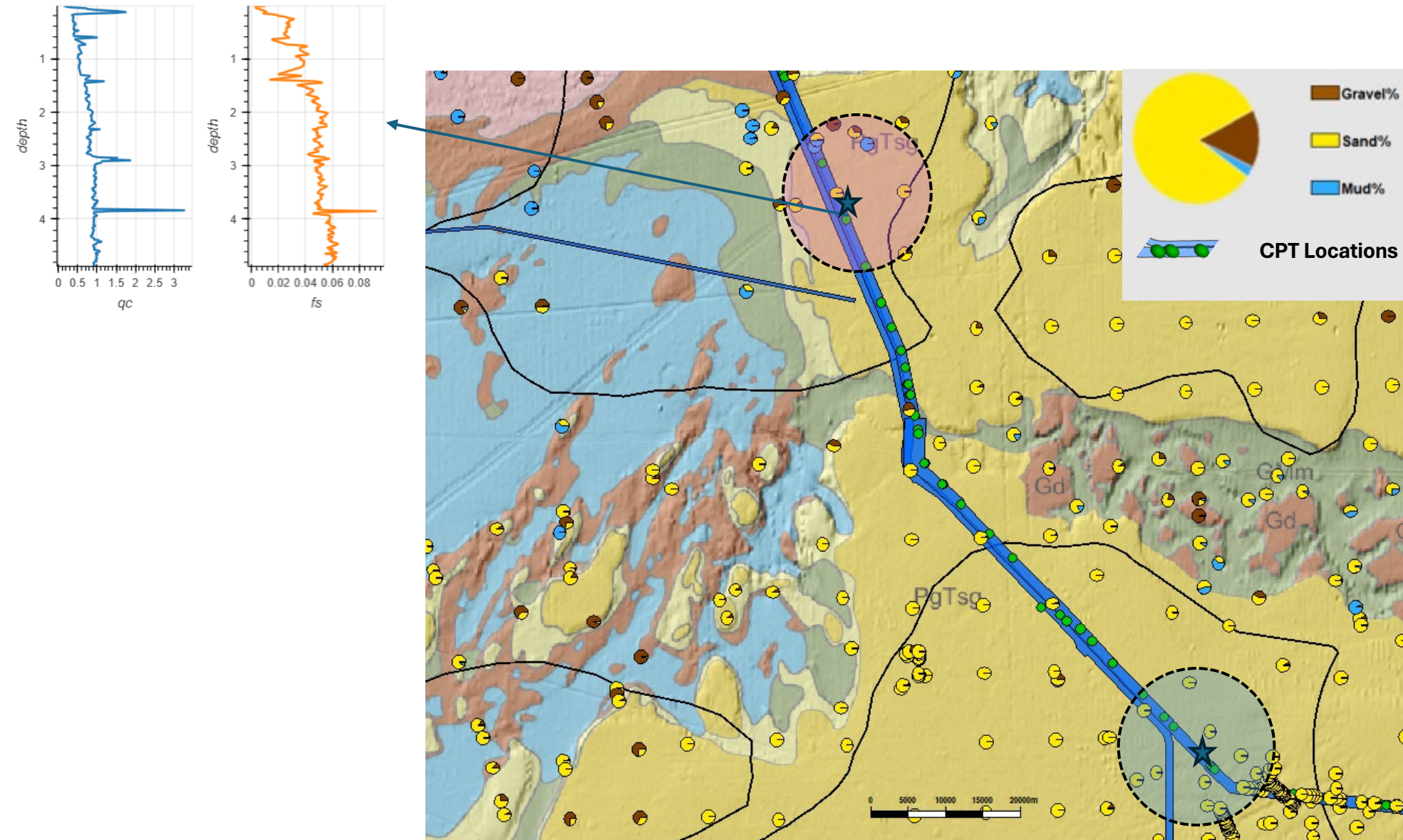
Good distinction of the fractions' distribution between certain geologic formations, but also some overlaps



# Joint visualization of Grain size and CPT

Note on units:

