



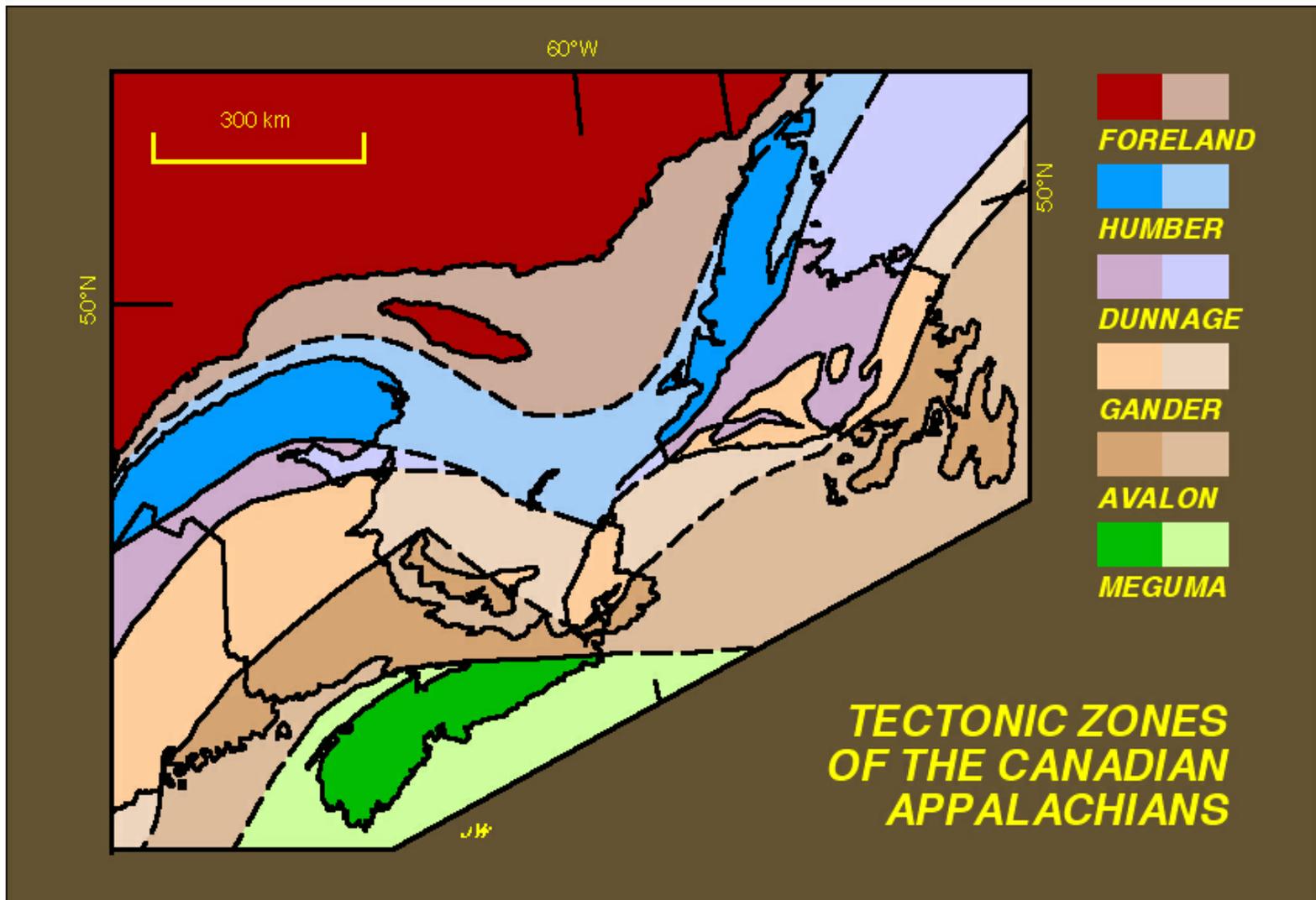
Structure and Deformation History of the Appalachian Thrust Front in the Parsons Pond and Port au Port Areas, Western Newfoundland: Implications for Petroleum Exploration

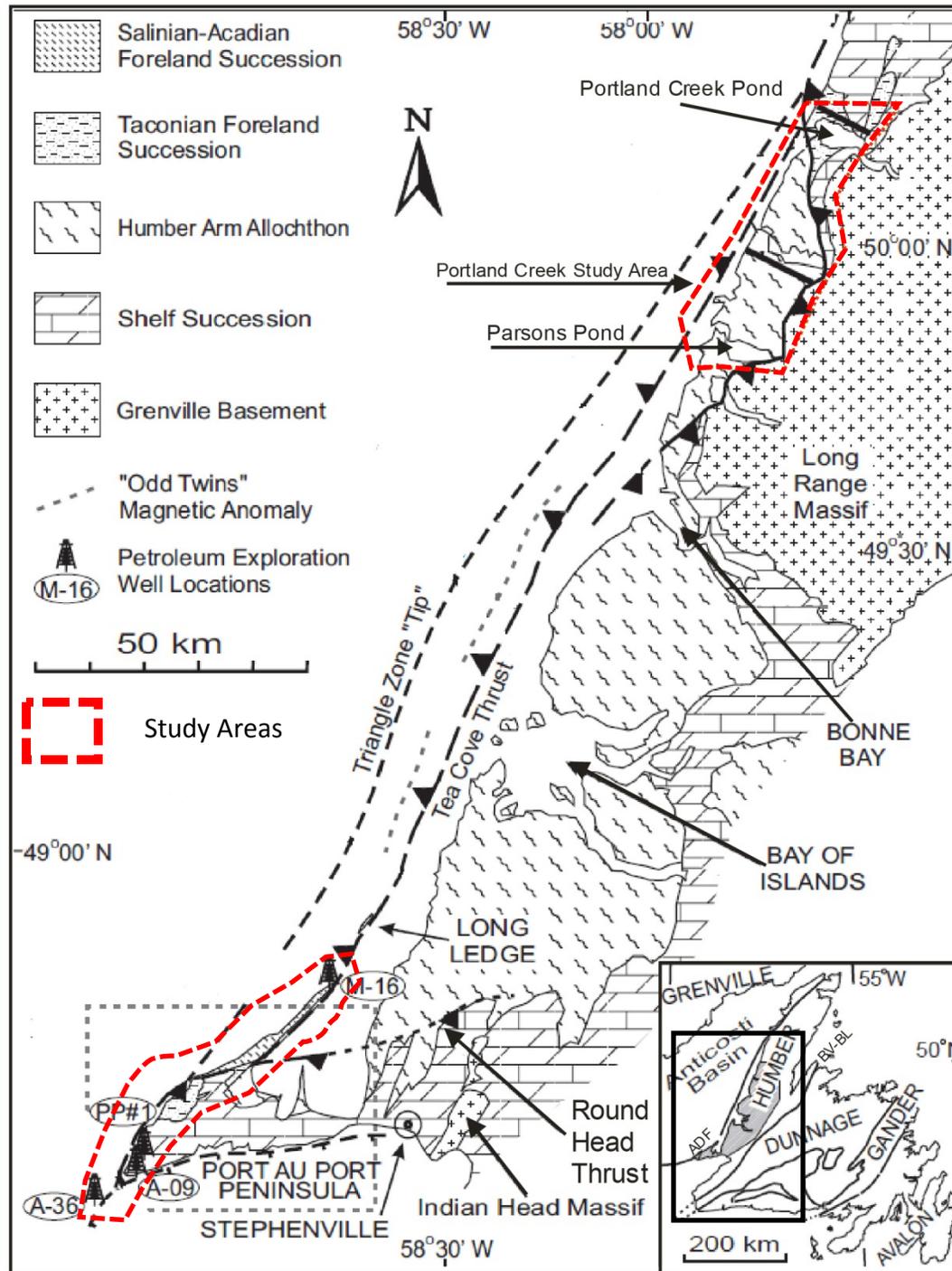


Shawna White, John Waldron
Department of Earth and
Atmospheric Sciences,
University of Alberta

Petroleum Exploration-Enhancement Program

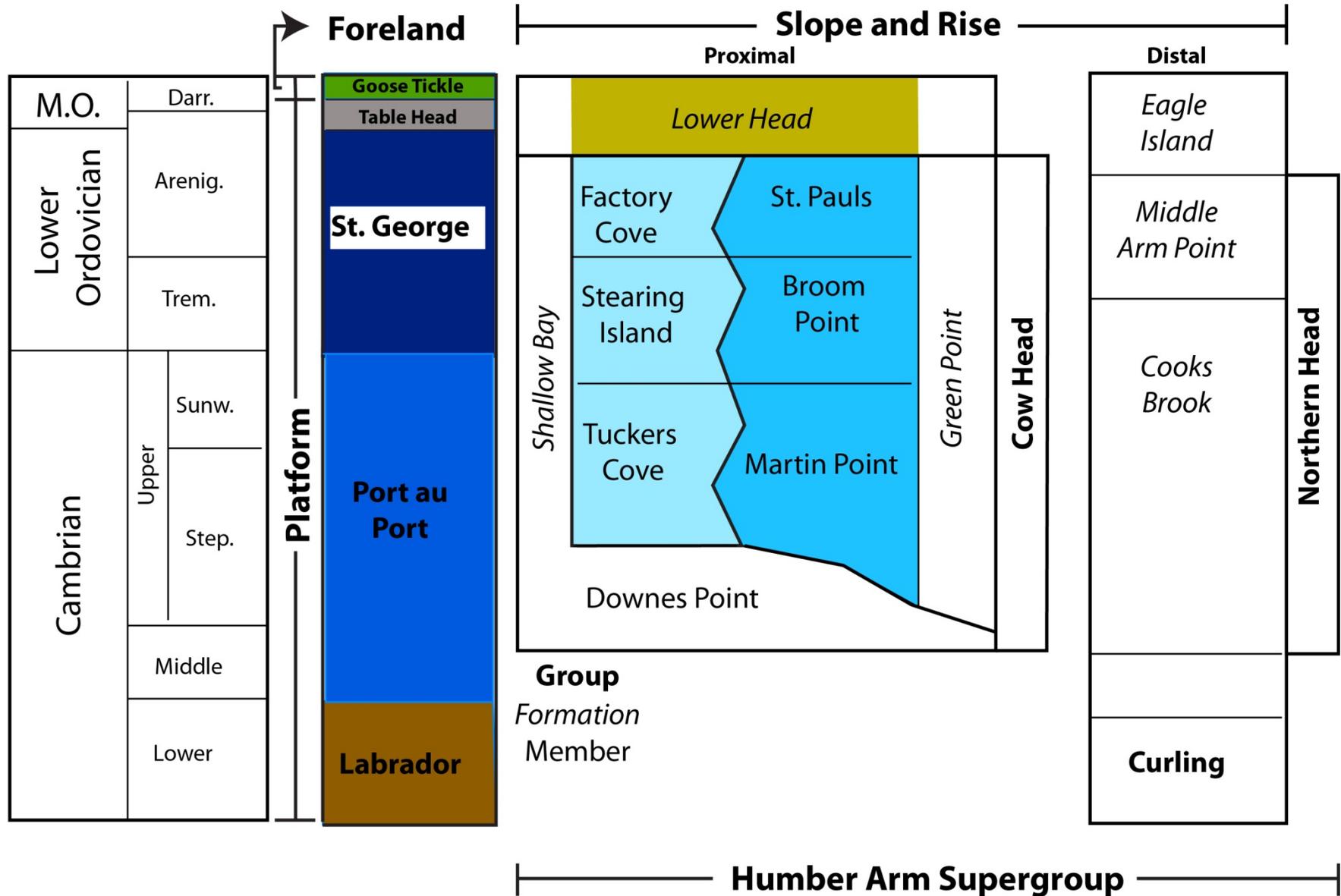
Tectonostratigraphic Zones: Canadian Appalachians



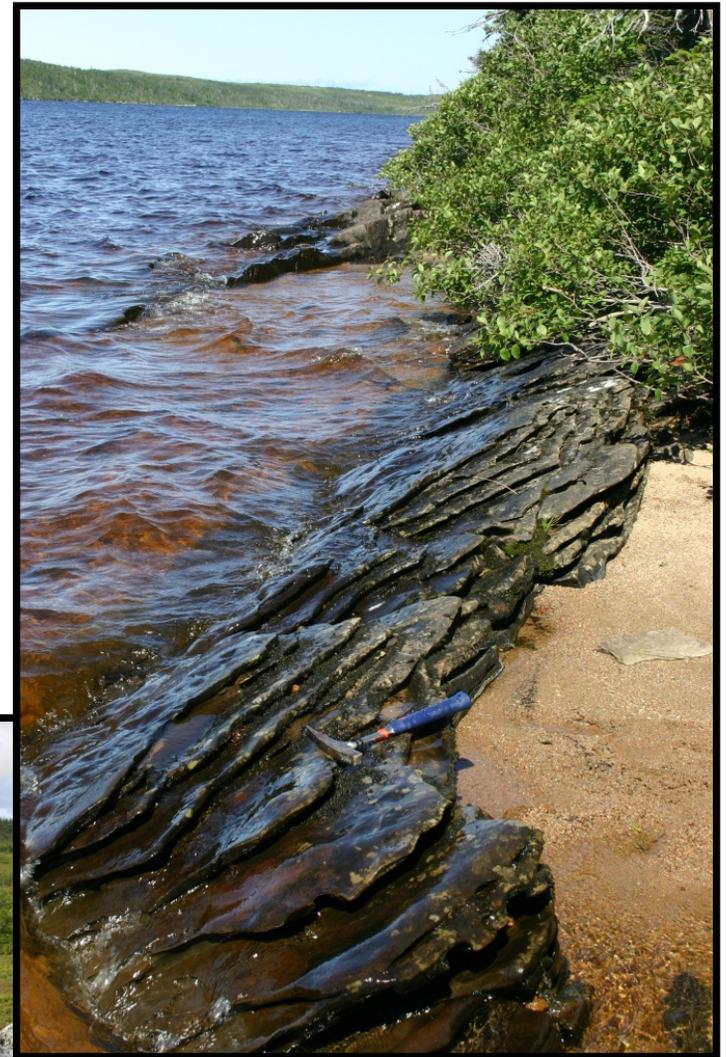
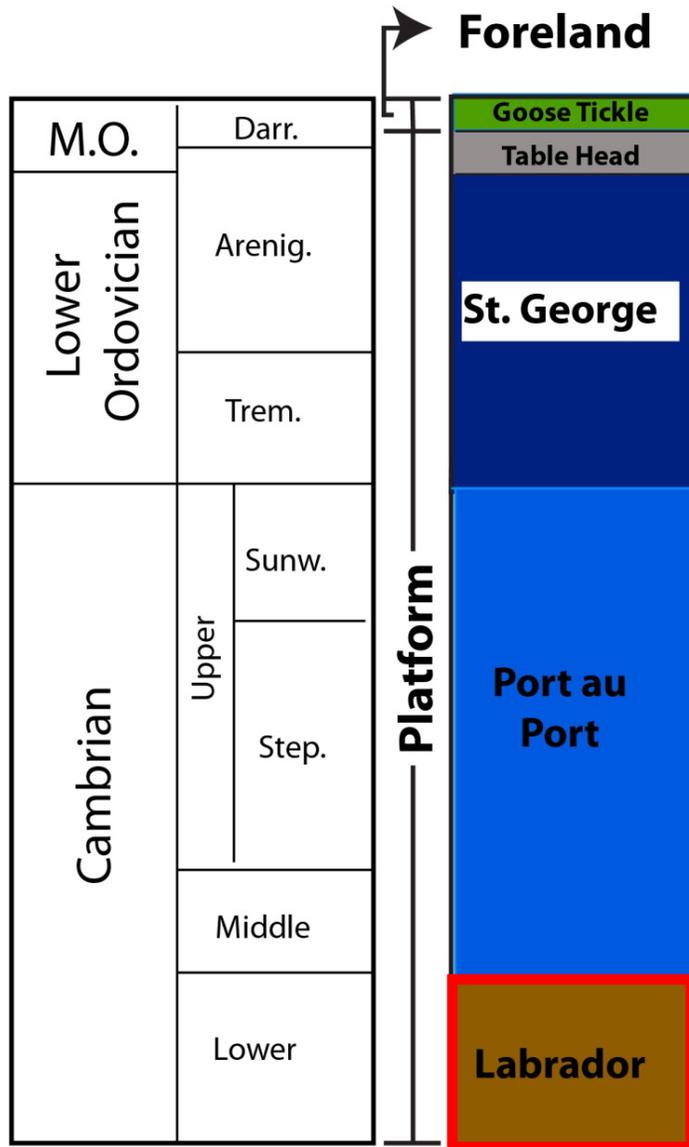


Stockmal et al., 1998

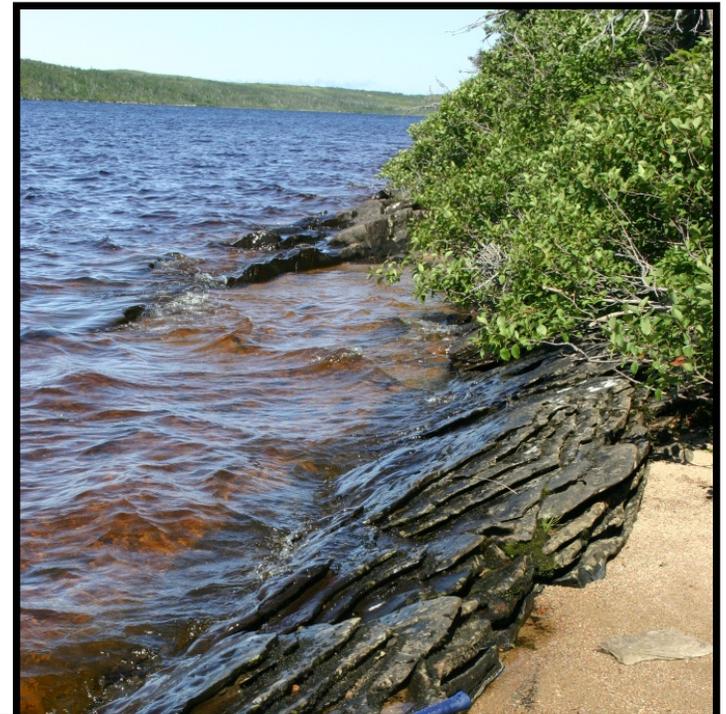
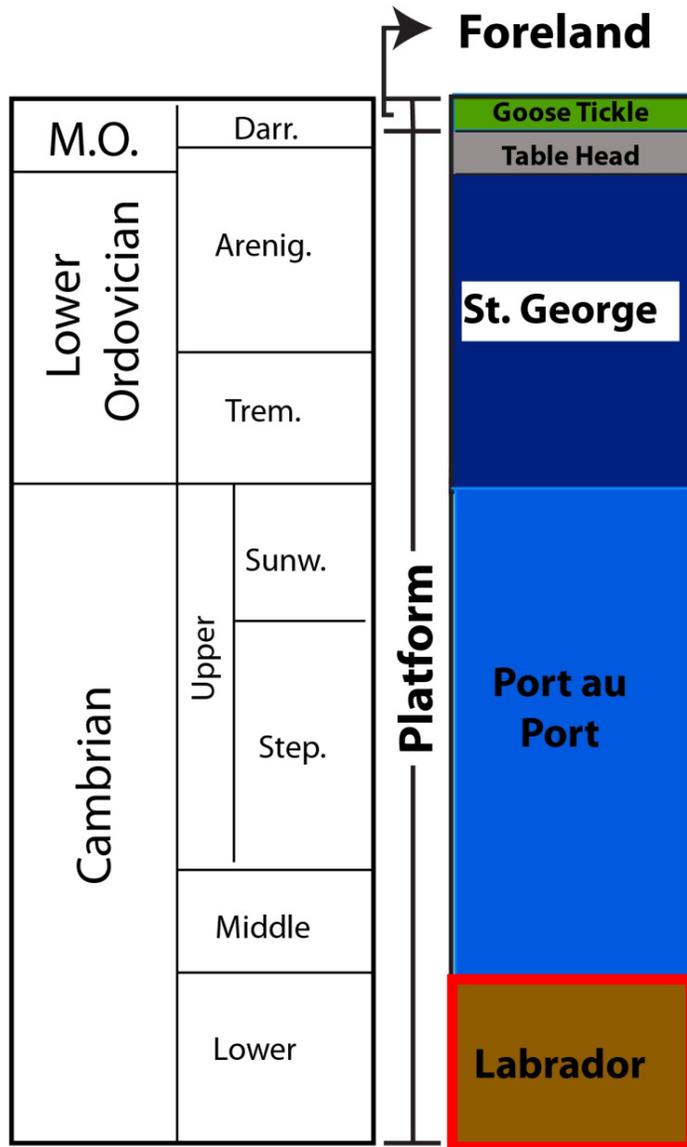
Stratigraphy-Parsons Pond



