

Quebec's Horizontal New Play for Light Oil in the Gaspé Peninsula: Reprocessed 2-D Seismic Reveals Complex Structures that could be Significant Fields*

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Search and Discovery Article #20364 (2016)**

Posted August 15, 2016

*Adapted from oral presentation given at AAPG Annual Convention and Exhibition, Calgary, Alberta, Canada, June 19-22, 2016

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Abstract

The search for commercial quantities of light oil in the Gaspé Peninsula looks promising along trend with the 2014 announced oil discovery in Galt Field. This discovery required horizontal drilling to maximize the wellbore contact with natural fractures and porosity in the previously uncommercial, Devonian-aged, Forillon Formation. Horizontal drilling is the key to commercial oil production in the Gaspé area. Thousands of acres along trend of the Galt Field discovery require a re-assessment as to horizontal drilling and exploration potential. This presentation will show where new discoveries could be found in central Gaspé Peninsula, based on reprocessed 2D pre-stack PSTM seismic lines, and surface and subsurface integration of geologic data. Mundiregina Resources Canada reprocessed 2008 2D lines in 2014-2015 and achieved an improvement in data quality. Reprocessed lines now image large thrust anticlines and synclines in central Gaspé. Interpretation of the reprocessed seismic lines will be presented. The Gaspé area Silurian and Devonian rocks were deformed into an Appalachian-style thrust belt during the Acadian Orogeny. Tectonic forces included syn-sedimentary, listric, faulting during the Silurian, and thrusting and strike-slip movement during the Middle Devonian. Carbonate and siliciclastic rocks experienced hydrothermal fluids along faults and fractures during structural movement, enhancing porosity. Ordovician source rocks charged the overlying Silurian and Devonian section. A key piece of well data for the area is the Mont Alexandre #1 well (2009) which penetrated the Forillon Formation along trend with Galt Field. The key elements of productive Forillon reservoirs, including hydrothermal dolomite in natural fractures, are demonstrated to exist in surface outcrops along trend to Galt Field, and over an extensive area of the central Gaspé Peninsula. Older wells in the central Gaspé were shallow, vertical wells. Light oil potential was left undiscovered by abandoning these old wells.

Quebec's Horizontal New Play for Light Oil in the Gaspé Peninsula:

Reprocessed 2D Seismic Reveals Complex Structures That Could Be Significant Fields

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AAPG ACE Calgary 2016

Quebec, Canada

A new light oil frontier

Great source rocks!!