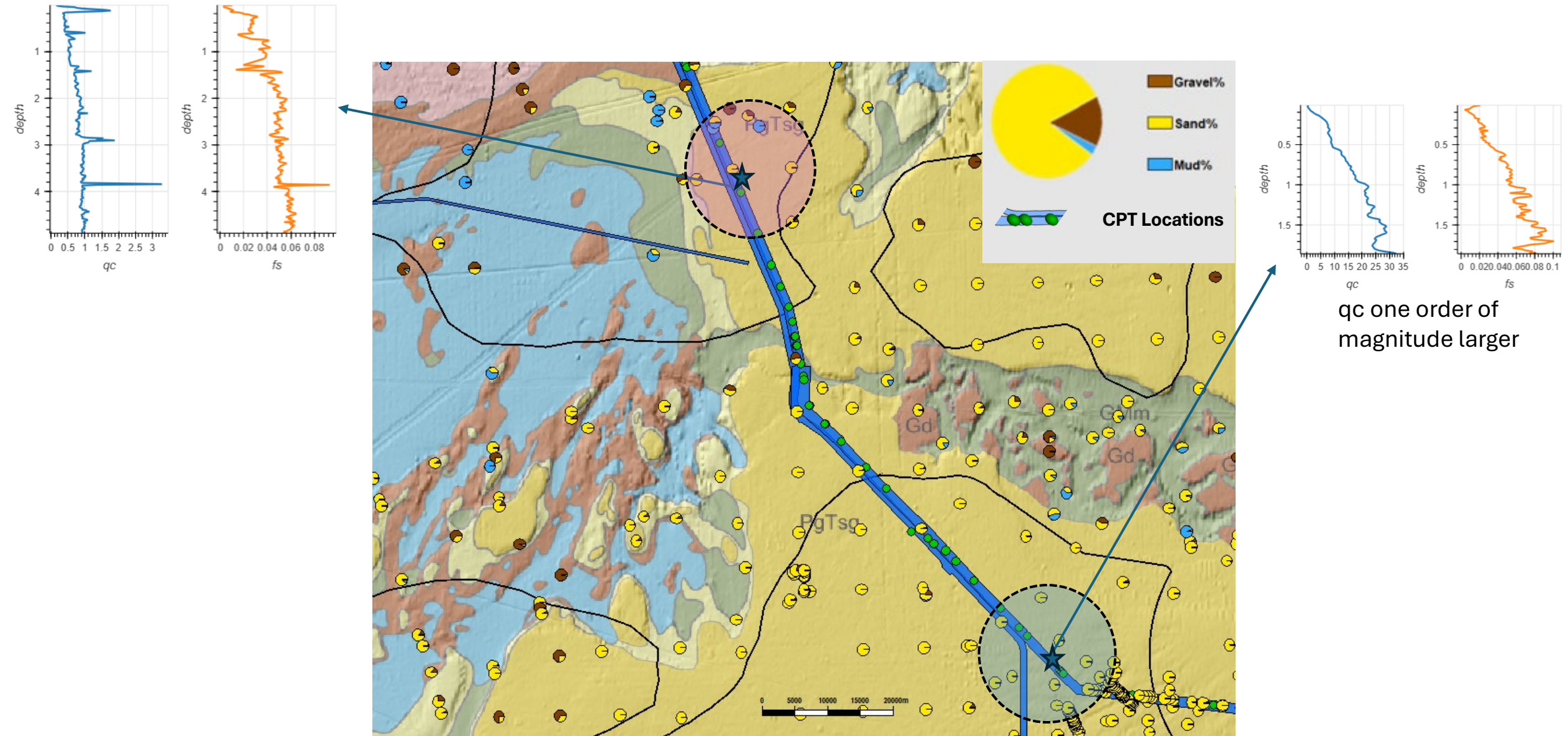
- Depths in meters below sea bottom;
- Cone resistance and Sleeve Friction in MPa