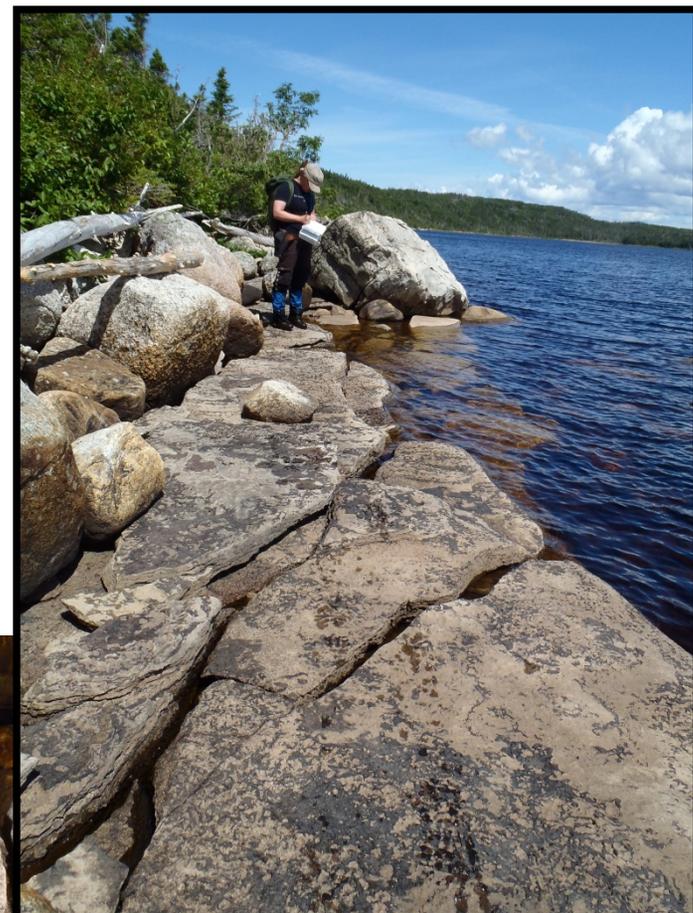
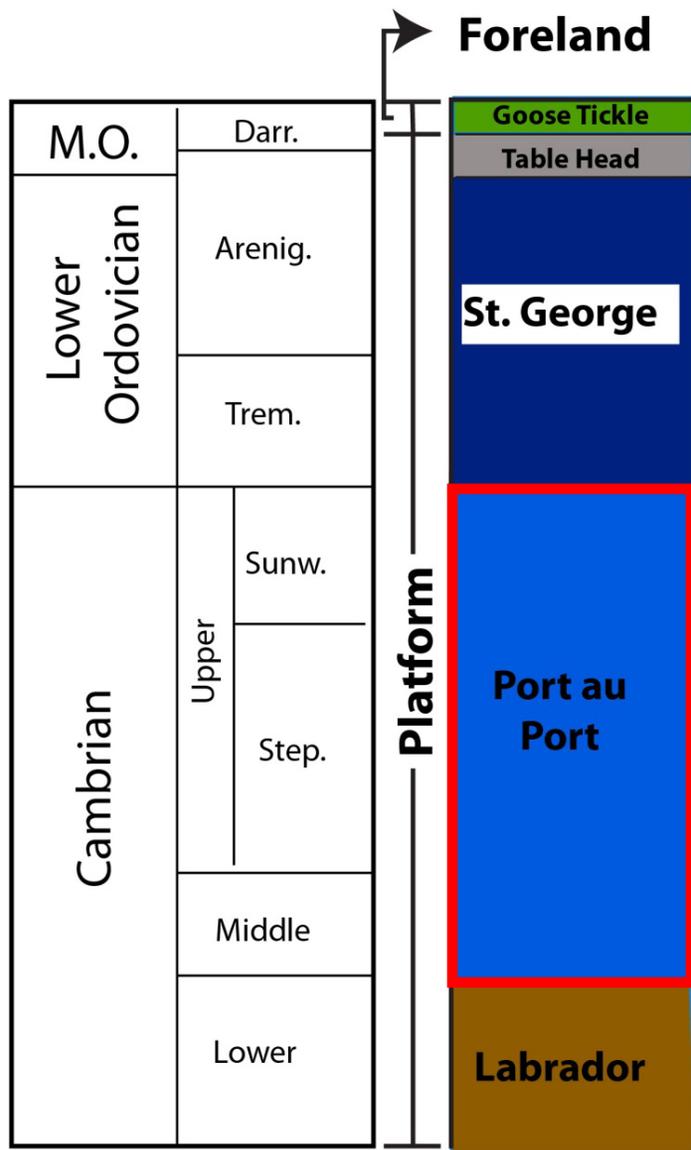
Lower Cambrian Labrador Group



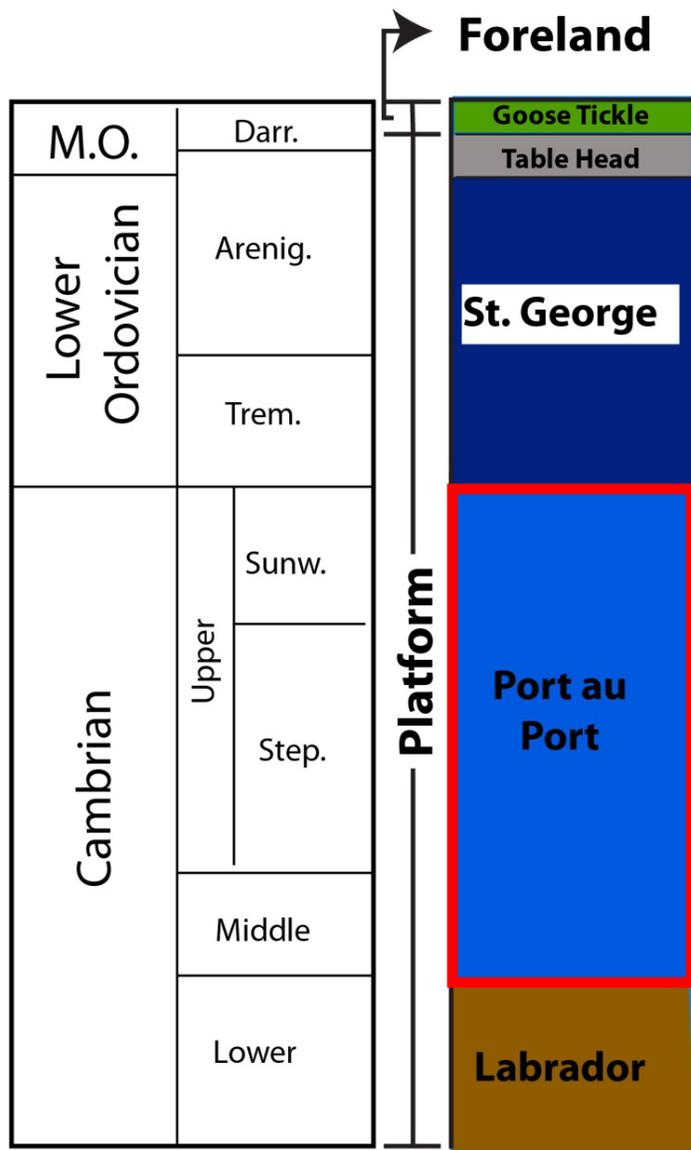
Lower Cambrian Labrador Group



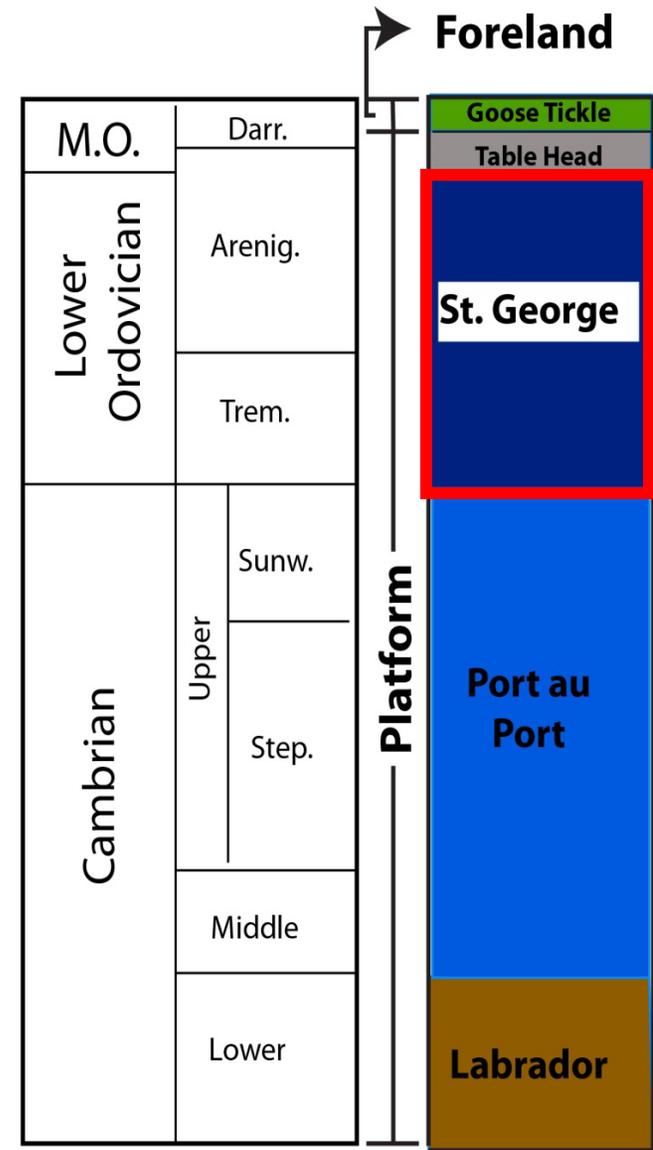
Middle to Upper Cambrian Port au Port Group



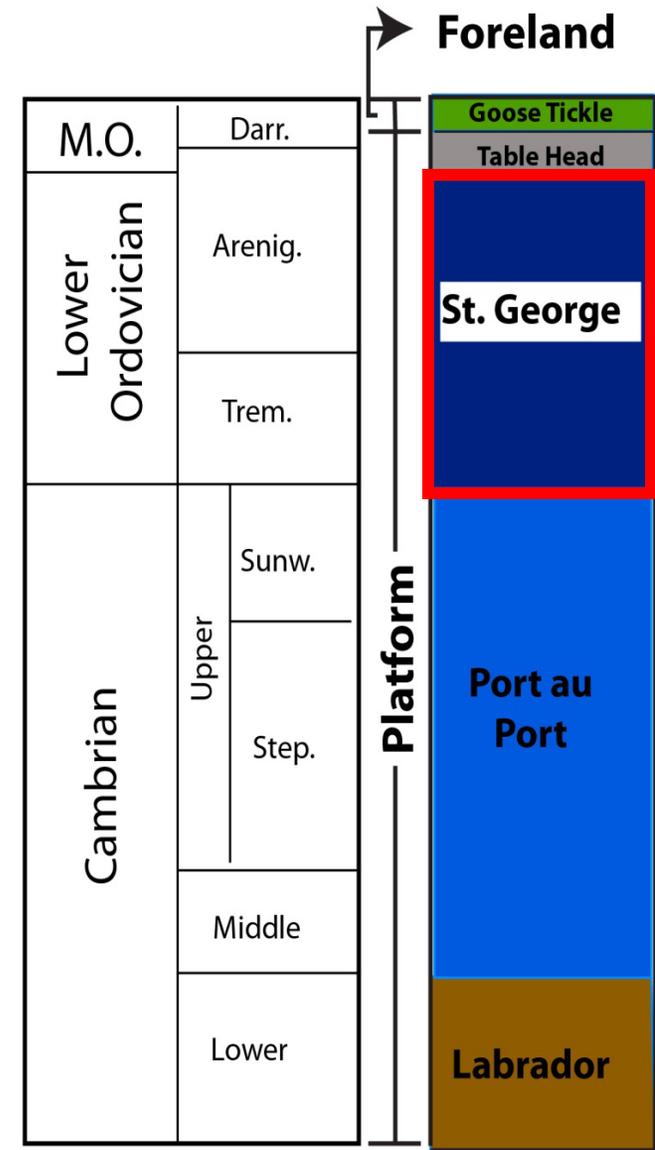
Middle to Upper Cambrian Port au Port Group



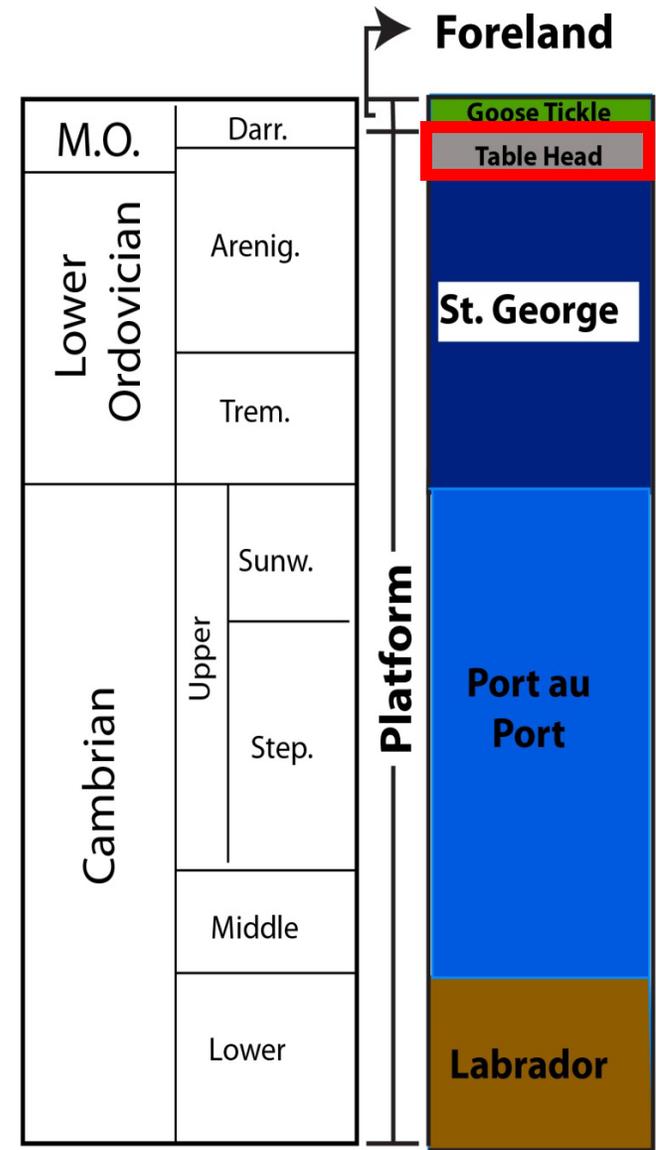
Lower Ordovician St. George Group



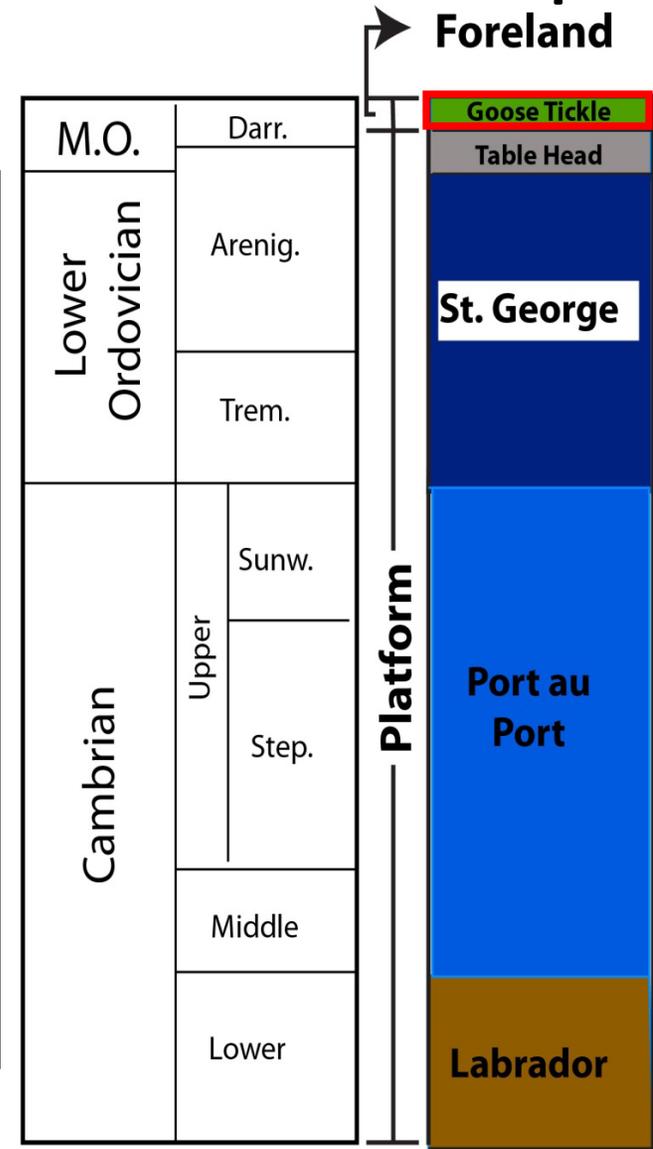
Lower Ordovician St. George Group



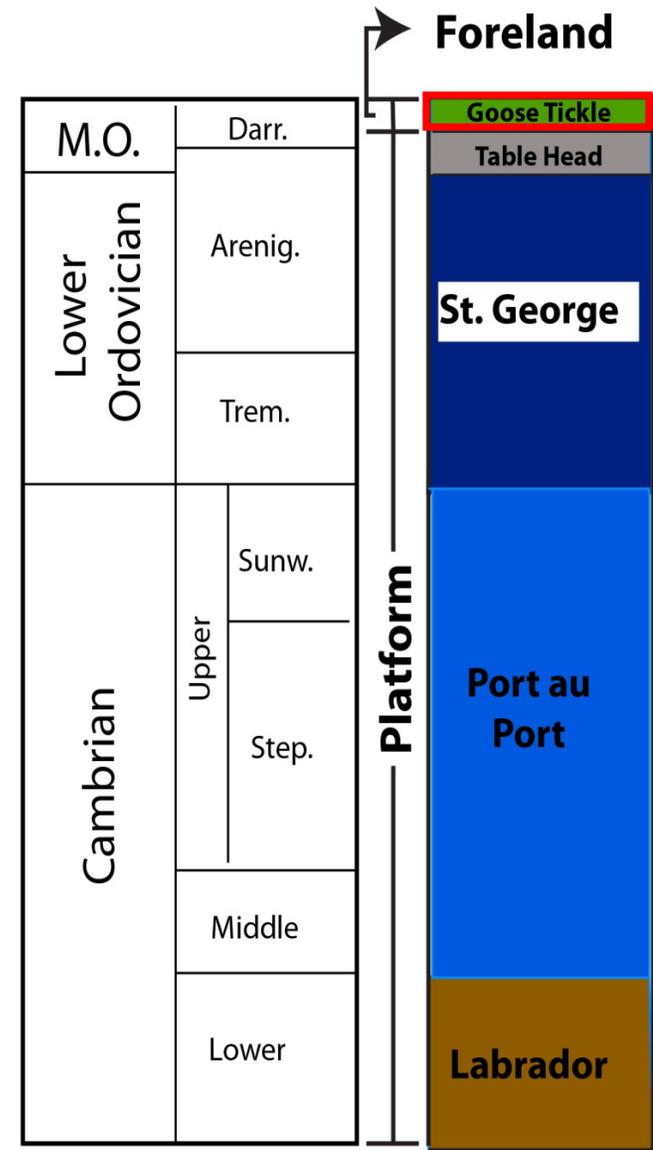
Middle Ordovician Table Point Formation



Middle Ordovician Goose Tickle Group



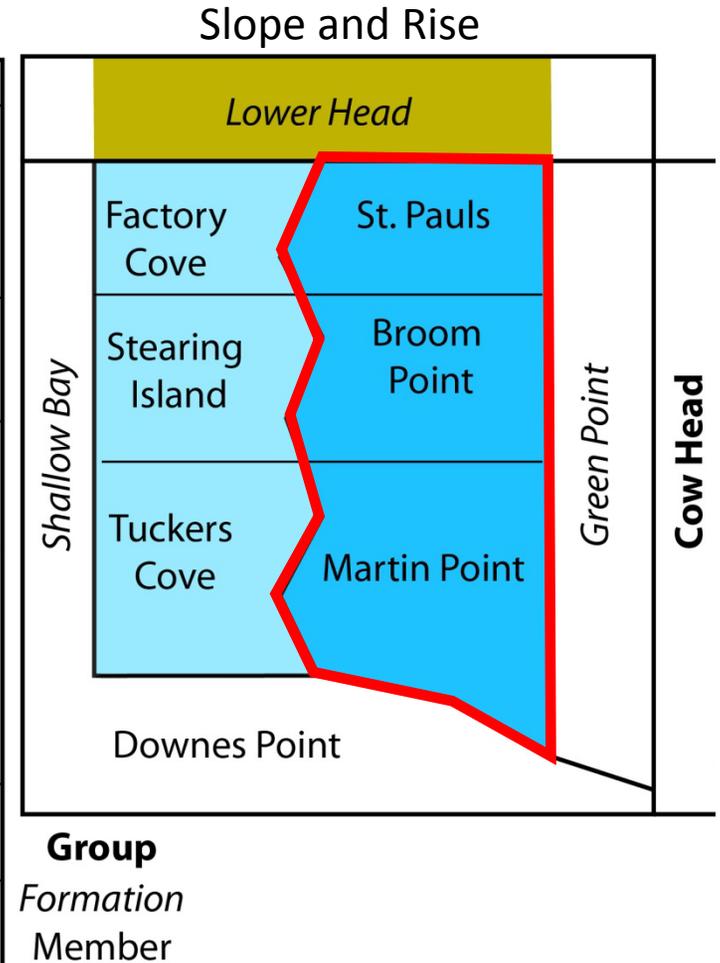
Middle Ordovician Goose Tickle Group



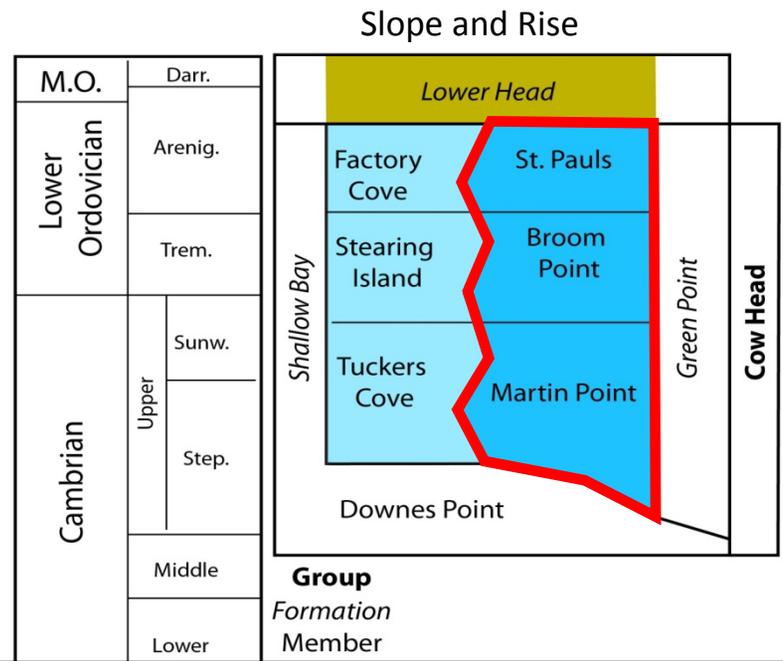
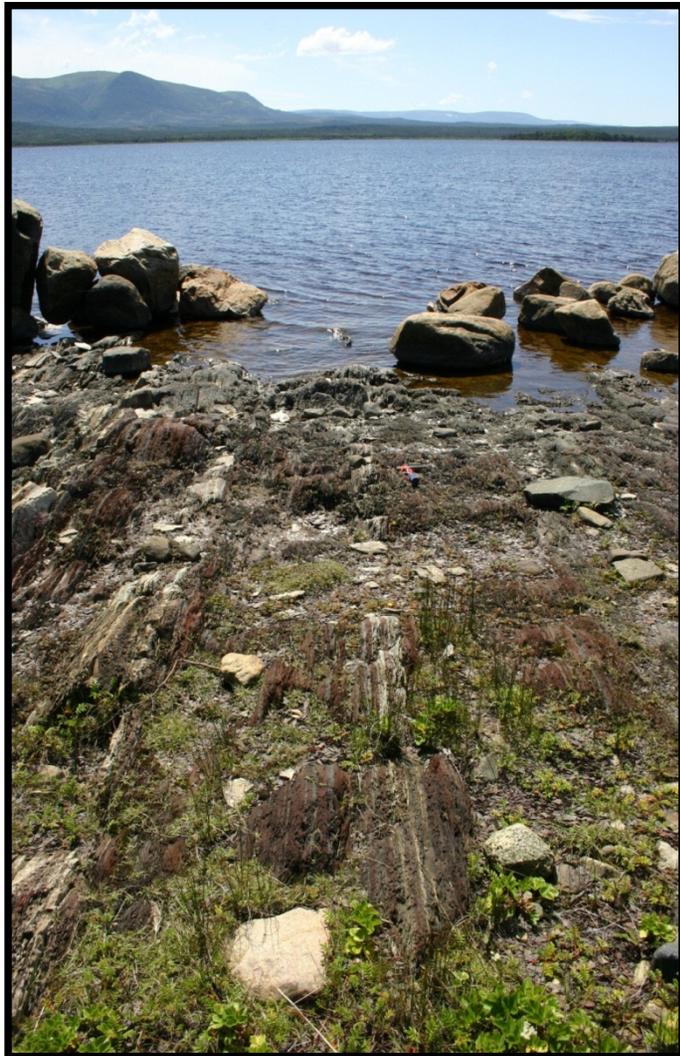
Cambrian-Ordovician Green Point Formation