**Light Oil (condensate)
discoveries**

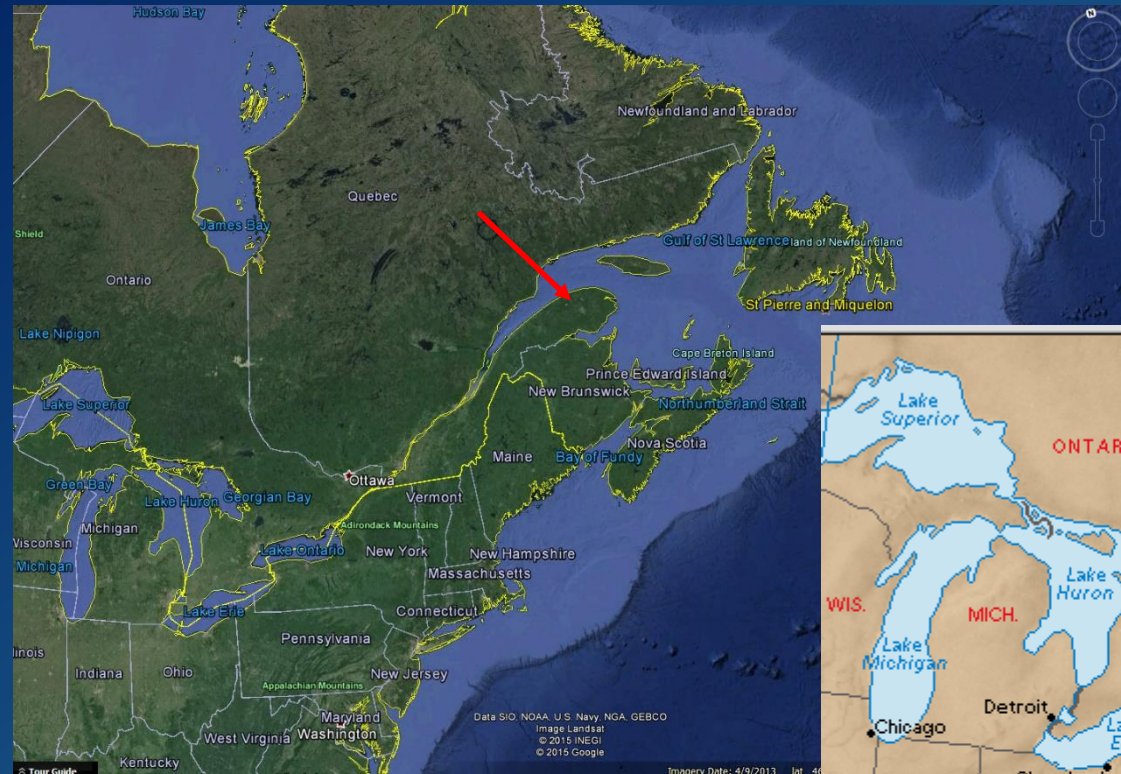
Thick oil columns

**Undrilled fairways and large
structures**

Location of the Gaspé Peninsula



Appalachian Fold Belt

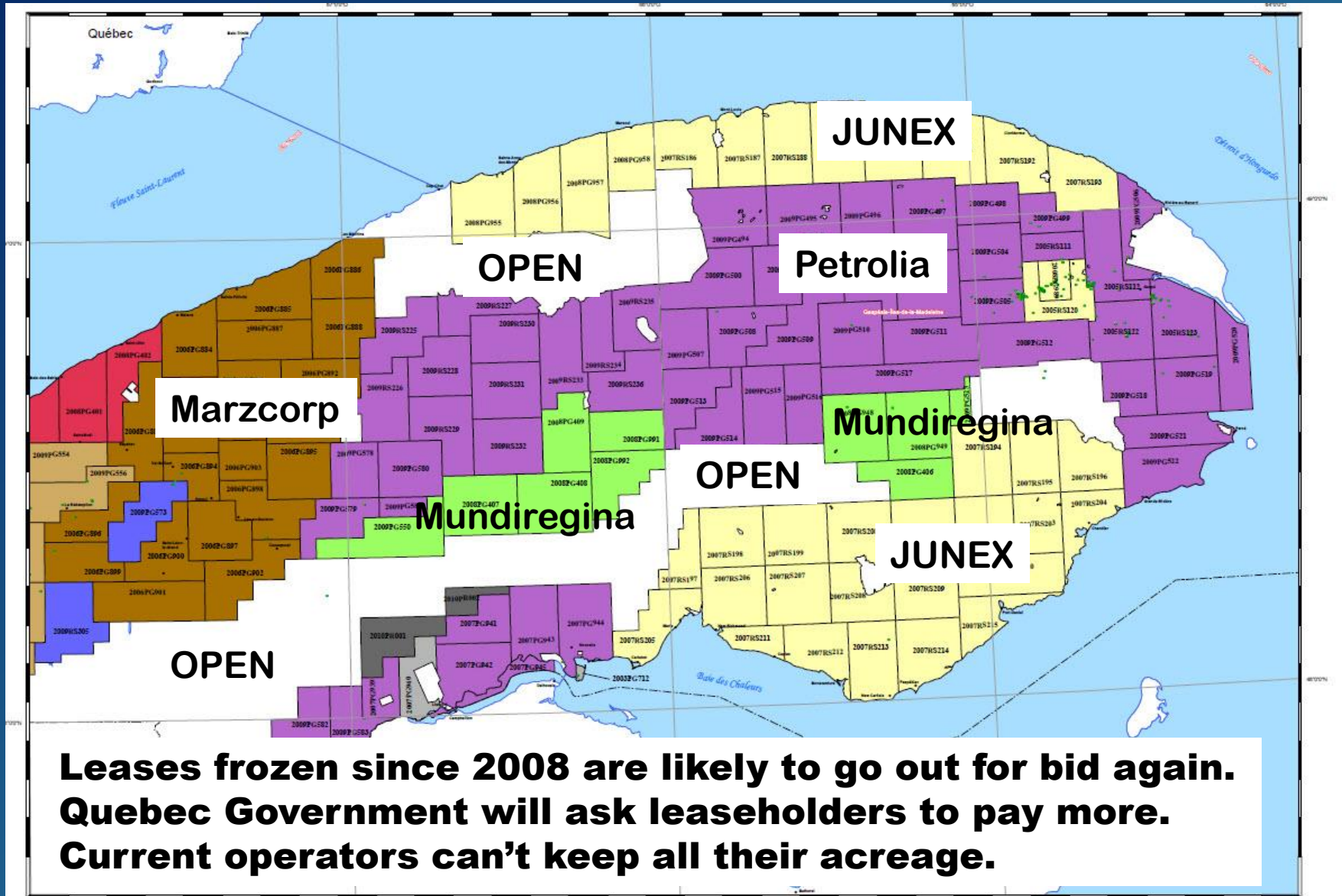


Notice that the Gaspé Peninsula is the northern-most expression of the U.S. Appalachian fold belt