# Joint visualization of Grain size and CPT

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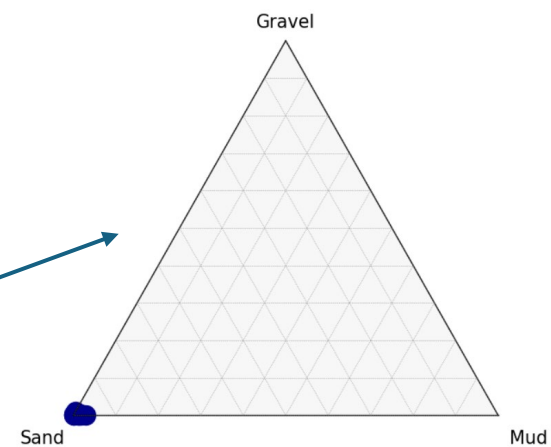
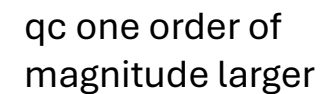
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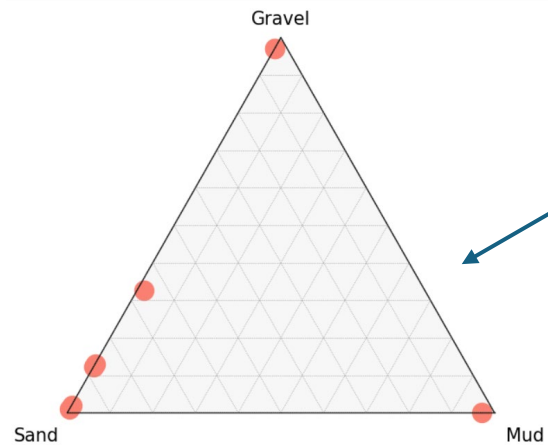
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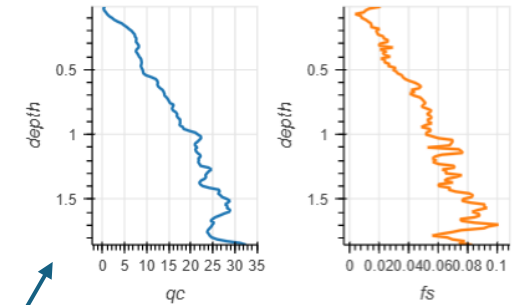
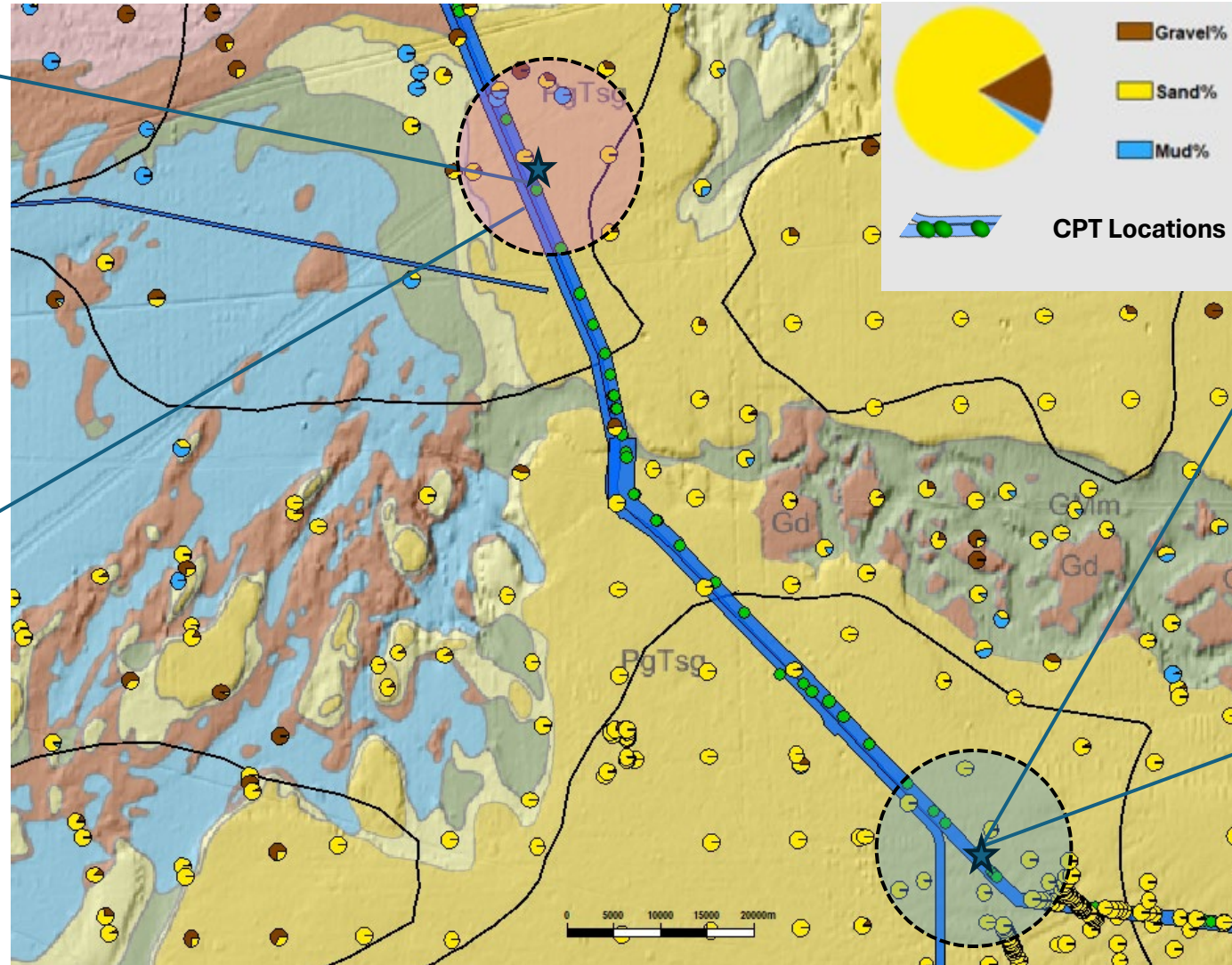