Lower Ordovician	M.O.	Darr.
		Arenig.
		Trem.
Cambrian	Upper	Sunw.
		Step.
	Middle	
	Lower	



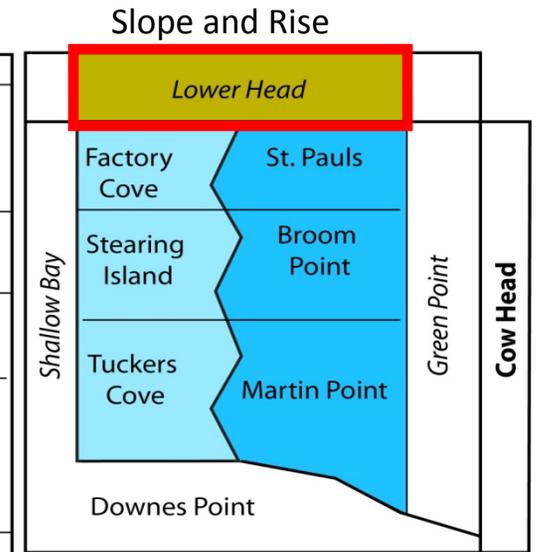
Cambrian-Ordovician Green Point Formation



Lower-Middle Ordovician Lower Head Formation

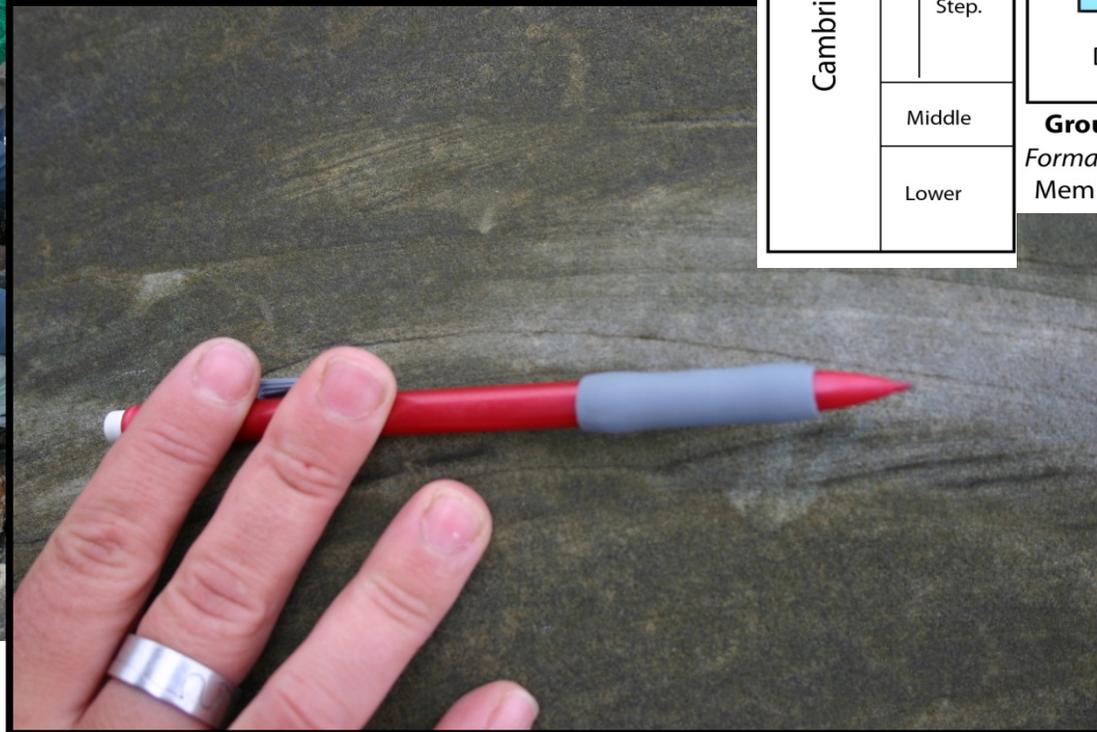


Lower Ordovician	M.O.	Darr.
		Arenig.
		Trem.
Cambrian	Upper	Sunw.
		Step.
	Middle	
	Lower	

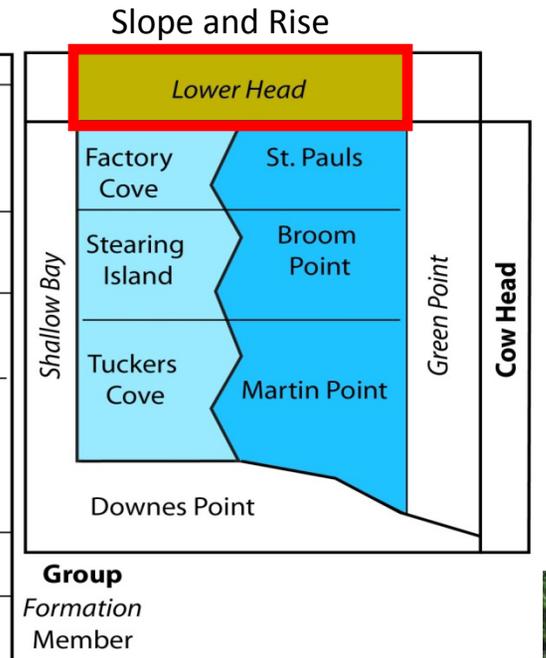


Group
Formation
Member

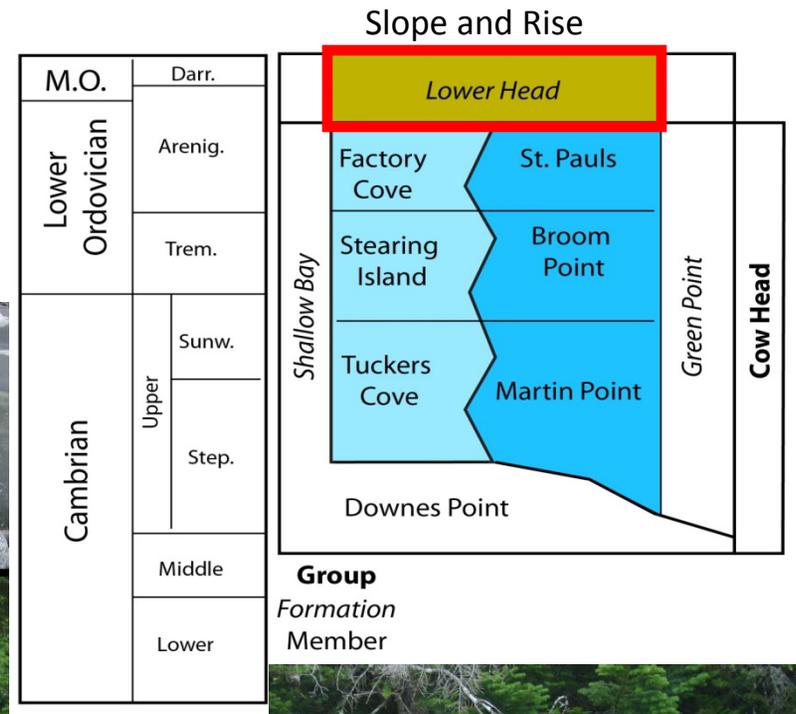
Lower-Middle Ordovician Lower Head Formation



Lower Ordovician	Upper	Darr.
		Arenig.
		Trem.
Cambrian	Upper	Sunw.
		Step.
	Middle	
Lower		



Lower-Middle Ordovician Lower Head Formation



Petroleum History

Early Oil Well, Parsons Pond



Photo from Newfoundland and Labrador Dept. of Natural Resources

- Oil seeps known since early 1800's.
- First Well drilled 1860's.
- 27 wells drilled in Parsons Pond until ~1960s.

Abandoned Well, Parsons Pond



Petroleum History

Early Oil Well, Parsons Pond

Earl!



Photo from Newfoundland and Labrador Dept. of Natural Resources



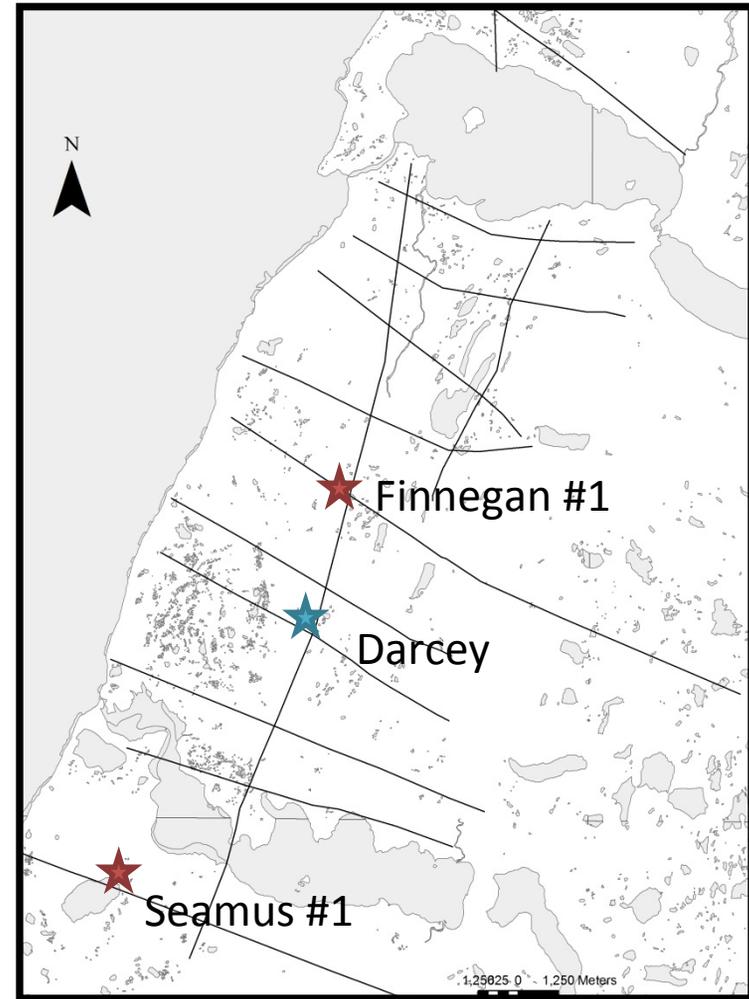
- Oil Seeps known since early 1800's.
- First Well drilled 1860.
- 27 wells drilled in Parsons Pond until ~1960s.

Recent Petroleum History



Stoneham drilling rig-Seamus No. 1. Photo from The Western Star.

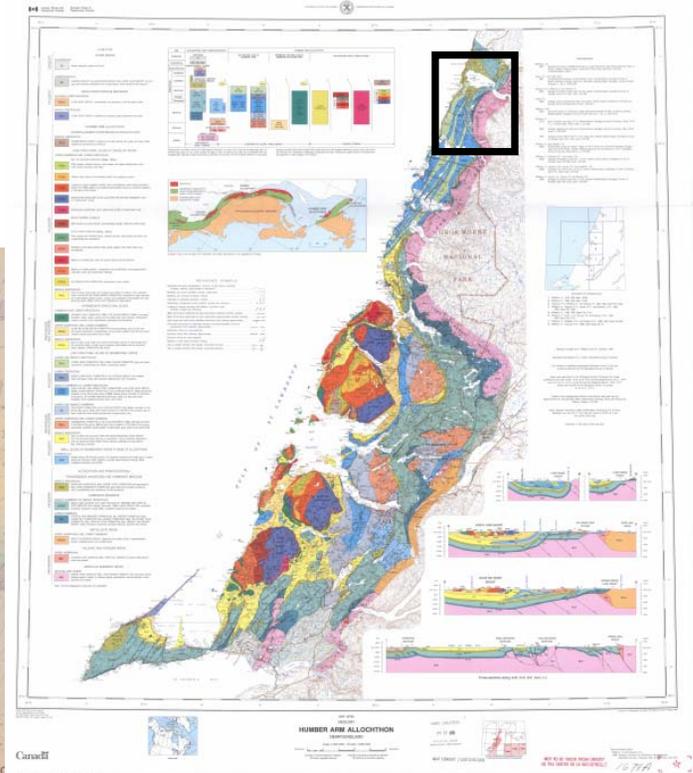
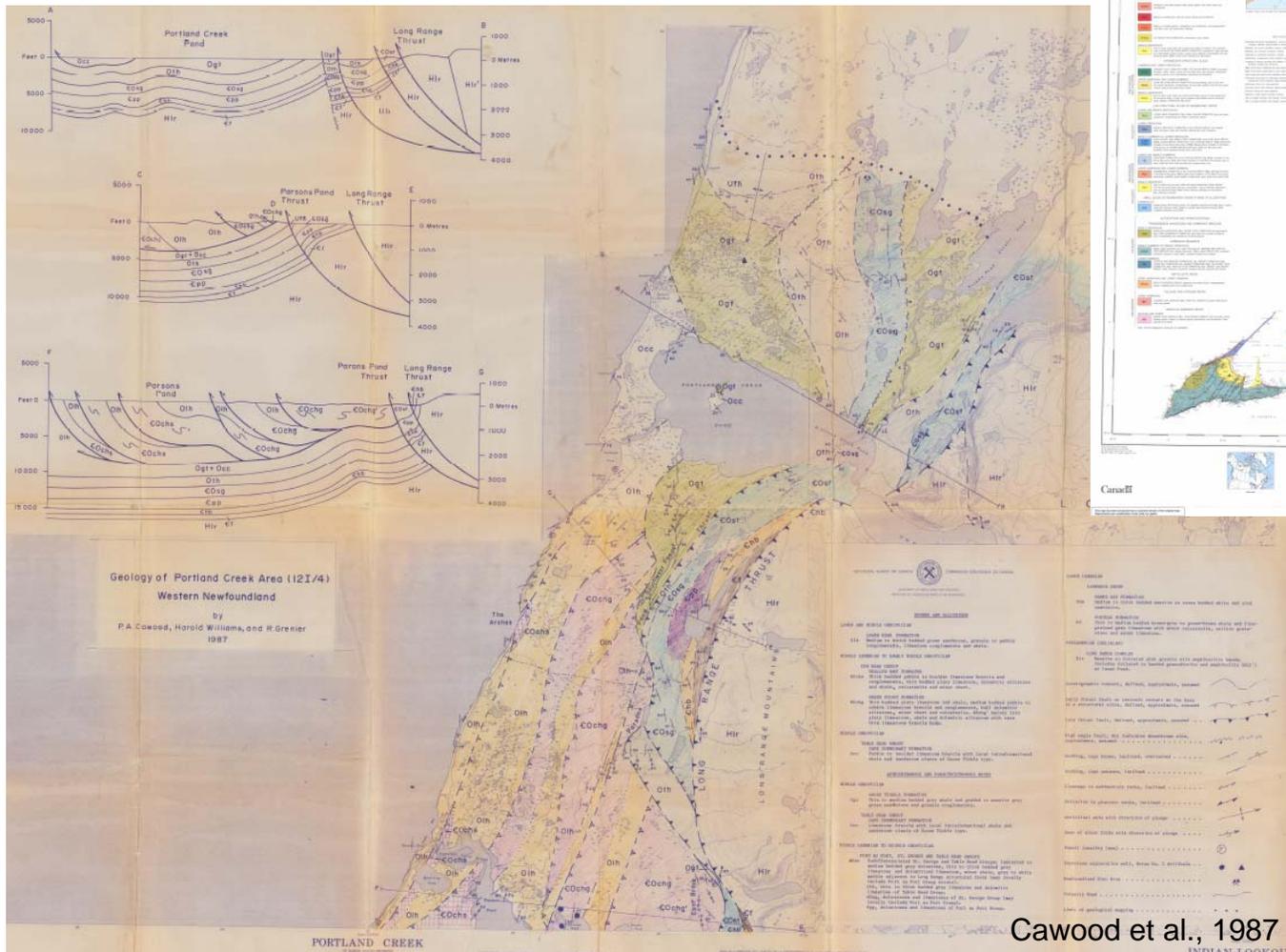
- Drilled in 2010.
- Target = north-south structural high.
- Encountered gas.



Location of Seismic Lines and Recent Wells Drilled (red) and Cancelled (blue).