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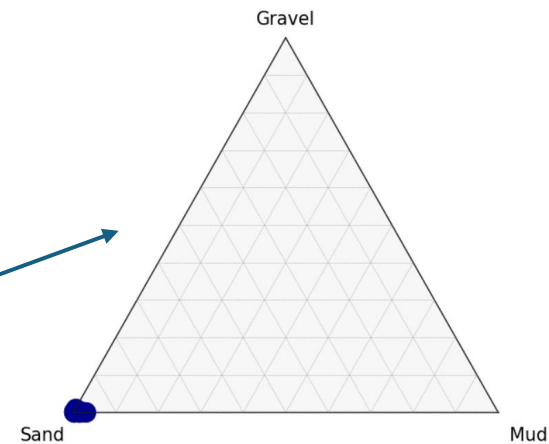
- 
- Figure 1 consists of two side-by-side plots. The left plot shows the distribution of  $qc$  (x-axis, 0 to 3) across depths (y-axis, 1 to 4). The right plot shows the distribution of  $fs$  (x-axis, 0 to 0.08) across depths (y-axis, 1 to 4). Both plots show a sharp increase in the variable value at depth 4.



Larger heterogeneity of  
sample fraction proportions  
at more local spatial scale



qc one order of  
magnitude larger

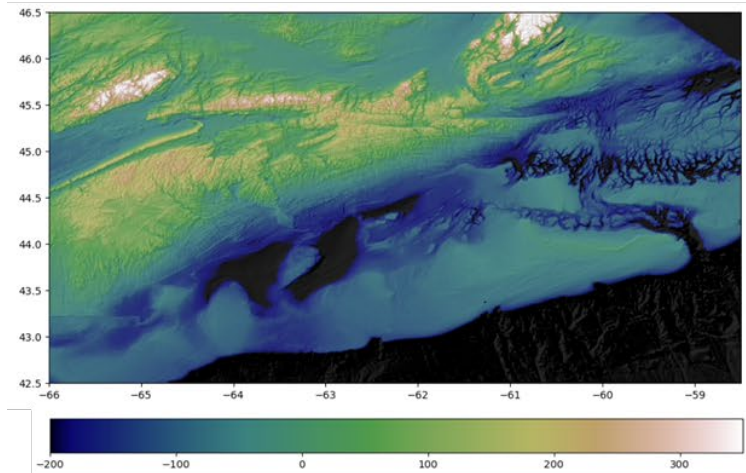




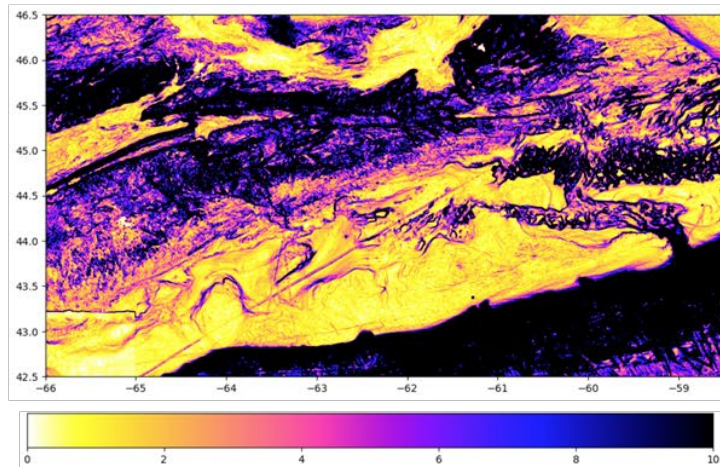
# Other work in progress

Bathymetry-bases geomorphometric analysis aiming at [geodiversity classification](#) and mapping

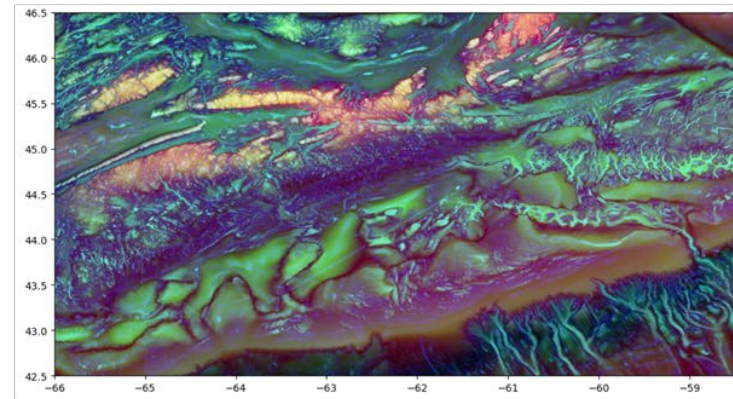
DEM raw input - with multidirectional hill-shade



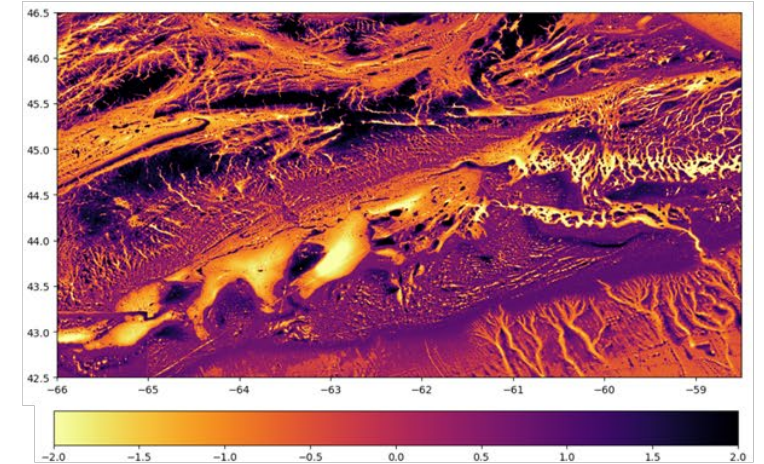
Ruggedness index (Riley et al.)



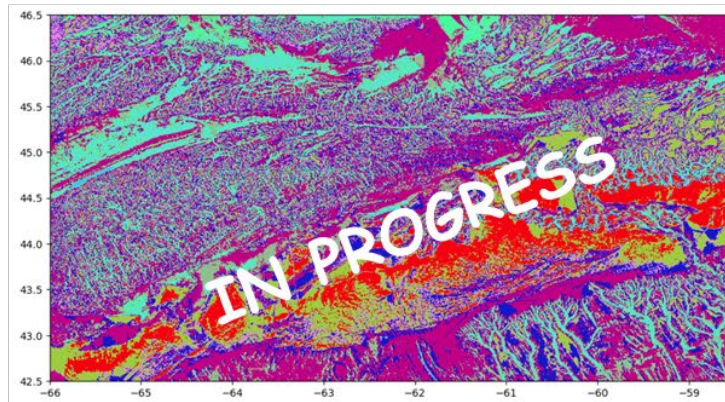
Multiscale topographic position (Lindsay et al.)



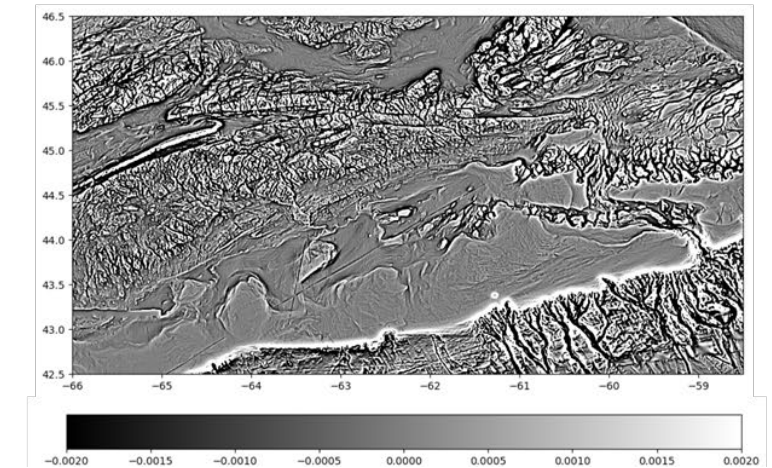
Multiscale deviation from mean elevation (Lindsay et al.)



Geomorphons (Jasiewicz and Stepinski)



Multiscale curvatures (Max, Min, etc. - Florinsky)



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