Mapping: Parsons Pond to Portland Creek Pond

Previous mapping in 1987 at reconnaissance scale



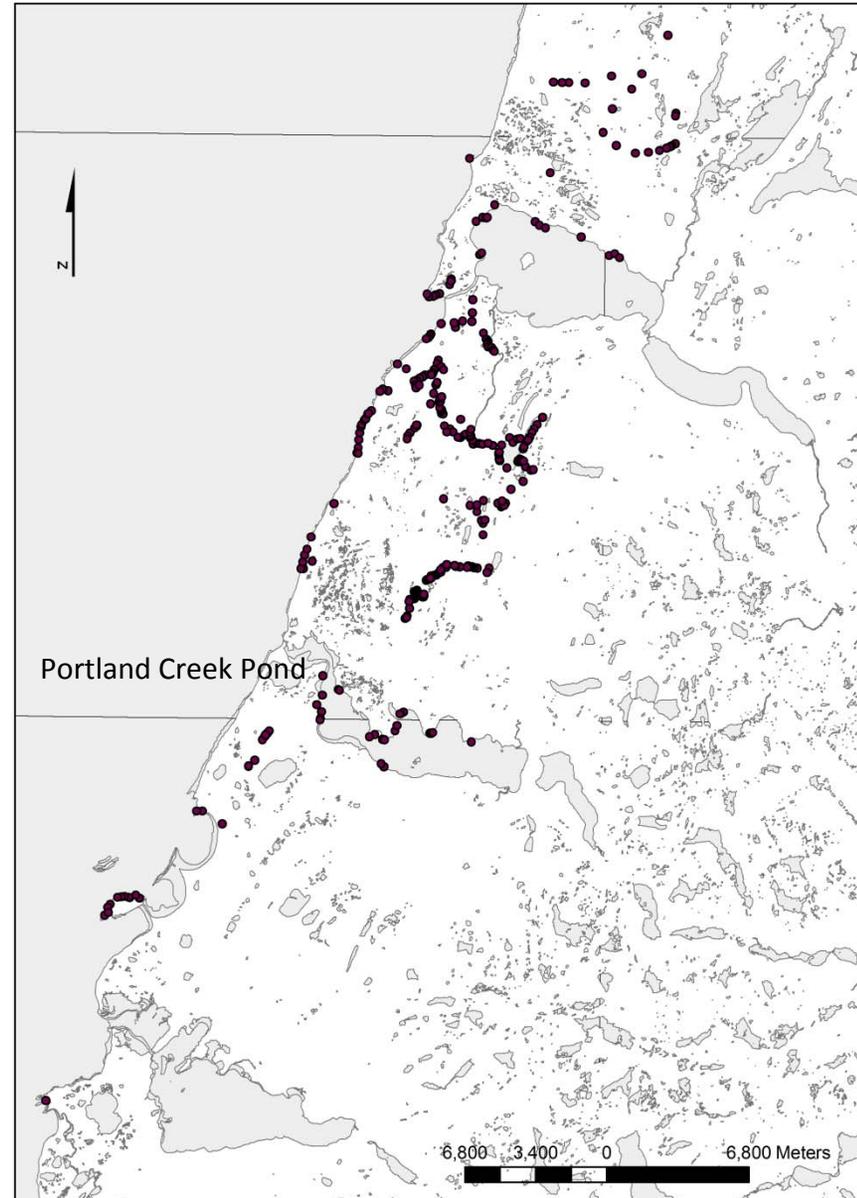
Map Construction

Field data: structural and lithological data

Seismic data: 2D reflection data

Mag data: 2nd VD

Will combine to generate a 3D structural model



Waypoints from summer 2011 field season

Measured Structures: Faults



019/16 = Fault Surface

099-16 = Slickenlines

Hinges of folded strata = 059-08
& 044-16



025/20 = Fault Surface

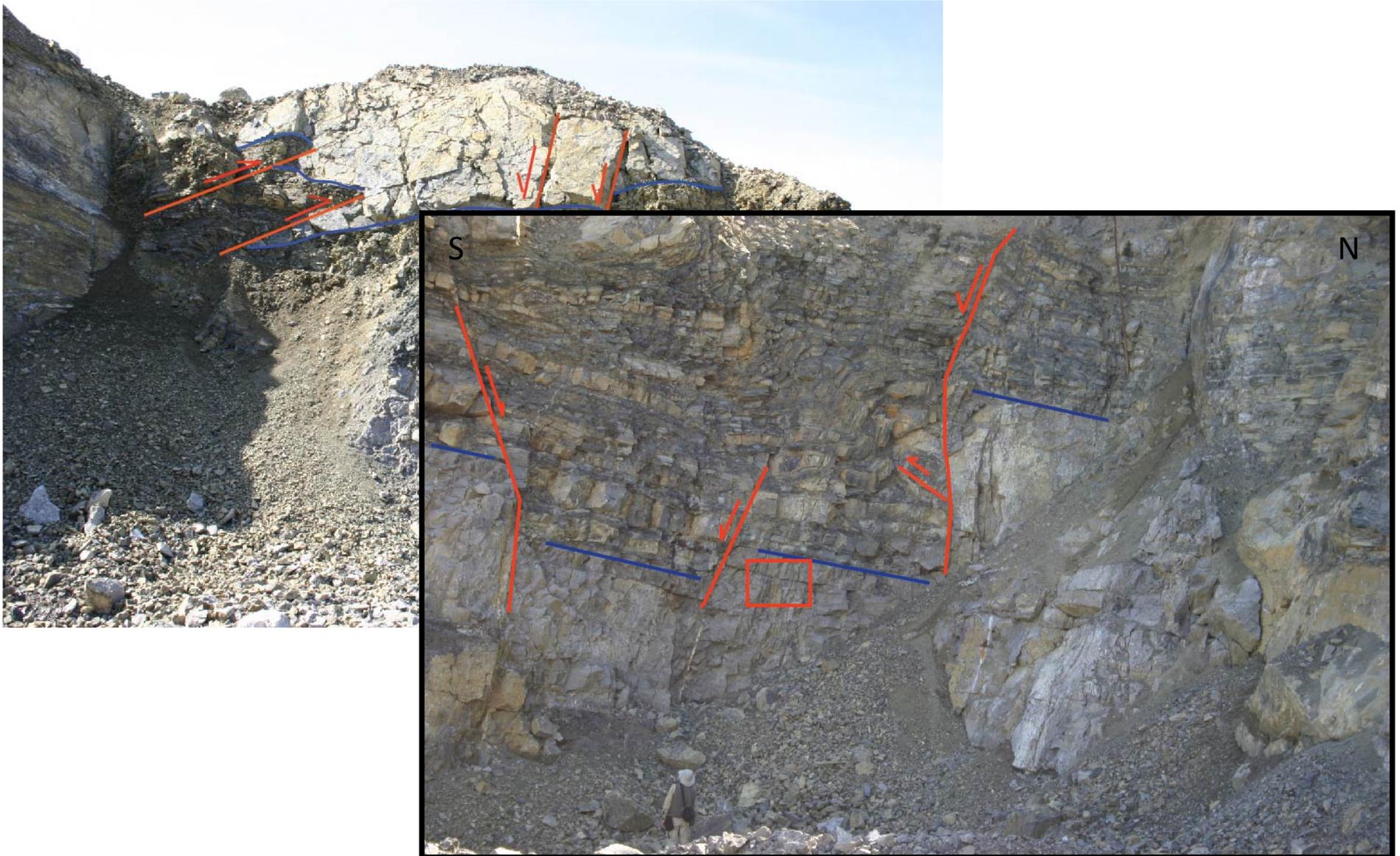
105-20 = Slickenlines

Hinges of folded fault = 205-11

Measured Structures: Faults



Measured Structures: Faults



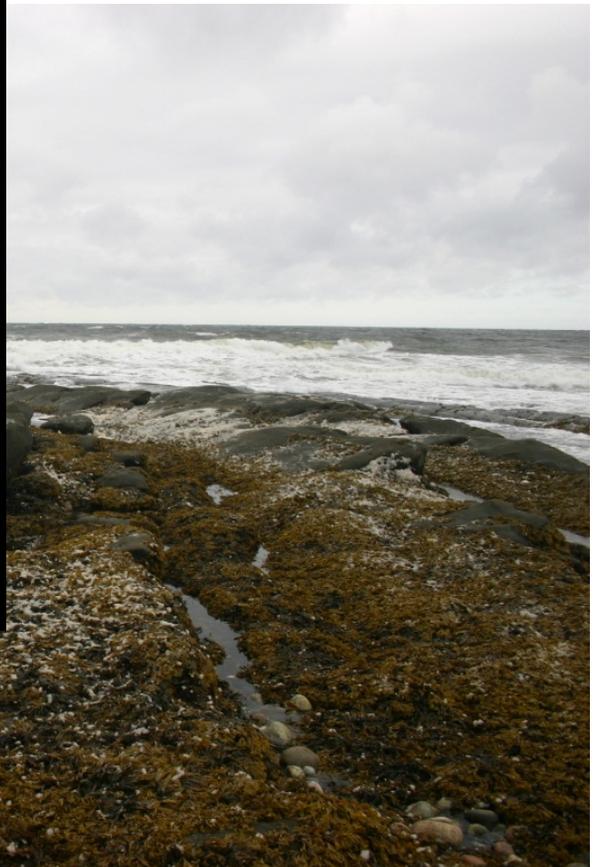
Measured Structures: Folds



Measured Structures: Folds



Measured Structures: Folds



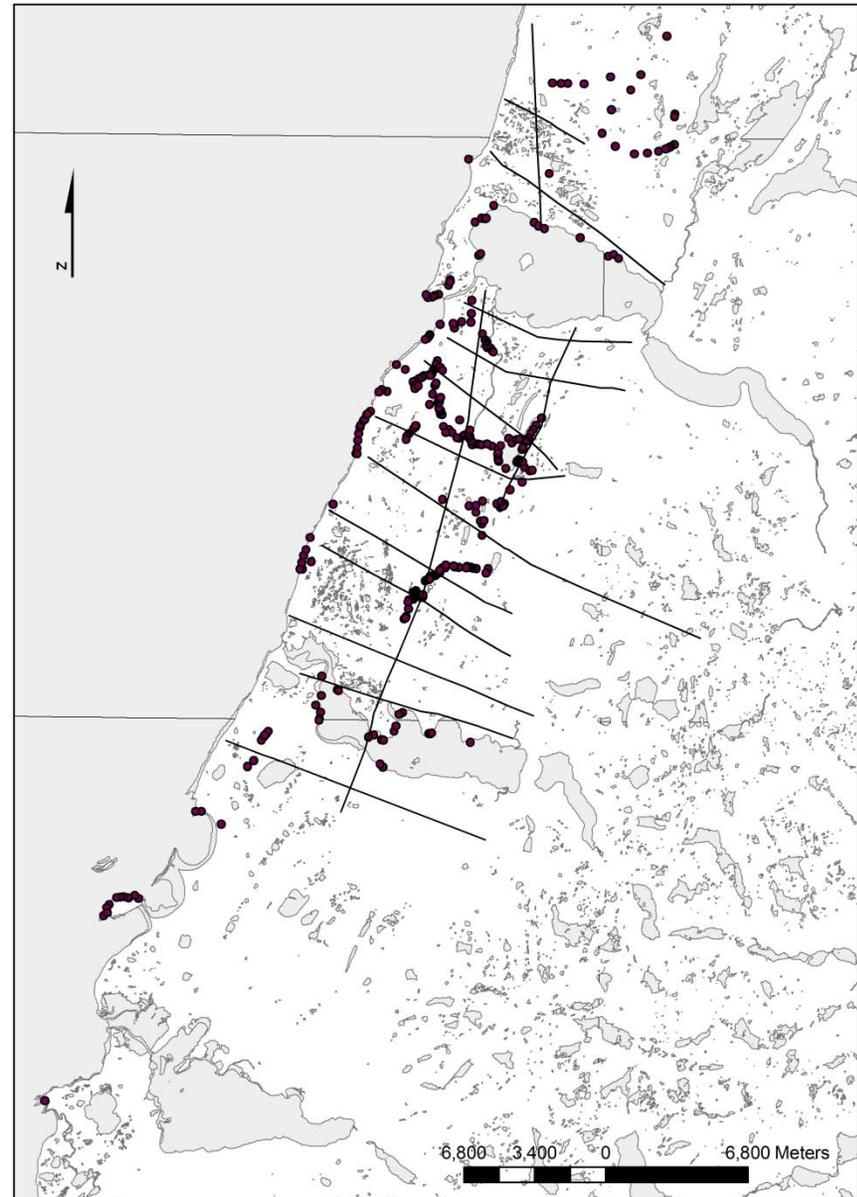
Map Construction

Field data: structural and lithological data

Seismic data: 2D reflection data

Mag data: 2nd VD

*Will combine to generate a 3D structural model *



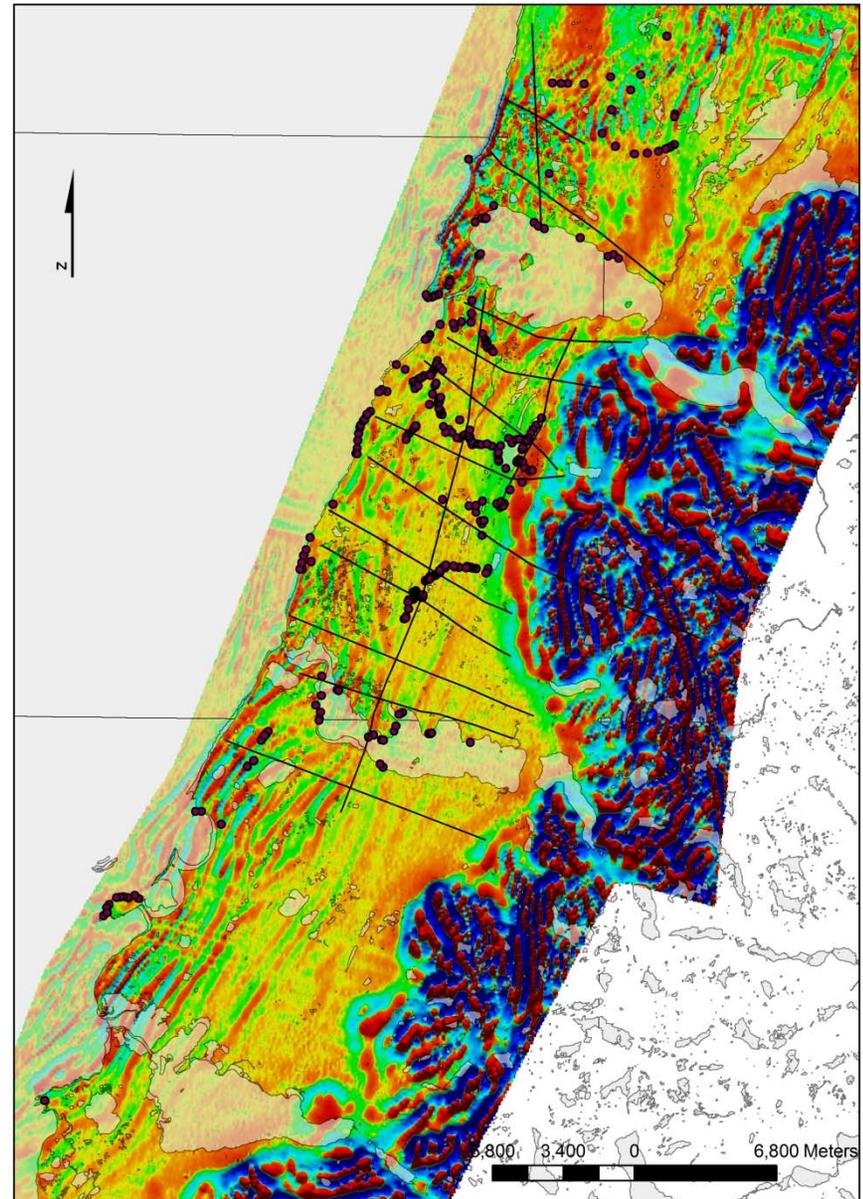
Map Construction

Field data: structural and lithological data

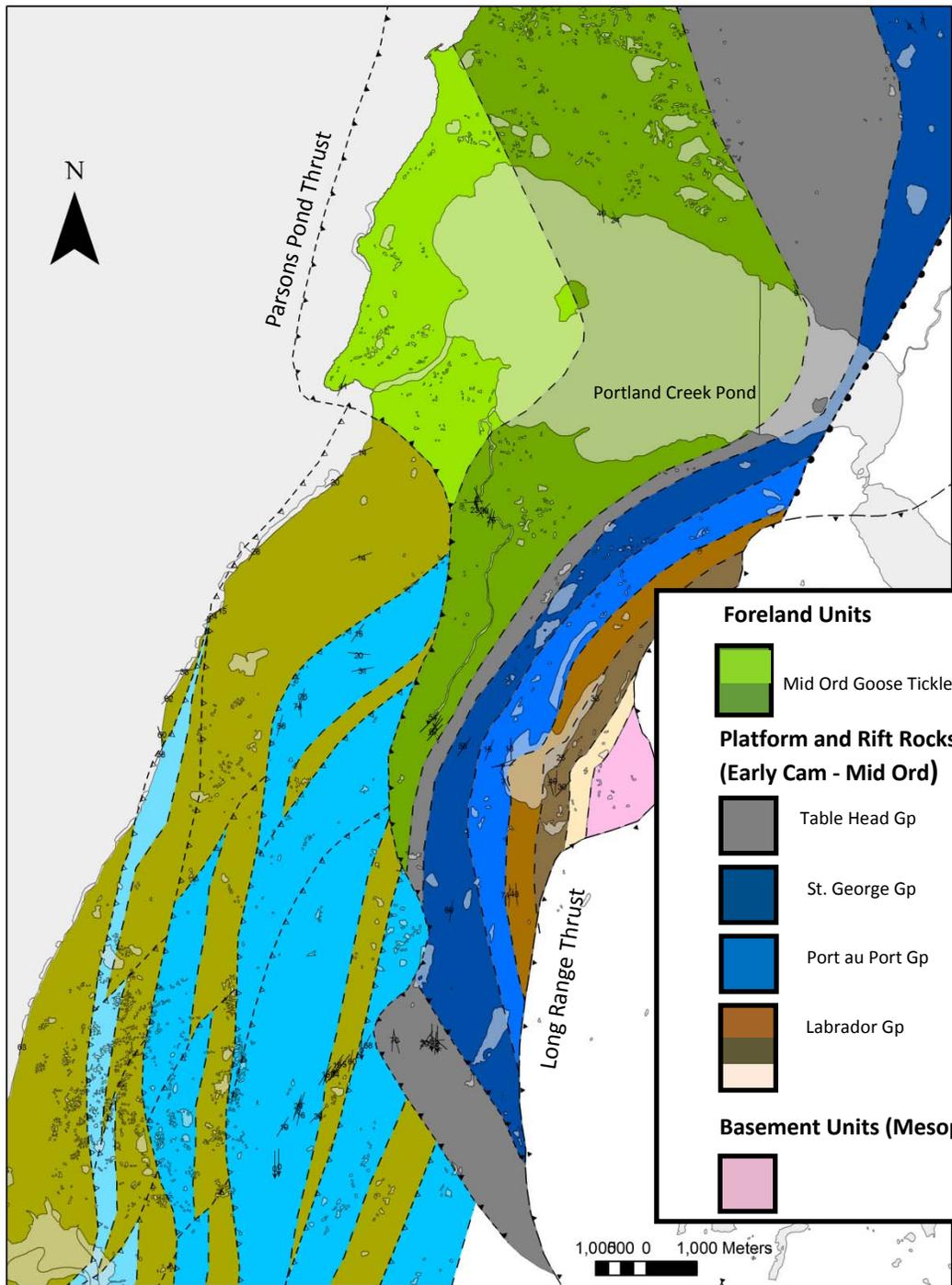
Seismic data: 2D reflection data

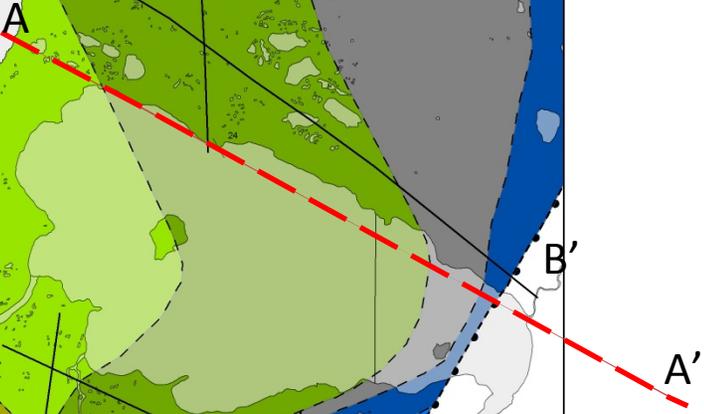
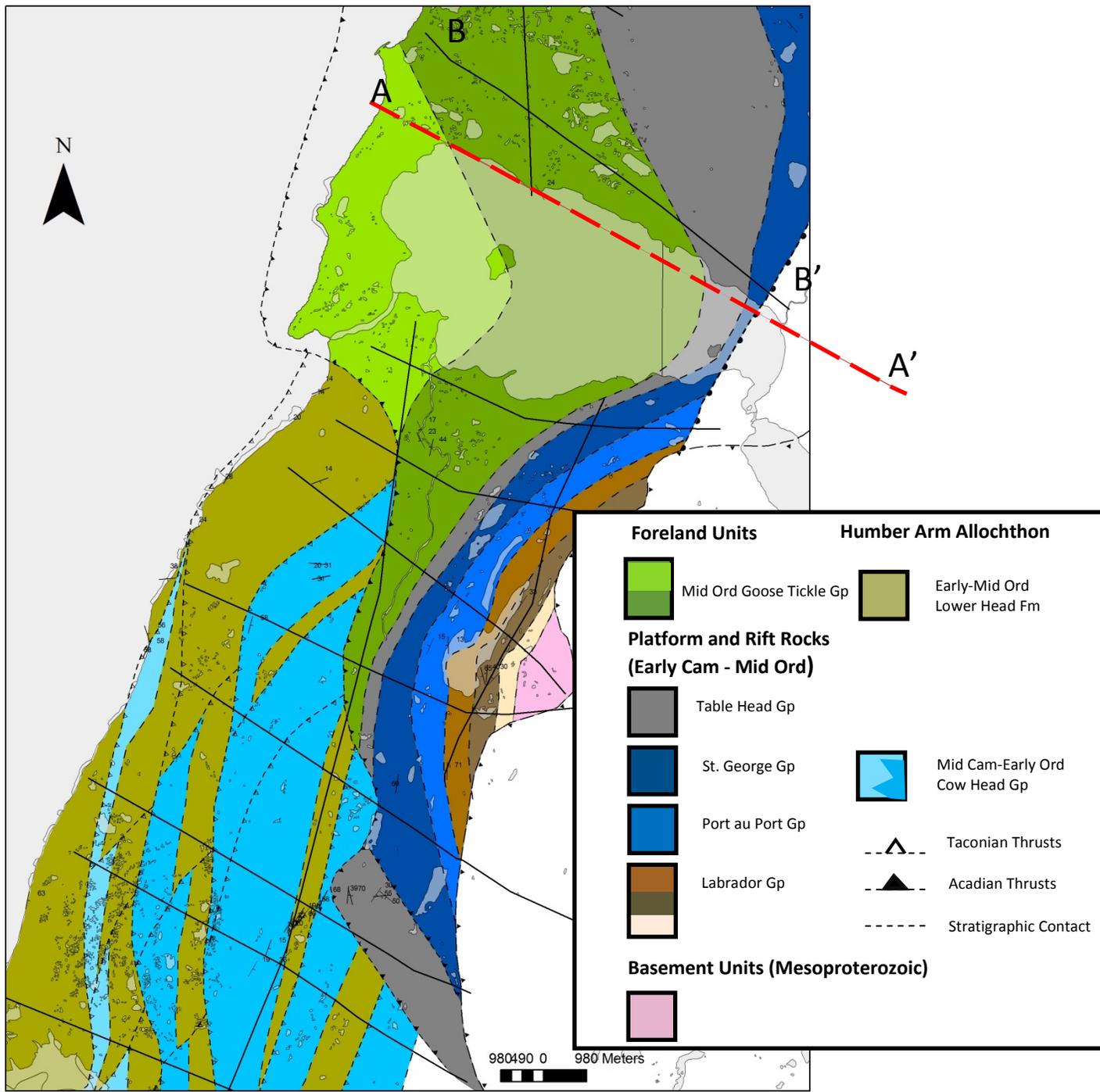
Mag data: 2nd VD

*Will combine to generate a 3D structural model *



Department of Natural Resources, Newfoundland and Labrador, 2012





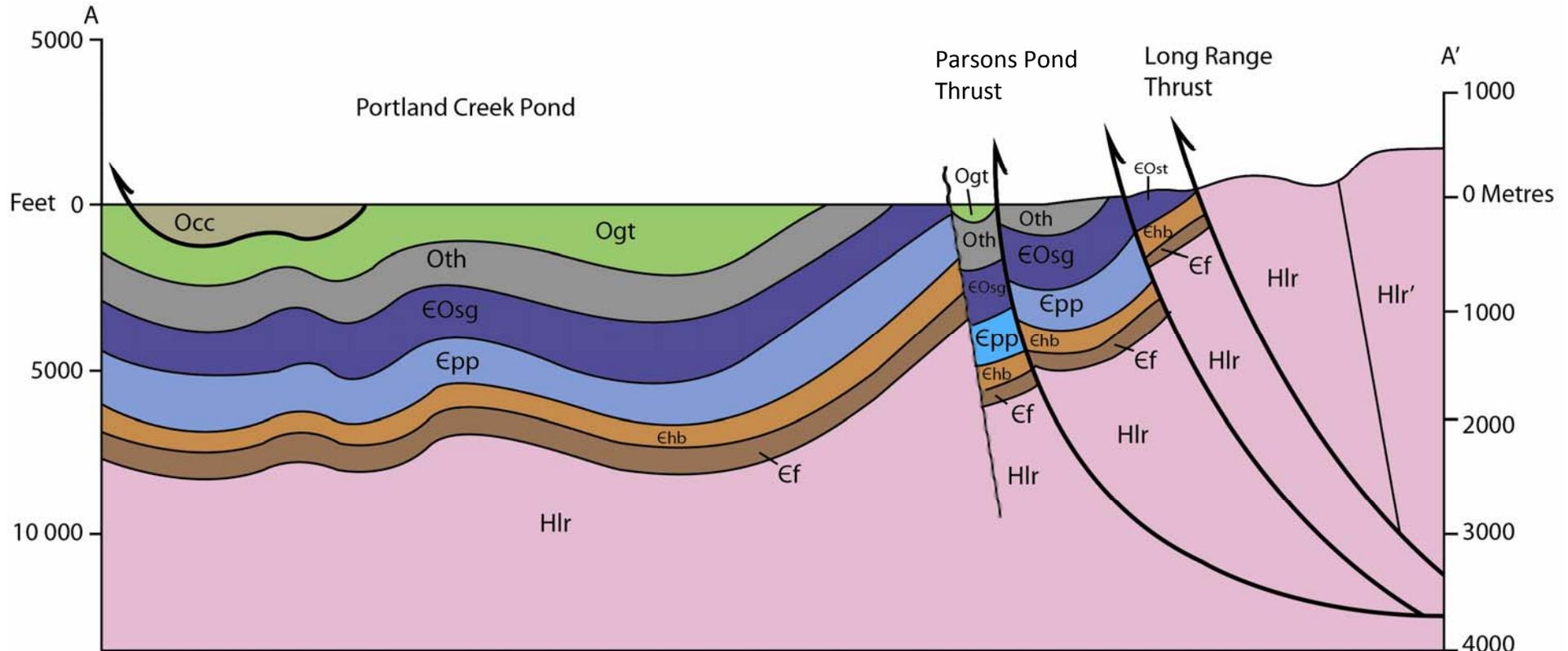
980490 0 980 Meters



Foreland Units		Humber Arm Allochthon	
	Mid Ord Goose Tickle Gp		Early-Mid Ord Lower Head Fm
Platform and Rift Rocks (Early Cam - Mid Ord)			
	Table Head Gp		Mid Cam-Early Ord Cow Head Gp
	St. George Gp		Taconian Thrusts
	Port au Port Gp		Acadian Thrusts
	Labrador Gp		Stratigraphic Contact
	Basement Units (Mesoproterozoic)		

Previous Interpretation

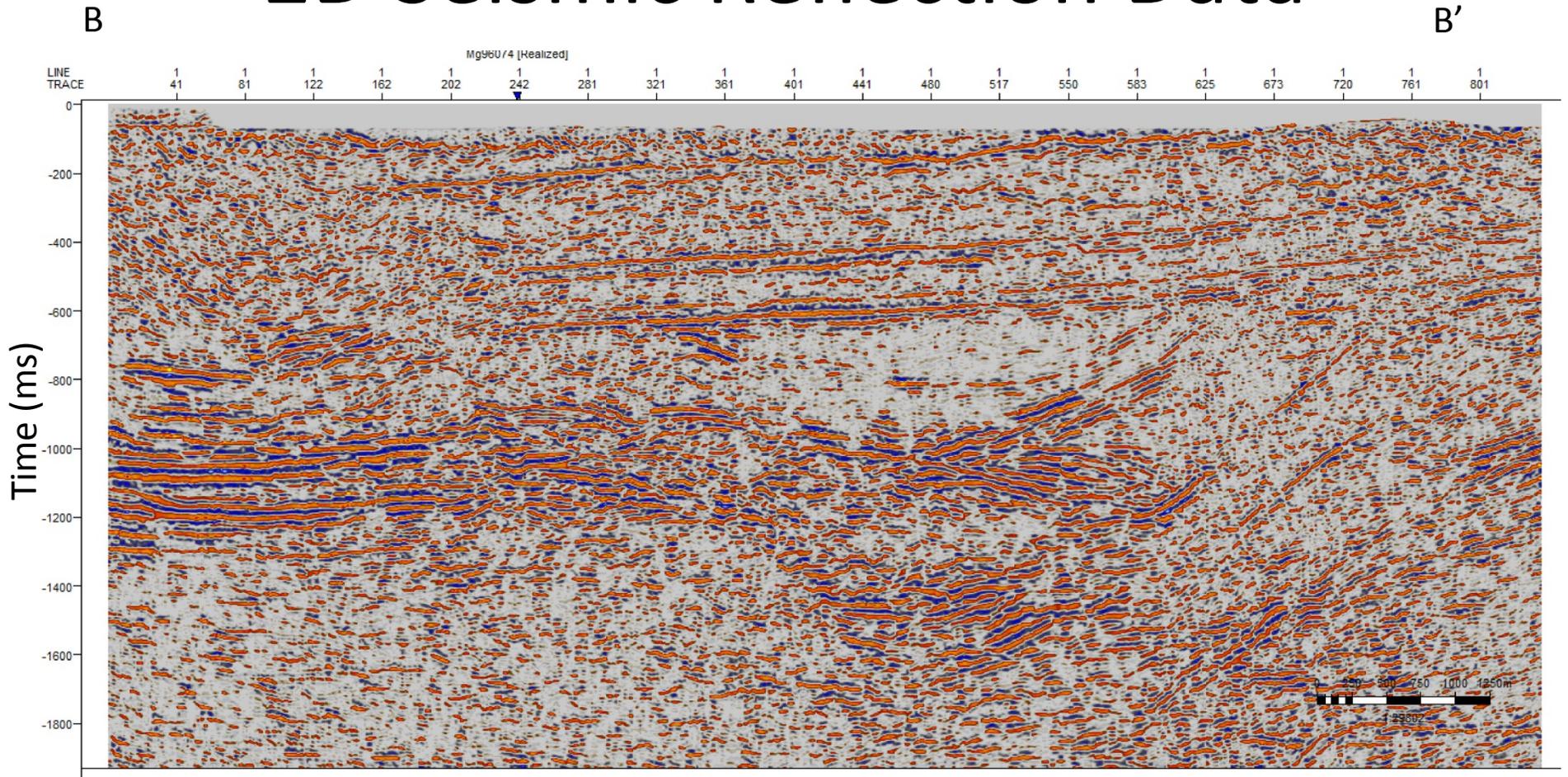
Section A-A': North of Portland Creek Pond



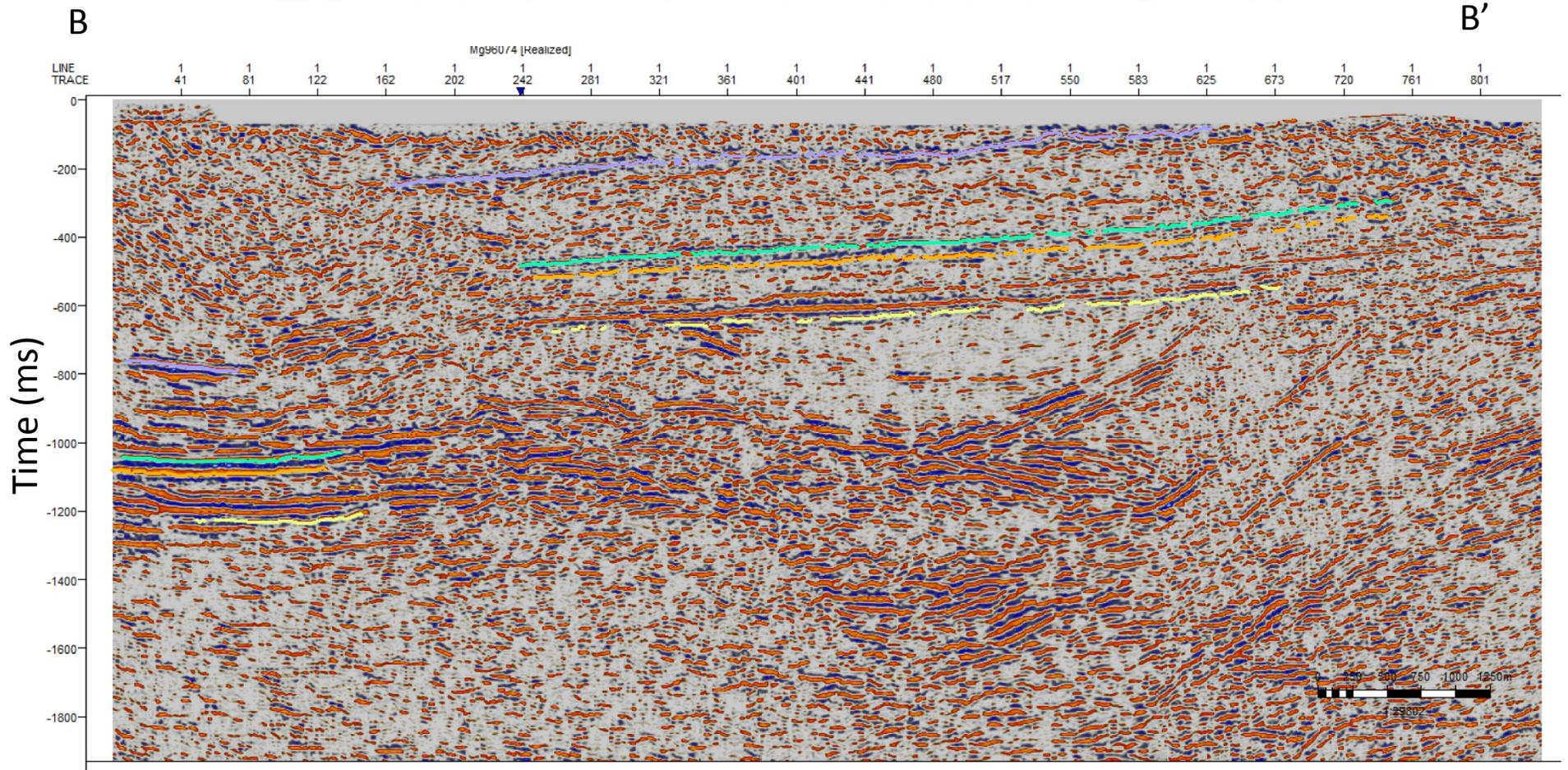
- Platform rocks are autochthonous.
- Platform rocks are exposed west of Parsons Pond thrust.
- Narrow thrust front, dominated by Long Range thrust.

Cawood et al., 1987

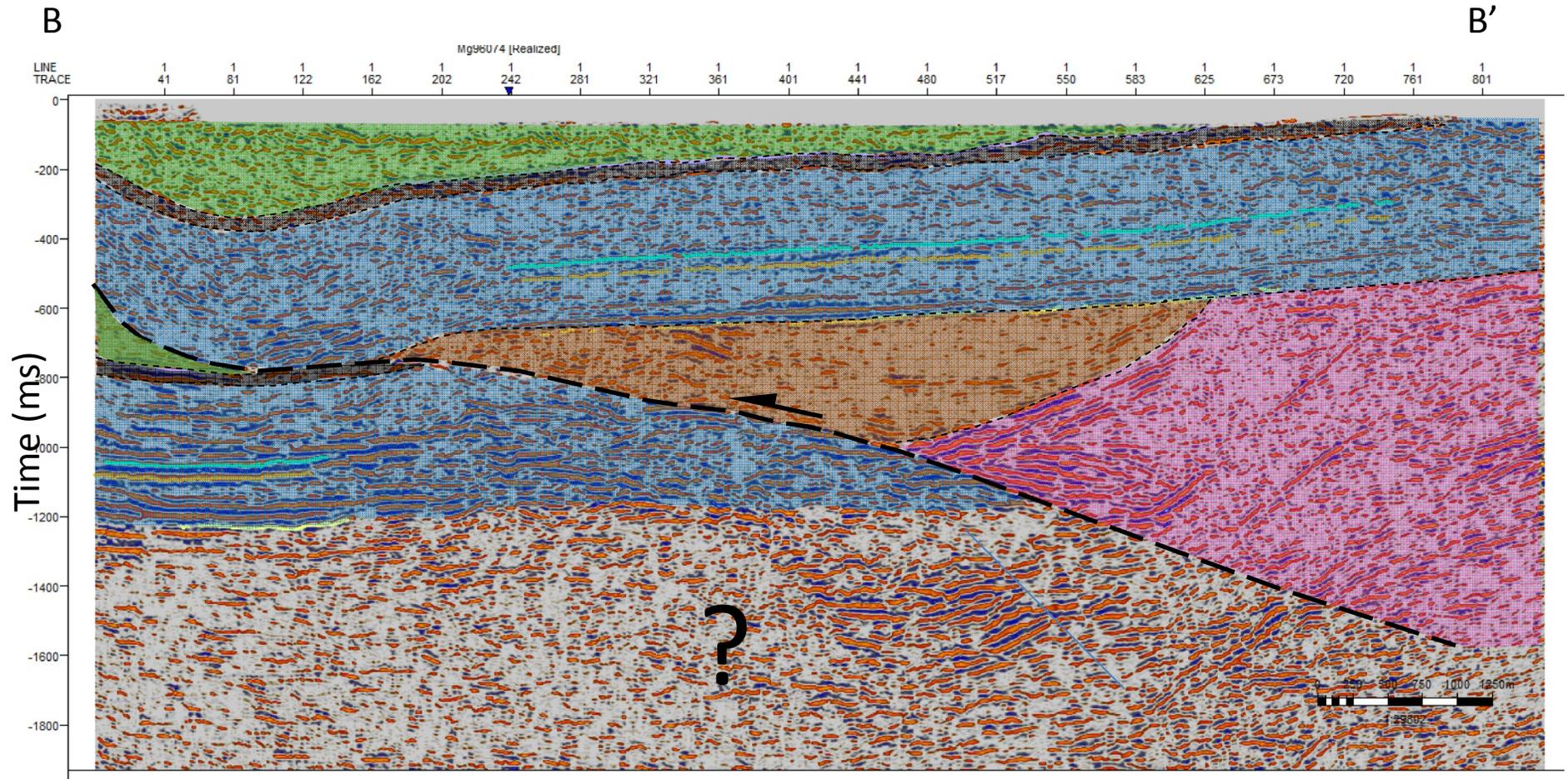
2D Seismic Reflection Data

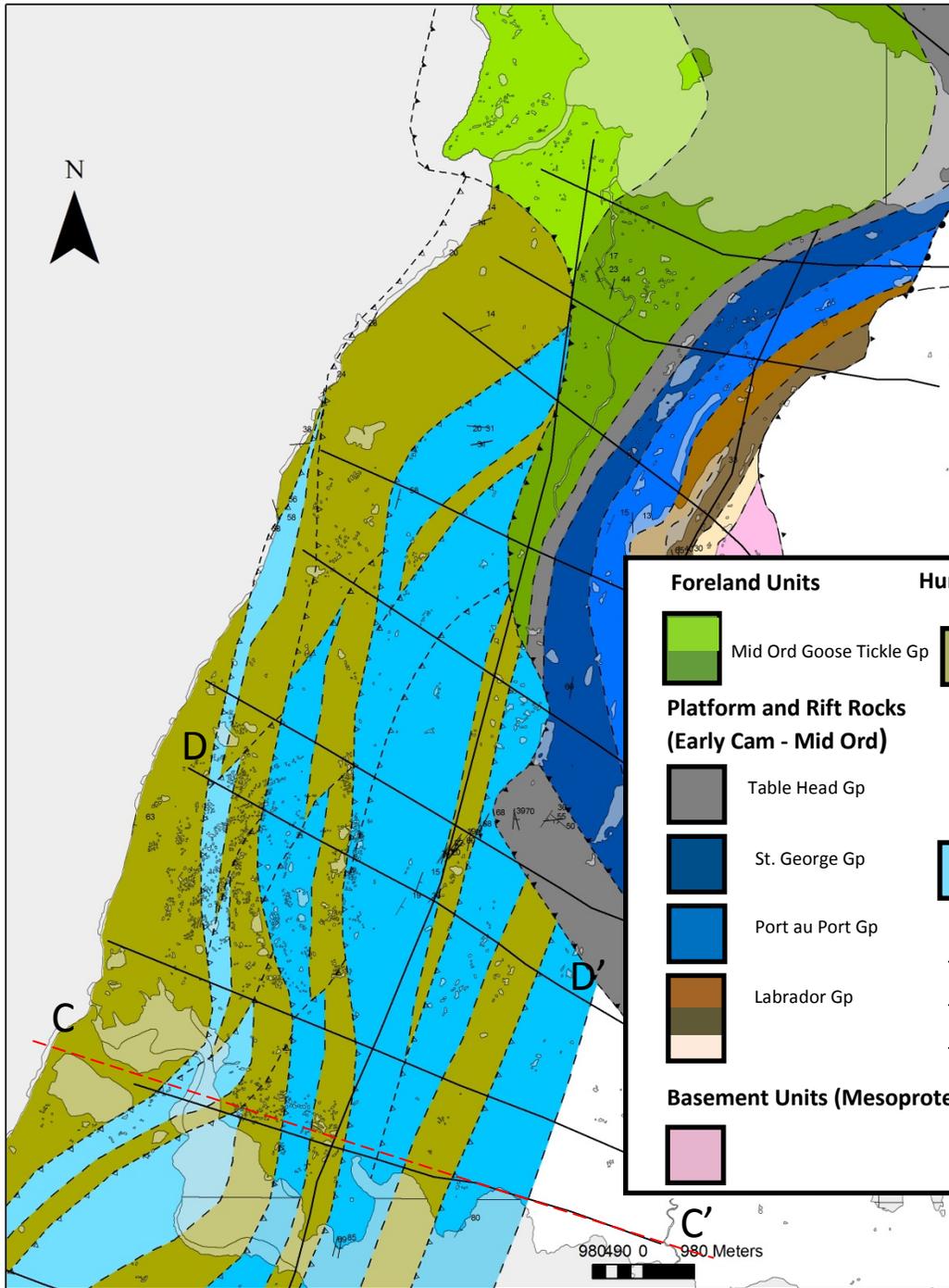


2D Seismic Reflection Data

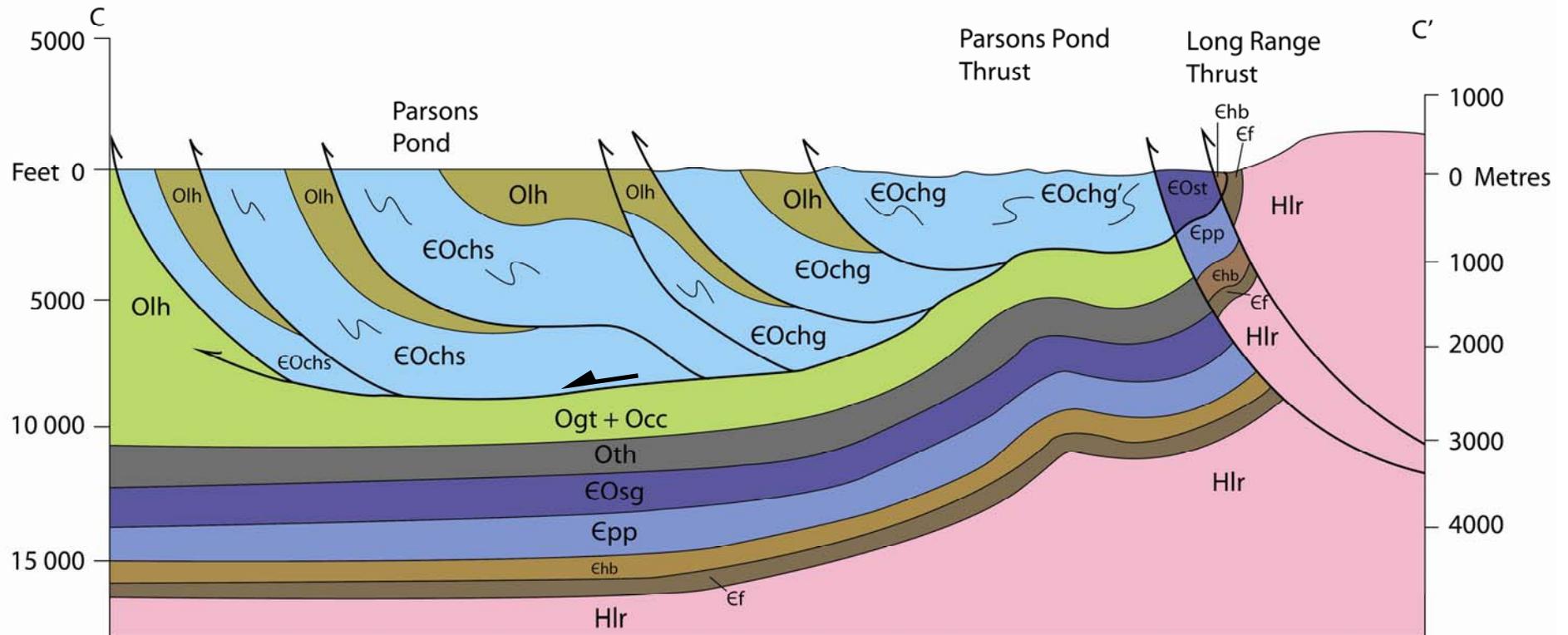


2D Seismic Reflection Data



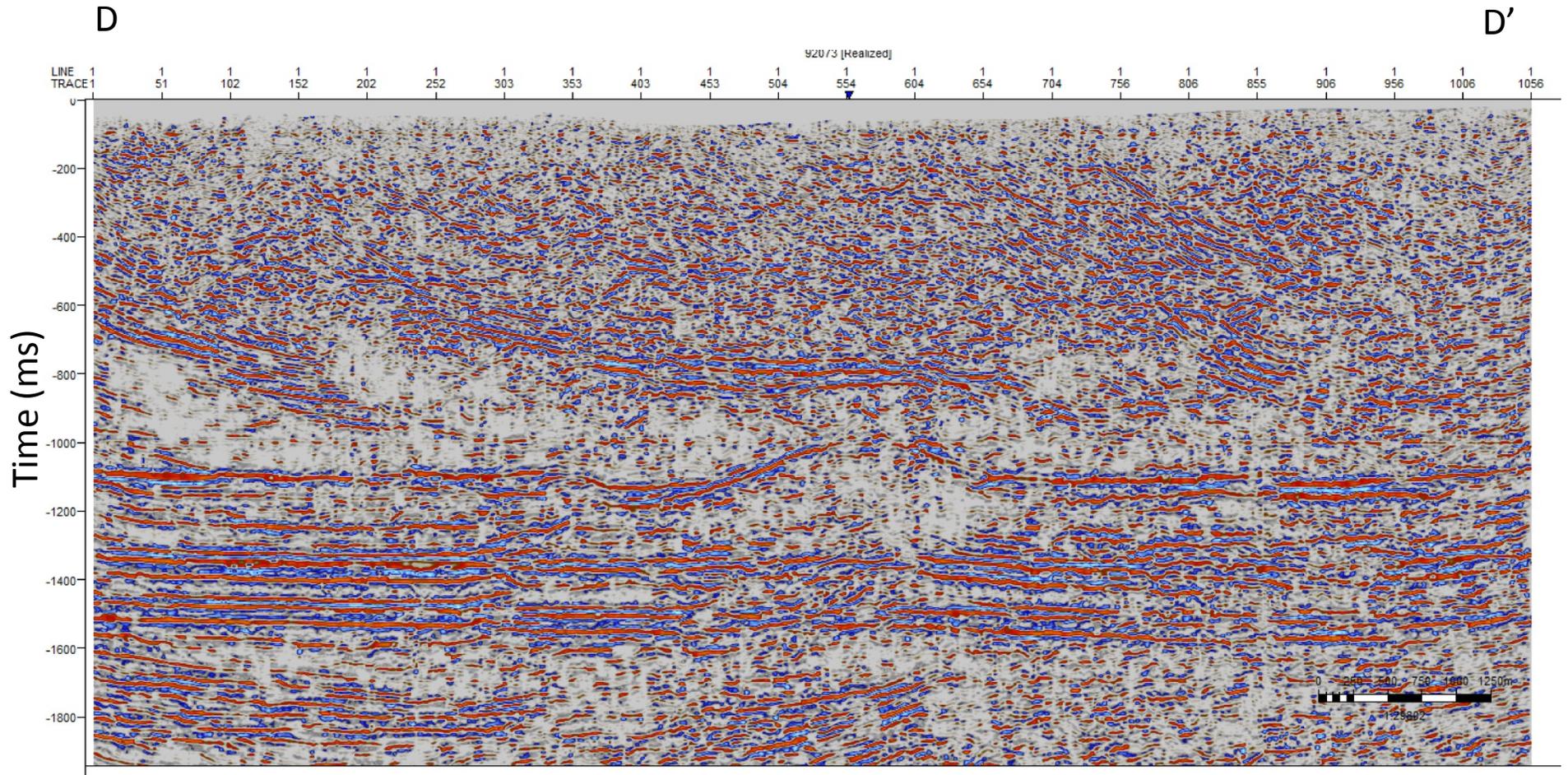


Previous Interpretation

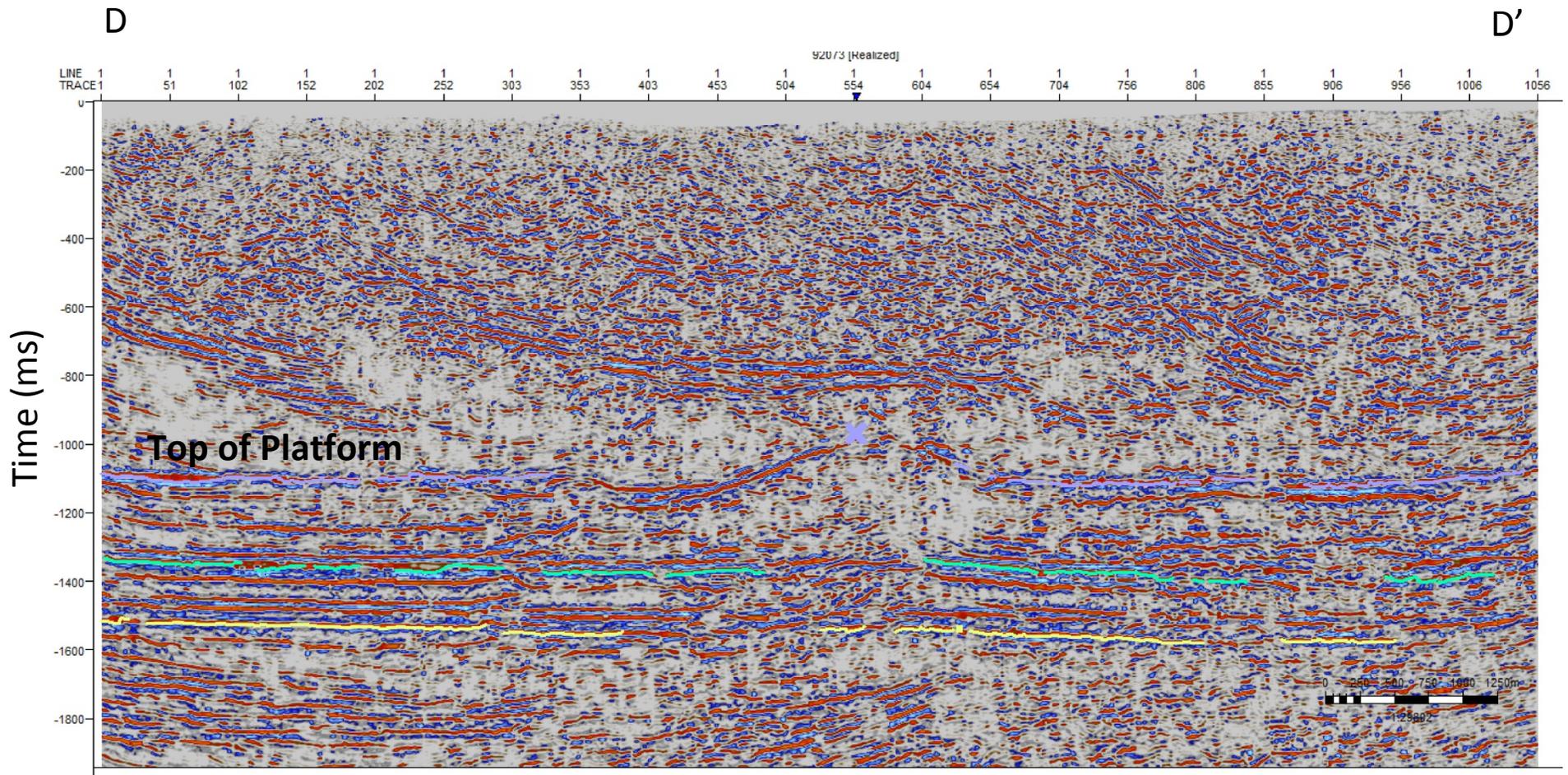


- Platform autochthonous - folded to surface due to basement duplex.
- Humber Arm Allochthon consisting of imbricated Cow Head Gp. and Lower Head Fm.

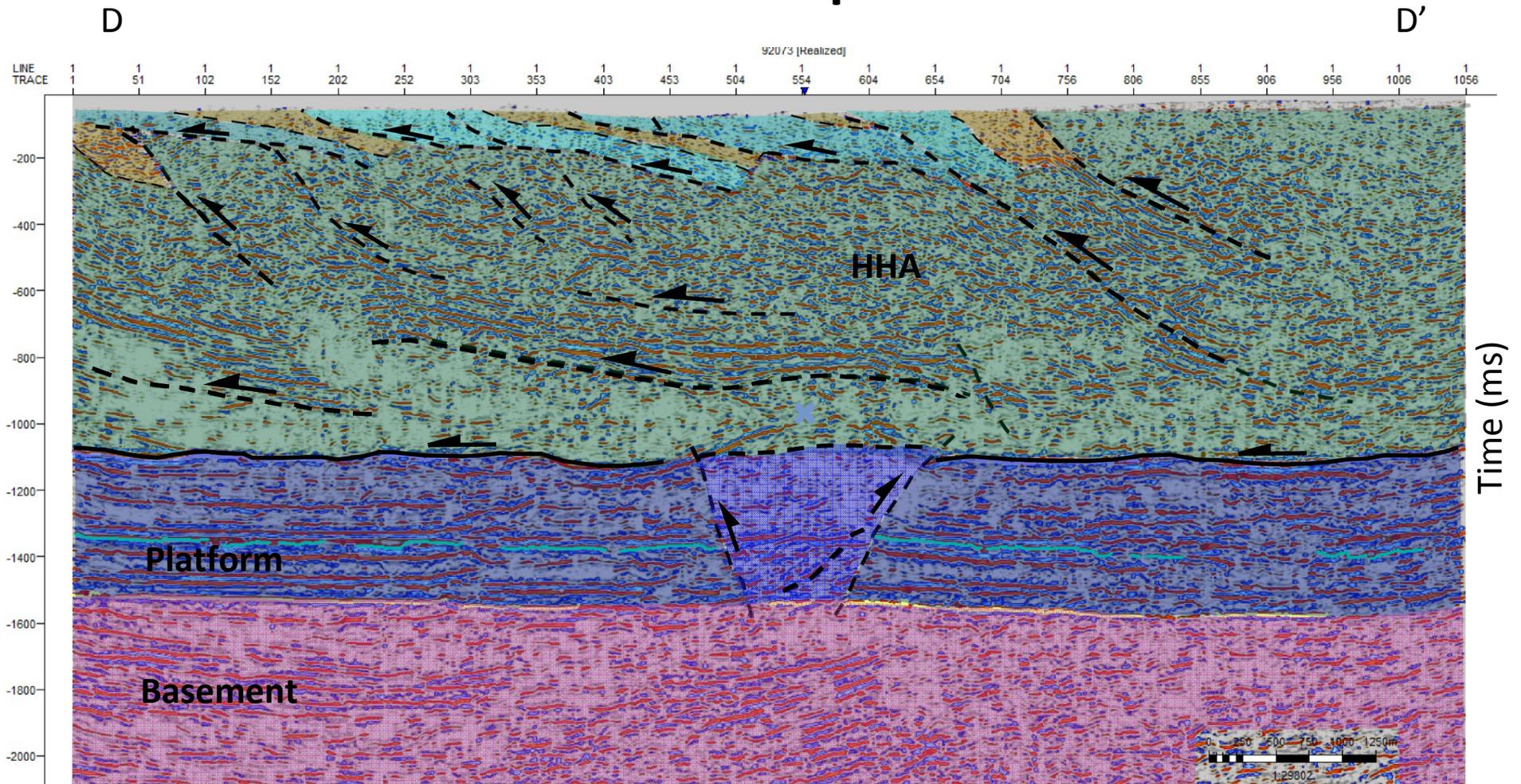
2D Seismic Reflection Data



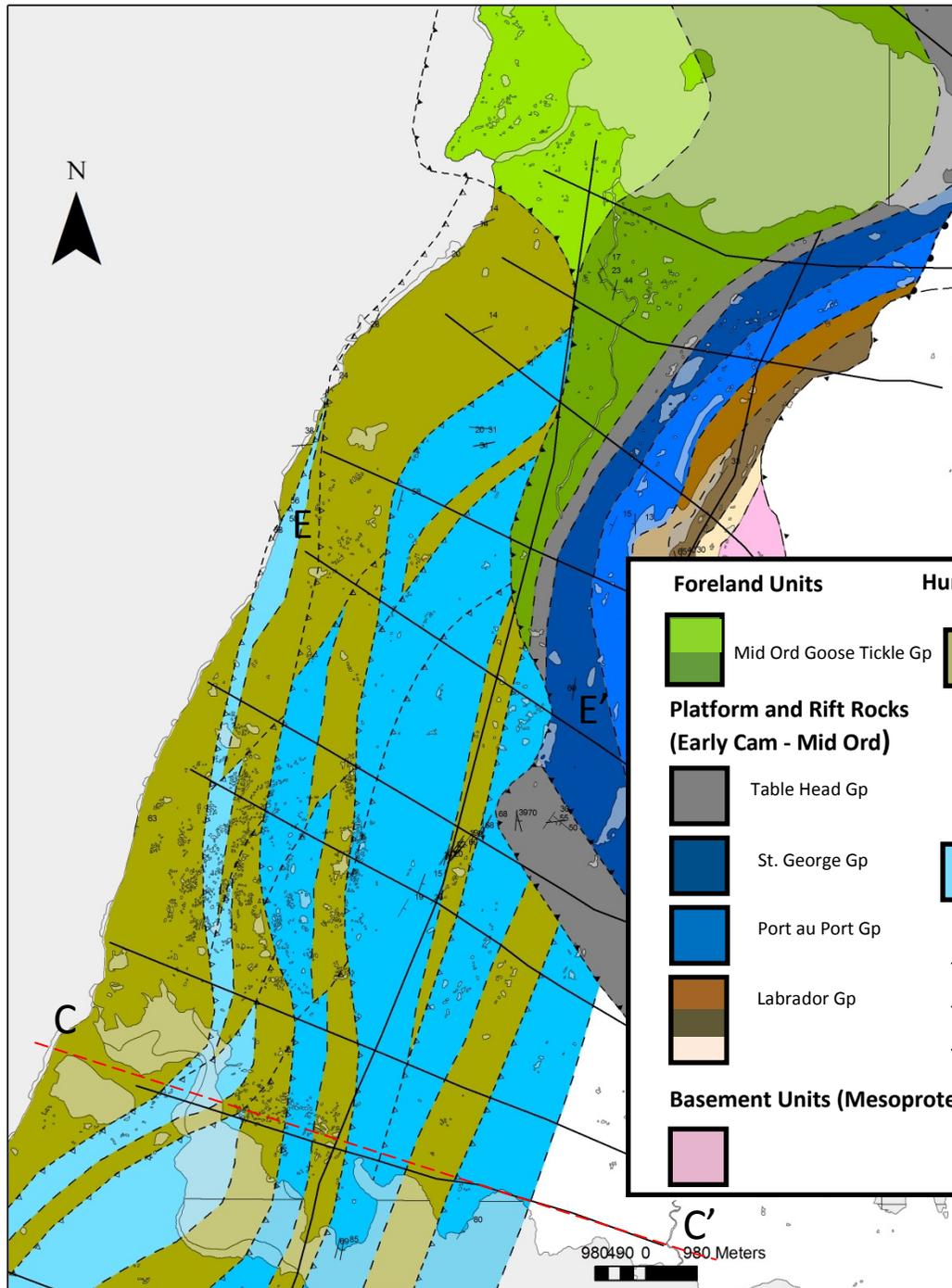
2D Seismic Reflection Data



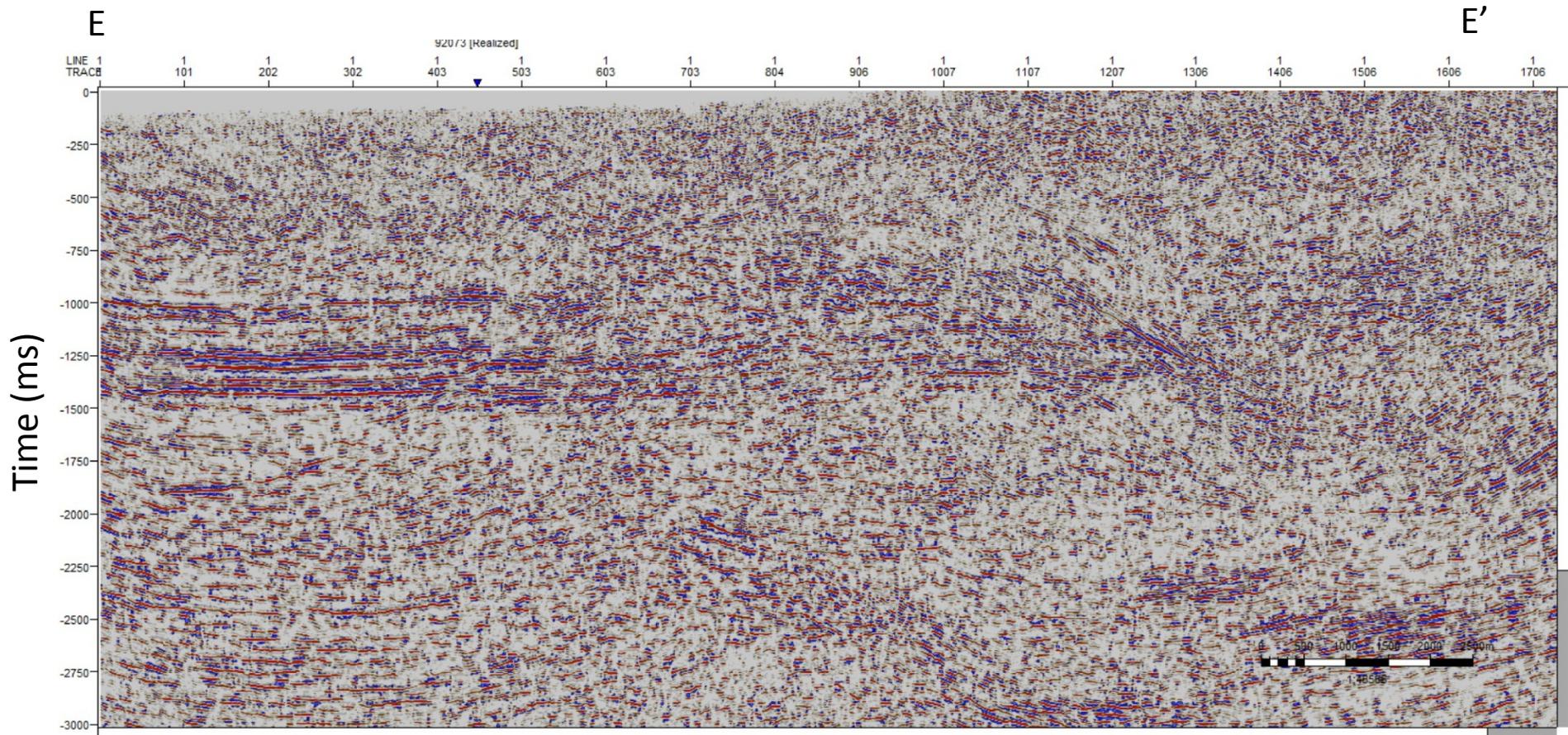
New Interpretation



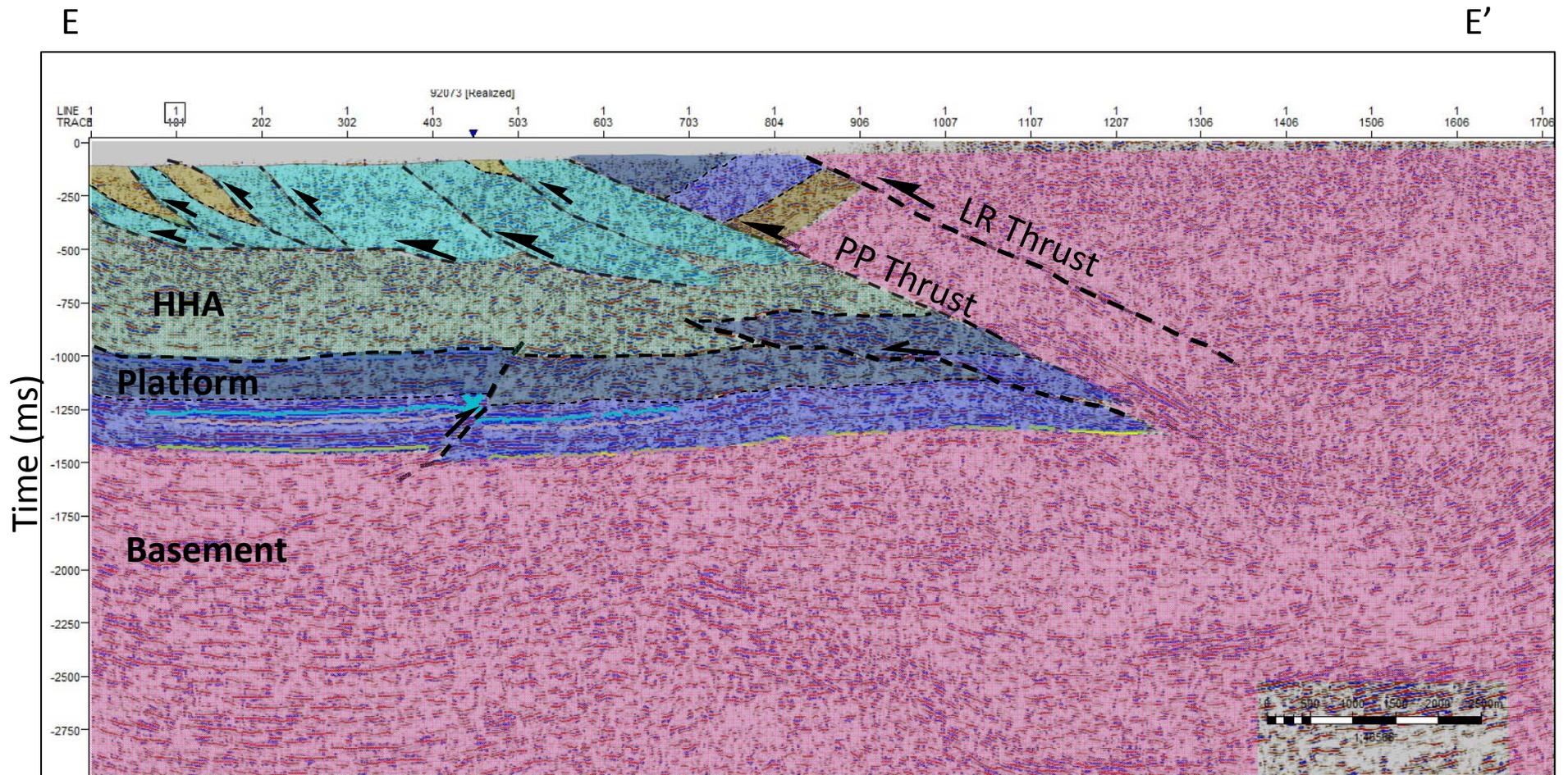
- Platform remains at depth below line of section (~2700 km).
- HHA involves duplexing of strata and stacking of duplexes.
- Late pop up structures (reactivation of deep basement faults).



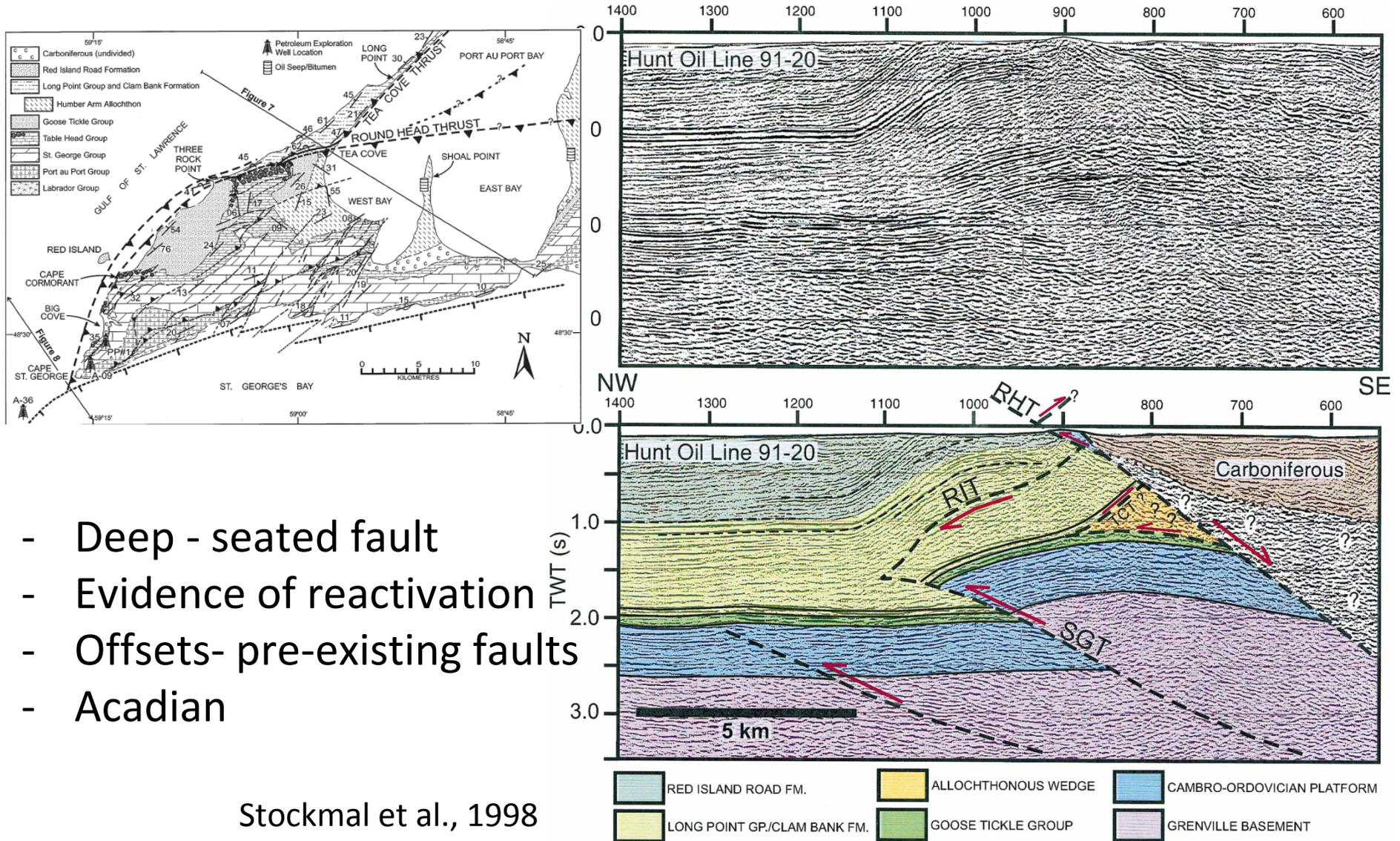
2D Seismic Reflection Data



2D Seismic Reflection Data

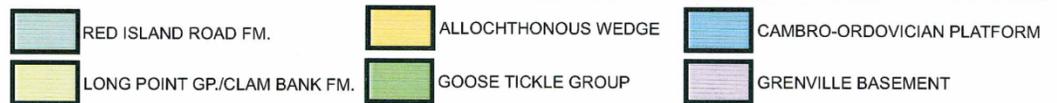


Round Head Thrust: Port au Port Peninsula

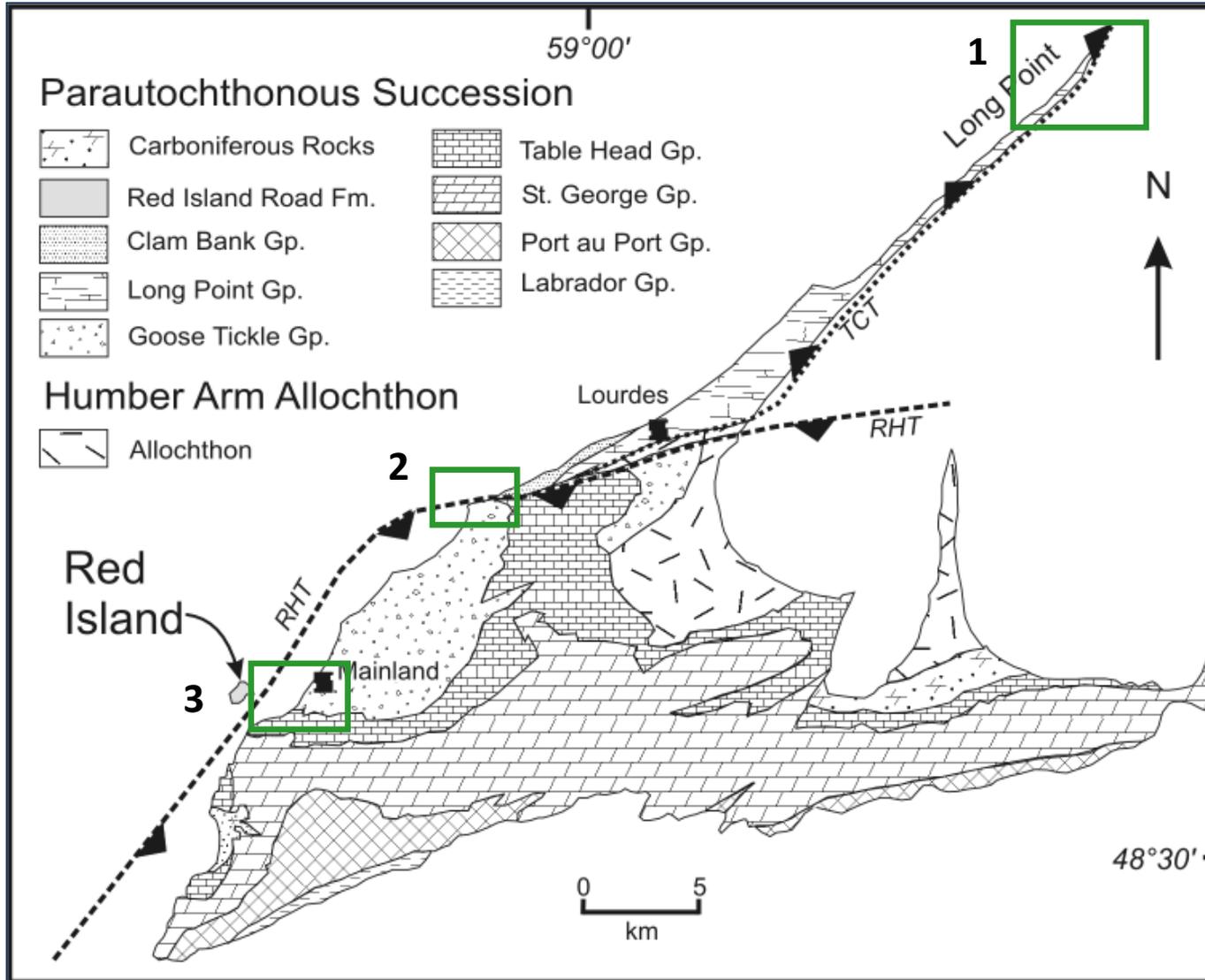


- Deep - seated fault
- Evidence of reactivation
- Offsets- pre-existing faults
- Acadian

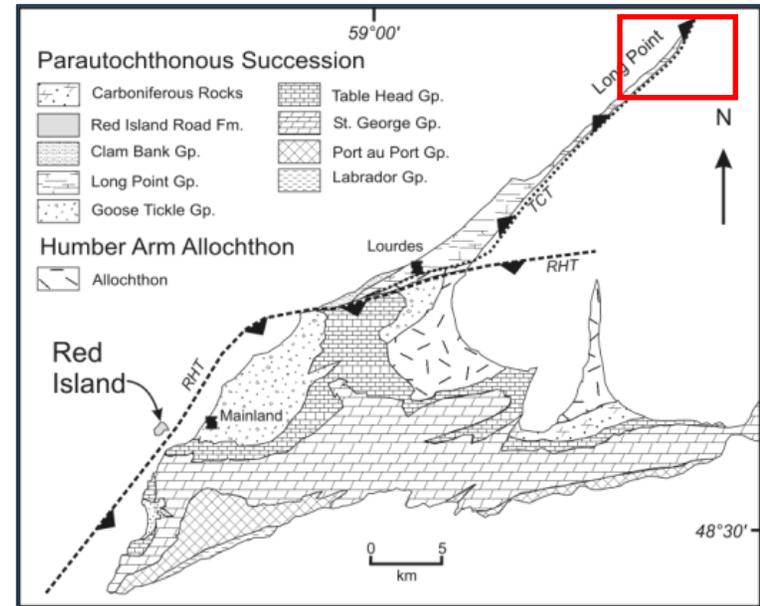
Stockmal et al., 1998



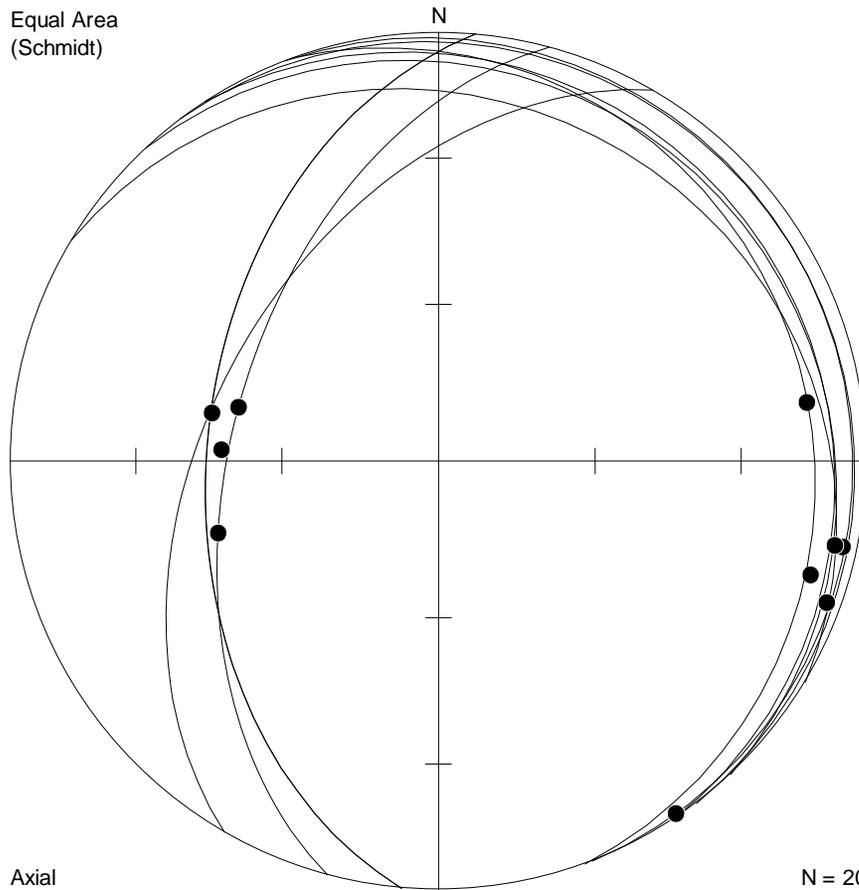
Round Head Thrust



Footwall of RHT- Long Point



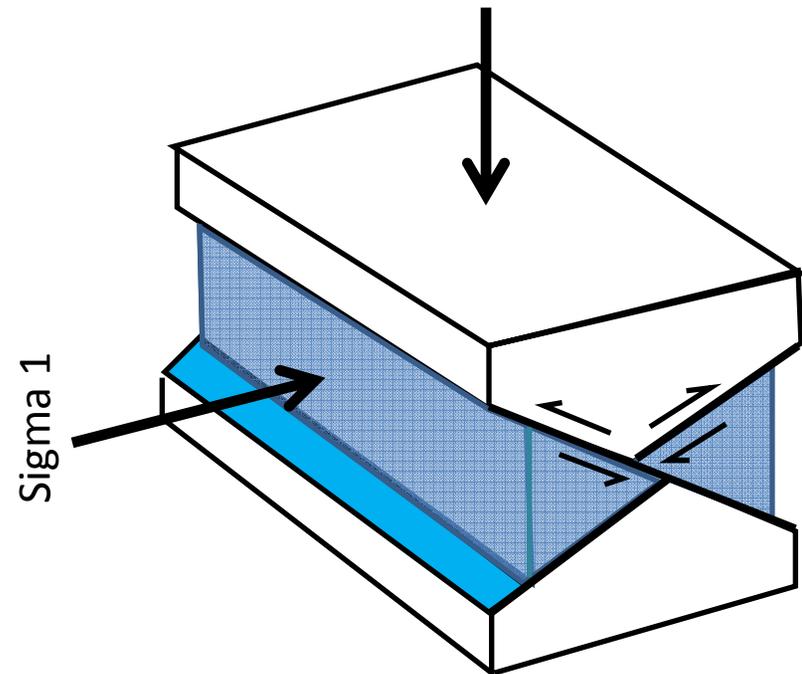
Equal Area
(Schmidt)



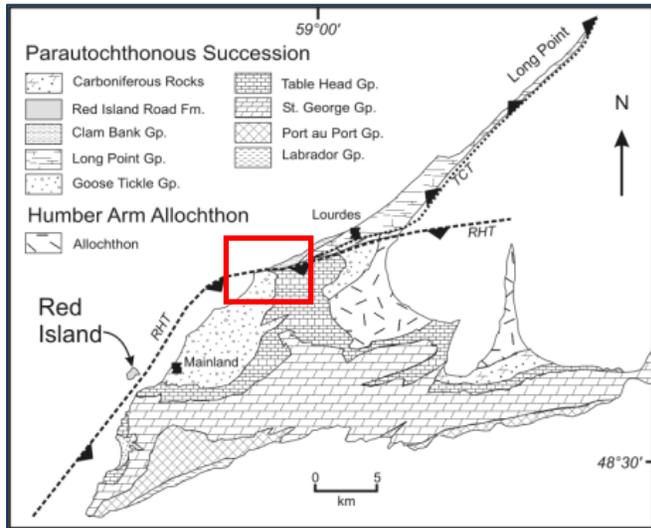
Axial

N = 20

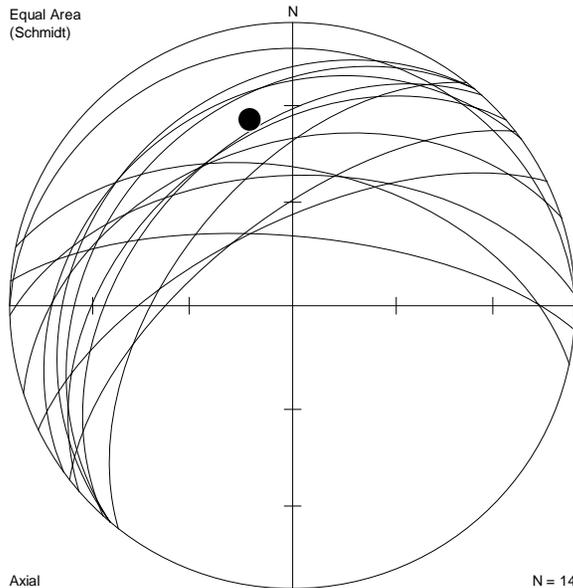
Sigma 3



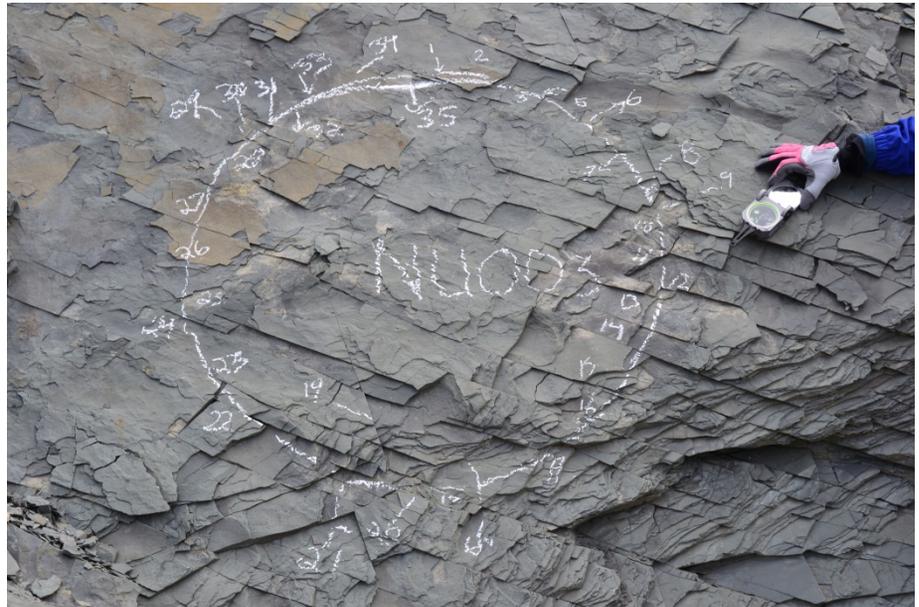
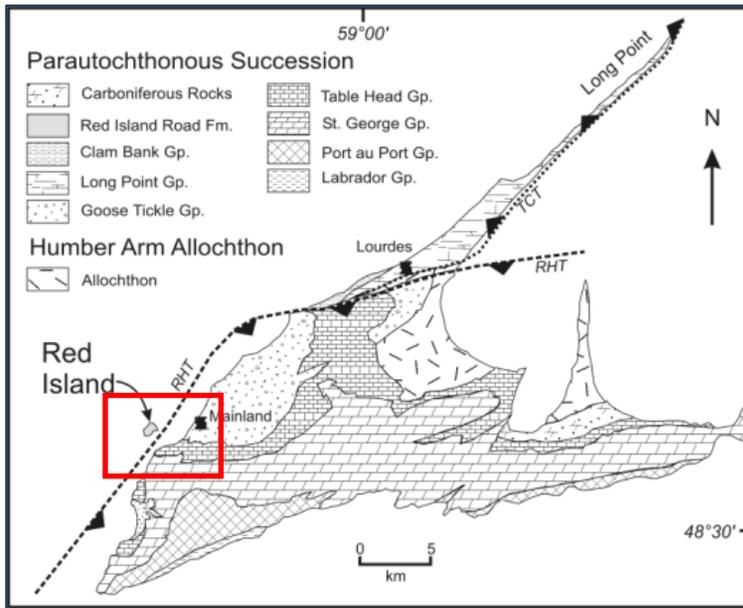
Footwall of RHT- Three Rock Point



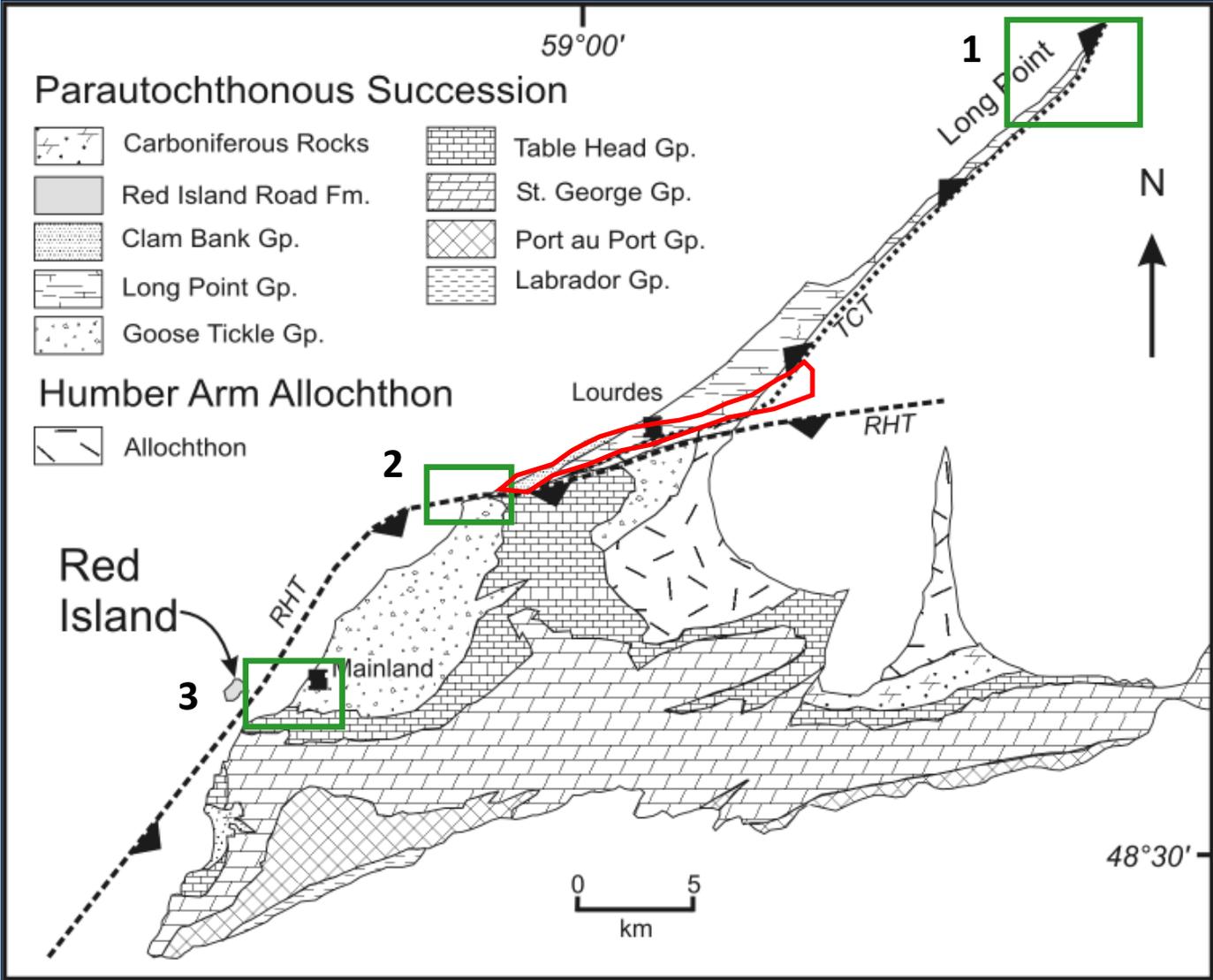
Equal Area
(Schmidt)



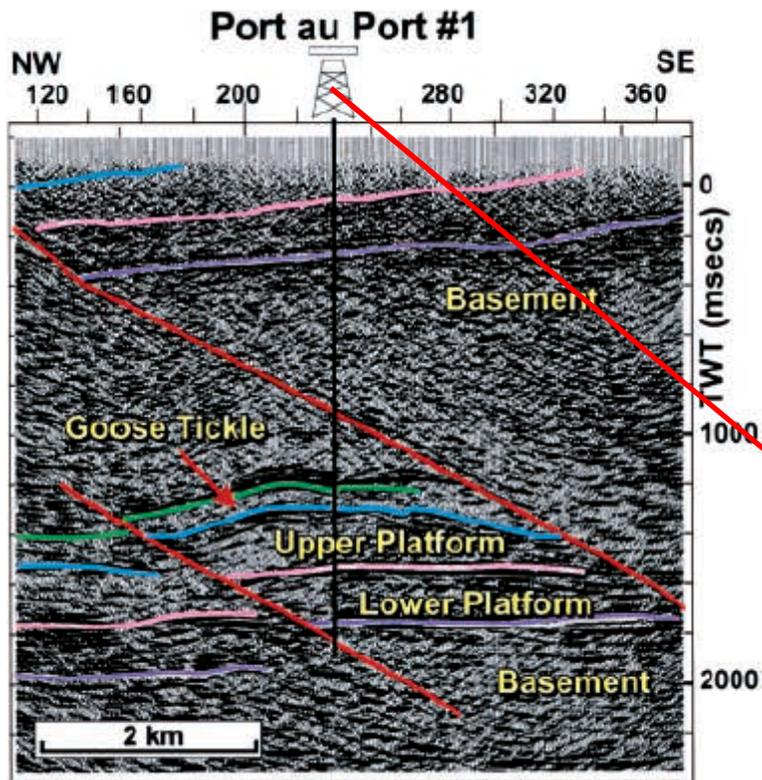
Hanging Wall of RHT-Cape Cormorant



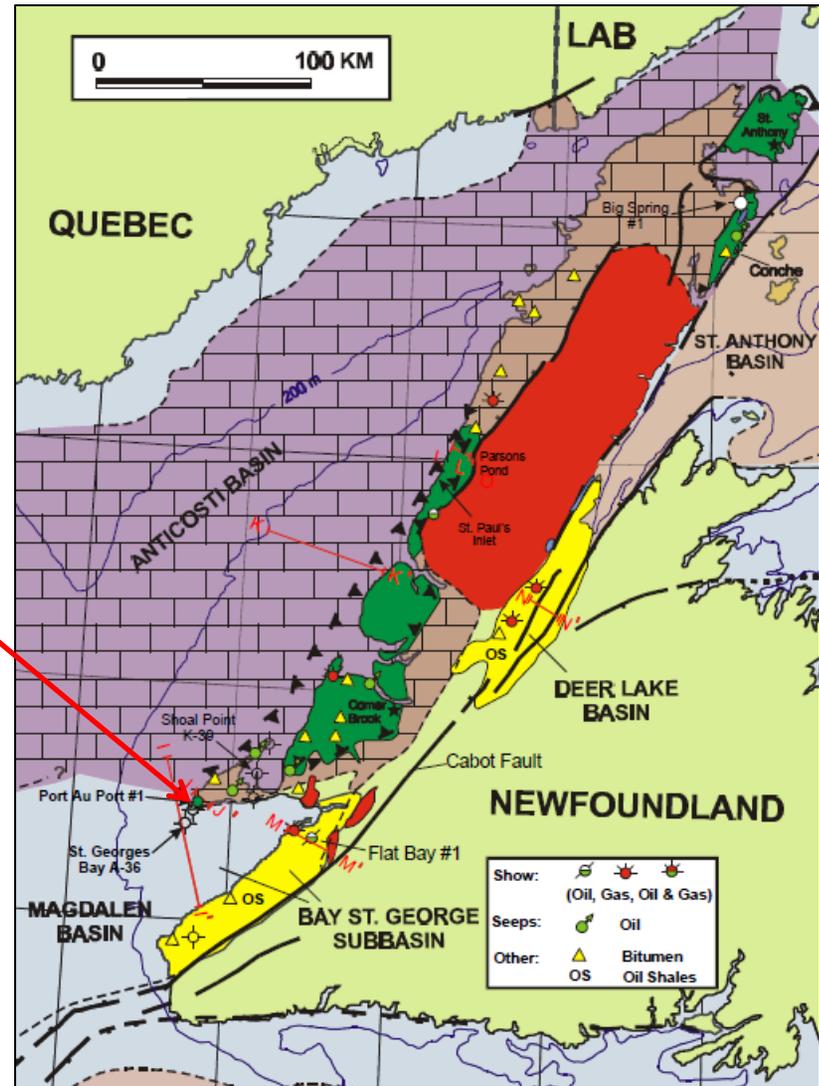
Round Head Thrust



Round Head Thrust: Petroleum Potential on Port au Port Peninsula

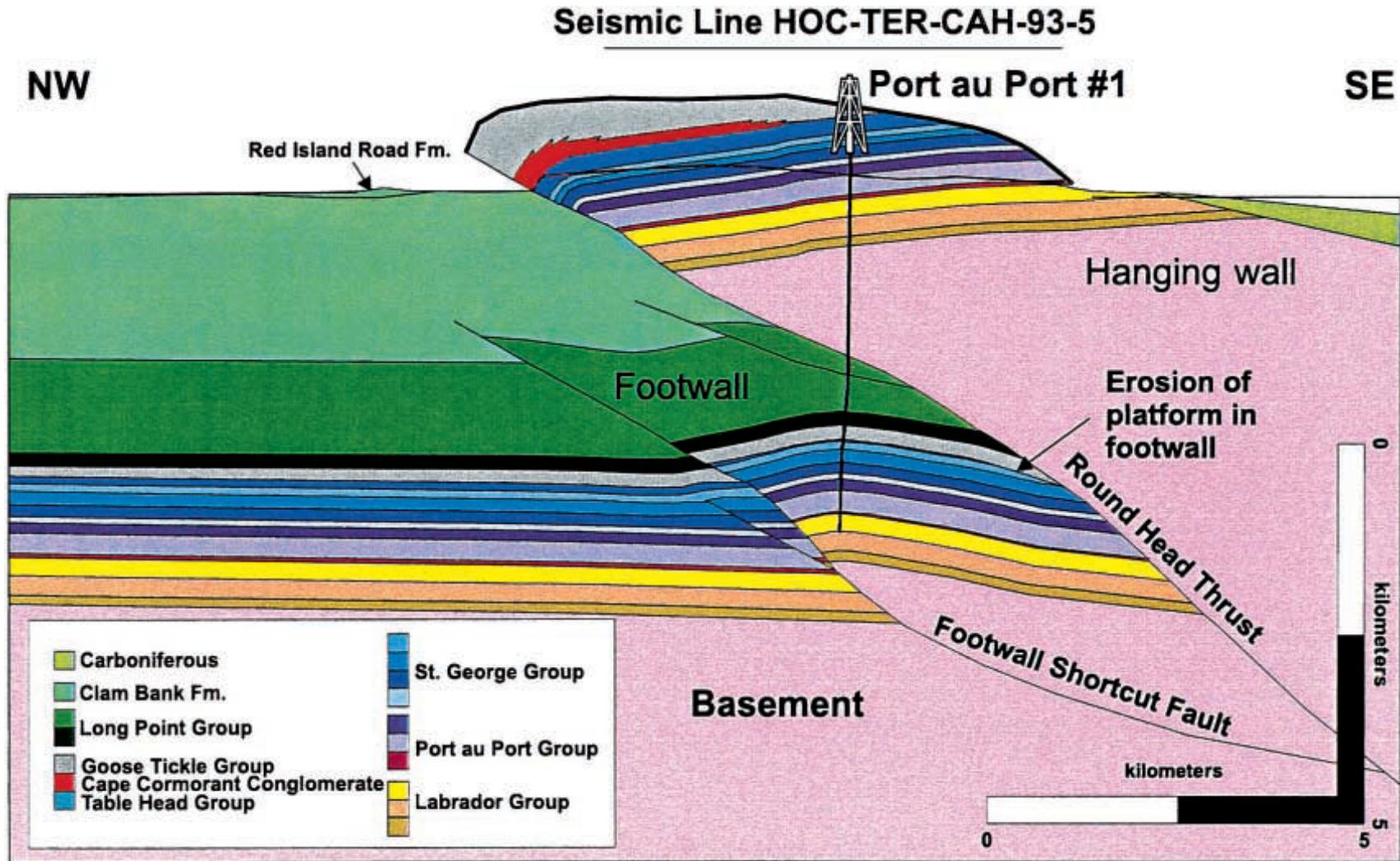


Cooper et al., 2001



NL Dept. of Mines and Ener: Report 2000-01

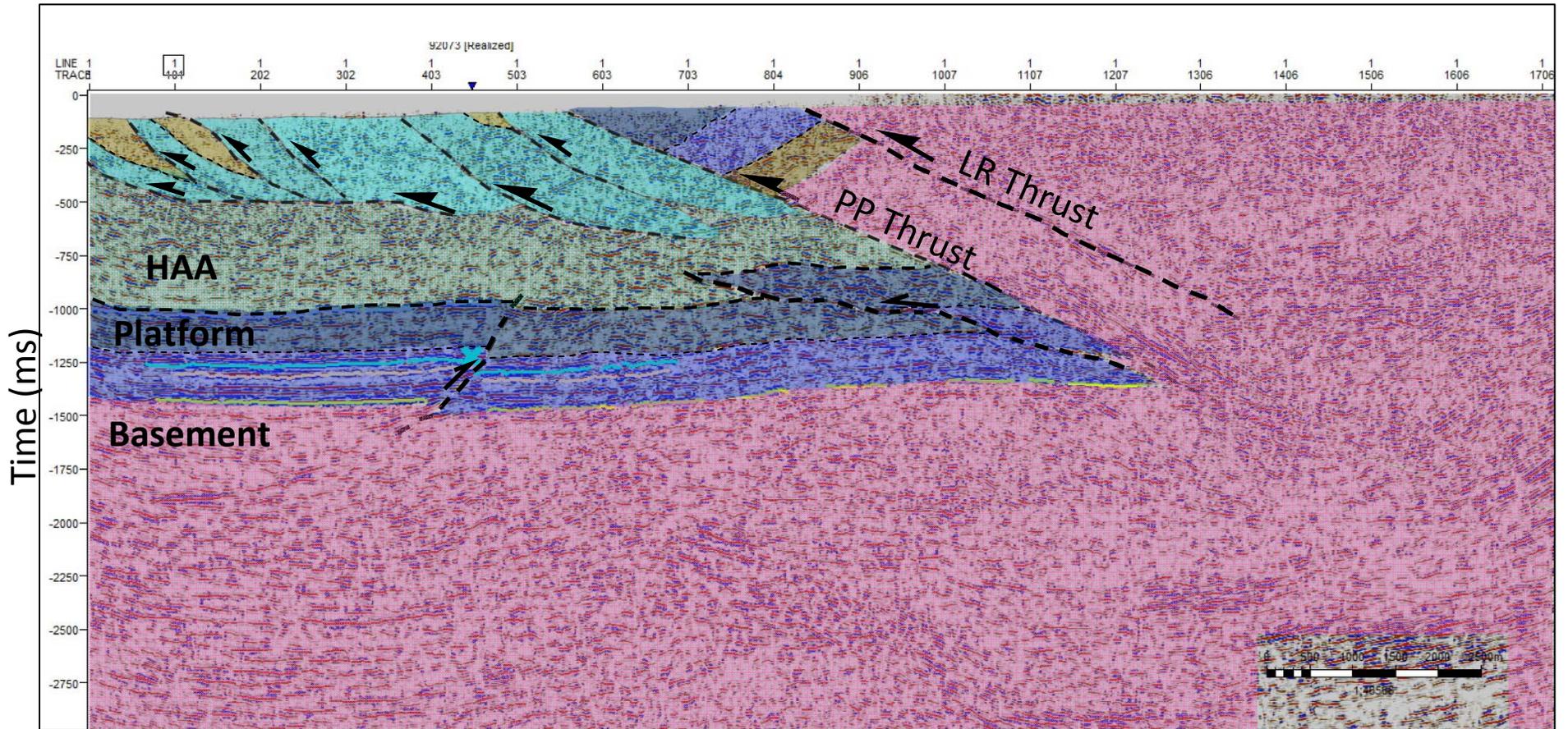
Port au Port-Round Head Thrust



Cooper et al., 2001

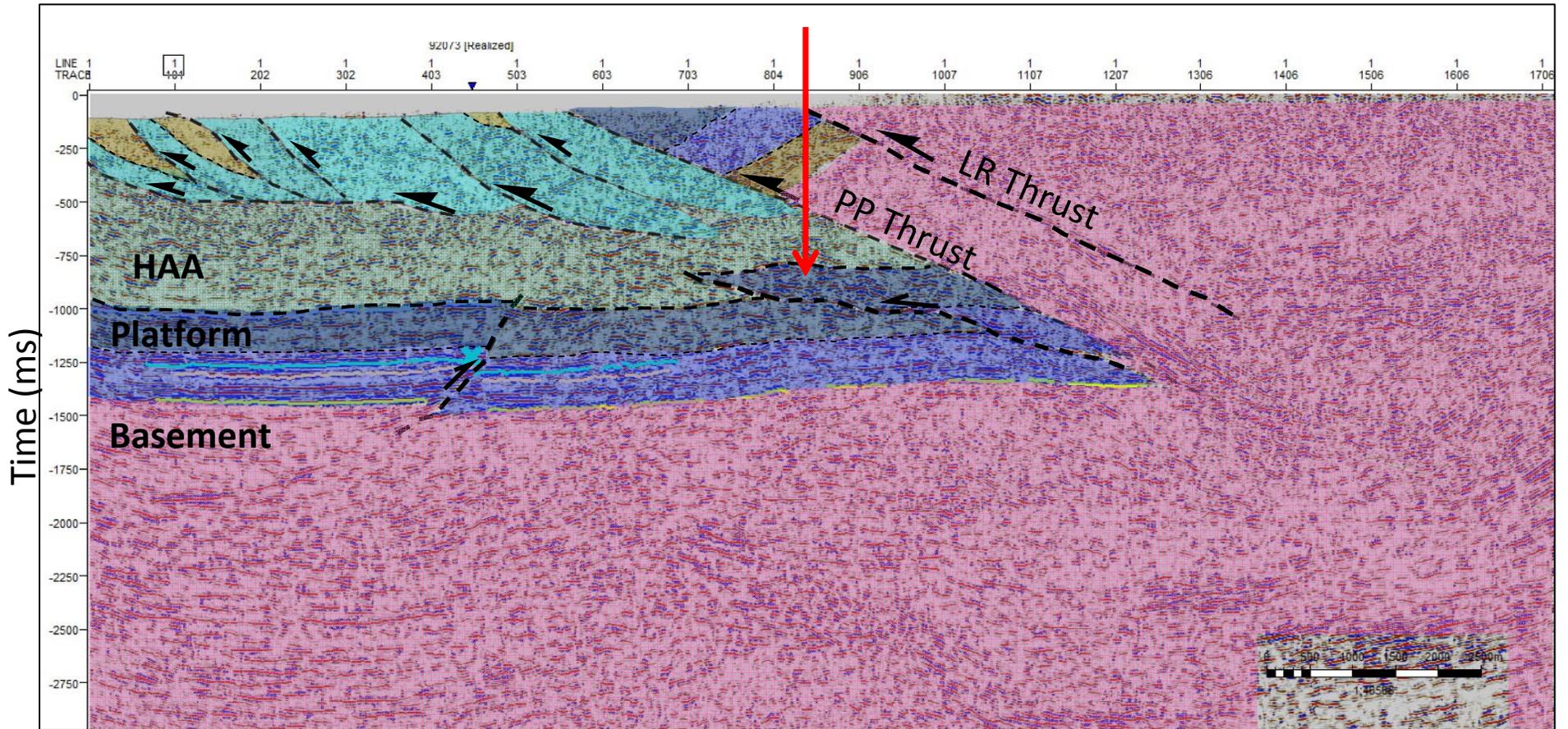
Parsons Pond Thrust, Parsons Pond

E E'



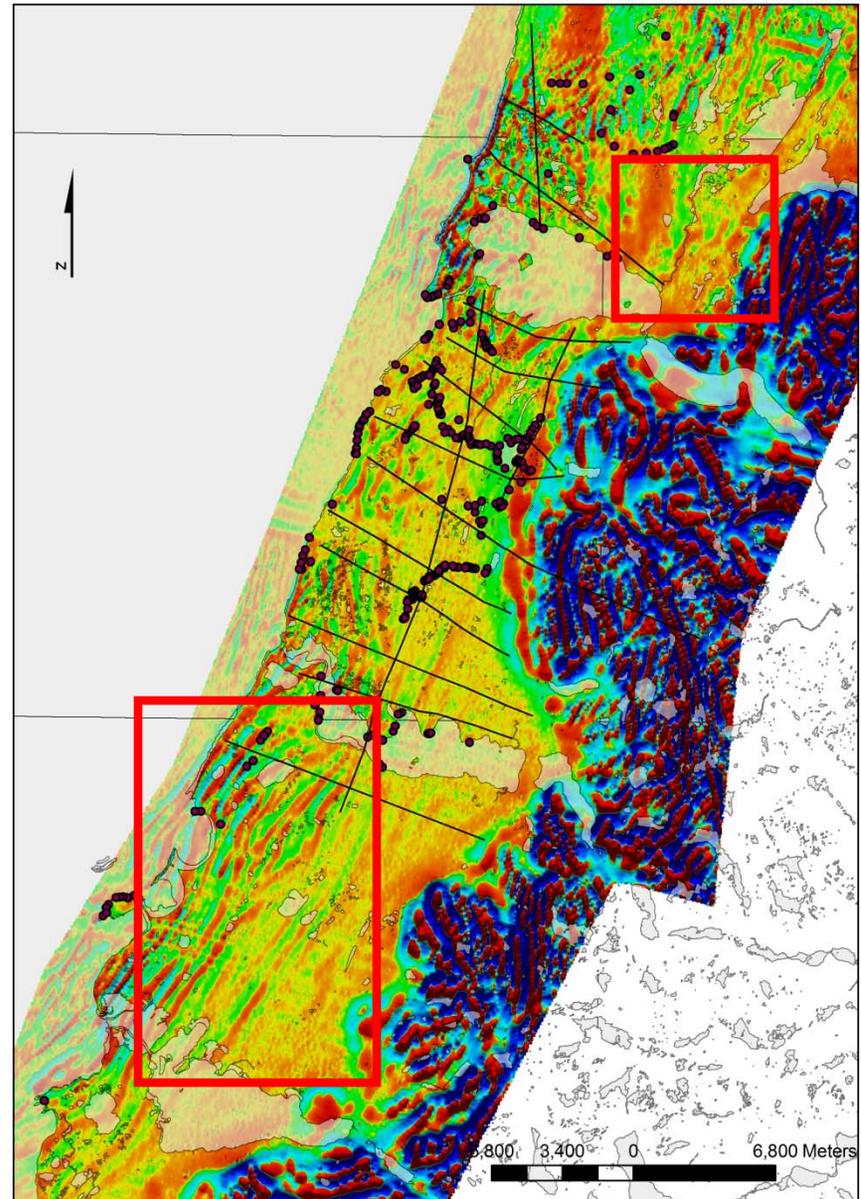
Parsons Pond Thrust, Parsons Pond

E E'



Future Work- Parsons Pond

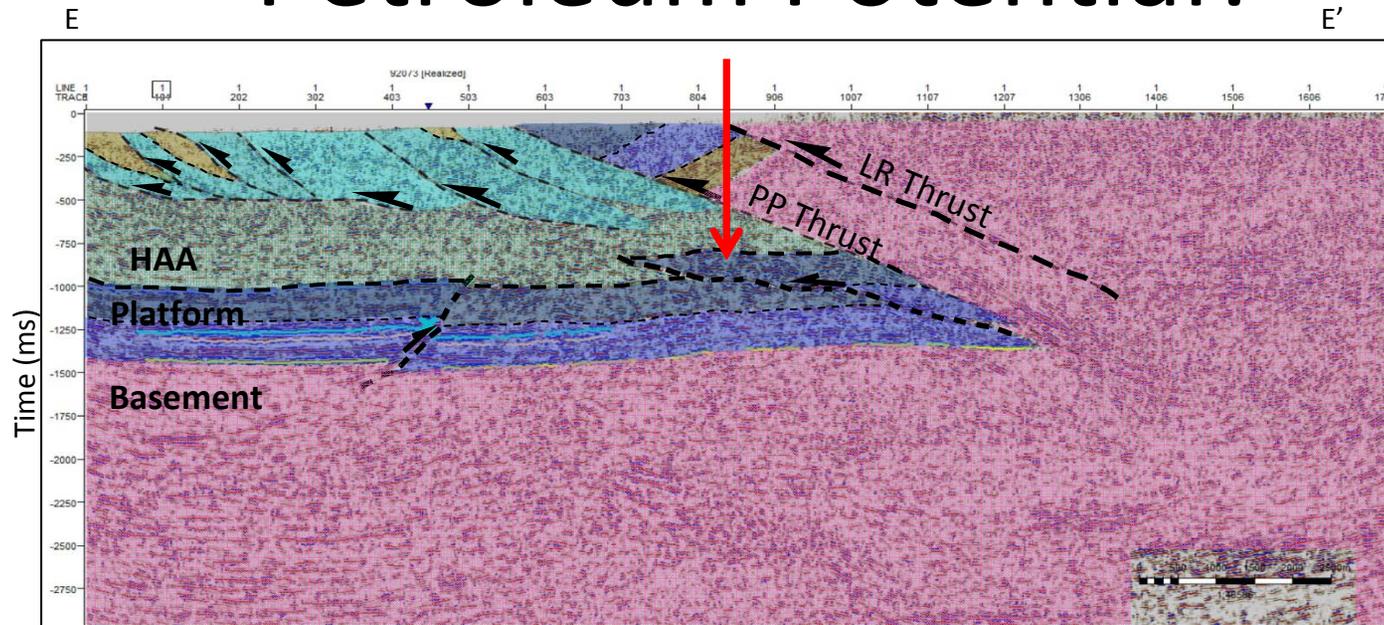
- Completion of regional map
- Completion of 2D seismic reflection data interpretation
- Completion of 3D structural model



Conclusions

- Middle Ordovician (Taconian) thrusting of Humber Arm Allochthon rocks over platform:
 - Deformation was thin skinned.
 - Not simple imbrication- duplex structures formed within HHA rocks.
 - Duplex structures are stacked (timing uncertain).
 - These structures formed due to N-NW thrusting.
 - Platform rocks in the footwall are generally not folded.
- Later Early Devonian (Acadian) thrusting:
 - Deformation involved deep-seated, basement involved faults.
 - These thrusts appear to be reactivated faults.
 - Platform rocks in the Parsons Pond area are transported westward above HHA rocks.
 - Platform rocks sit in the hanging wall of the Parsons Pond thrust.
 - Parsons Pond thrust carries significant displacement.

Petroleum Potential?



- Platform rocks in the footwall of the Parsons Pond thrust produced gas.
- Target was a north-south trending structural high (reactivated normal faults – pop up structure?).
- Humber Arm Allochthon rocks are a potential target.
- Structures associated with the Parsons Pond thrust might also be potential structural traps (Analogue: Round Head thrust, Port au Port Peninsula).



Thanks!