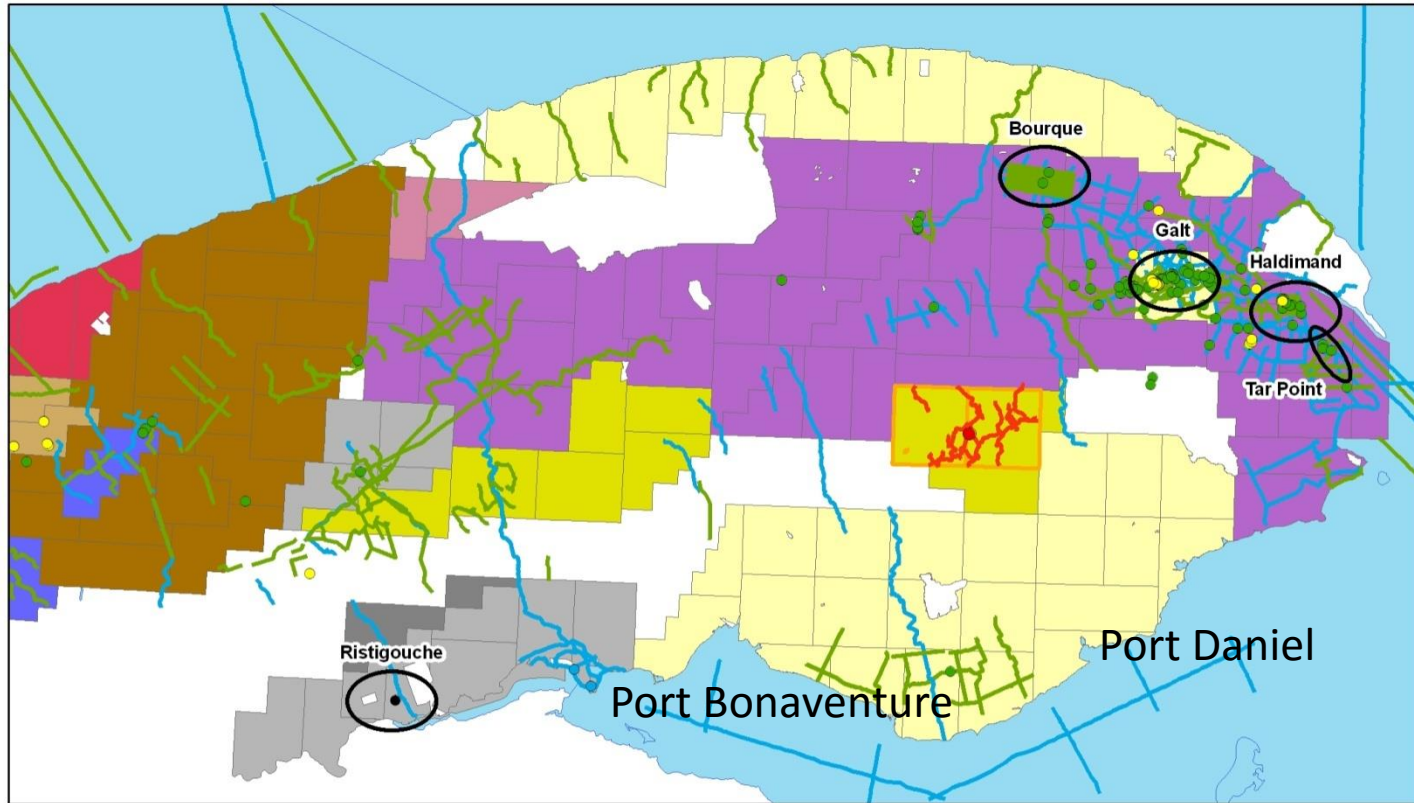
Logan's line



Upcoming Lease Opportunities

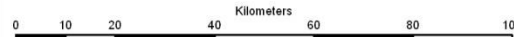


Location of Discoveries & Deepwater Ports



- | | | |
|----------------------------------|-----------------------------------|--------------------------------------|
| ABBA eastern exploration permits | Other companies wells | Soquip, MRN and Hydro-Quebec seismic |
| Hydro-Quebec P&G wells | Diamond coring wells for O&G | Mundiregina Resources Canada seismic |
| ABBA Quebec Resources well | Permitted locations - not drilled | Other companies seismic |

Gaspé Peninsula exploration status



Mundiregina Resources Canada Inc.





JUNE
En route to the first
commercial oil production
in Quebec?

**People think this is a
gas play, but its not!**

Proven Commercial Oil

**Source rocks are in the
oil window**



**OIL DISCOVERY AT GALT NO. 4
HORIZONTAL WELL**

Junex Oil Discovery- Galt Field

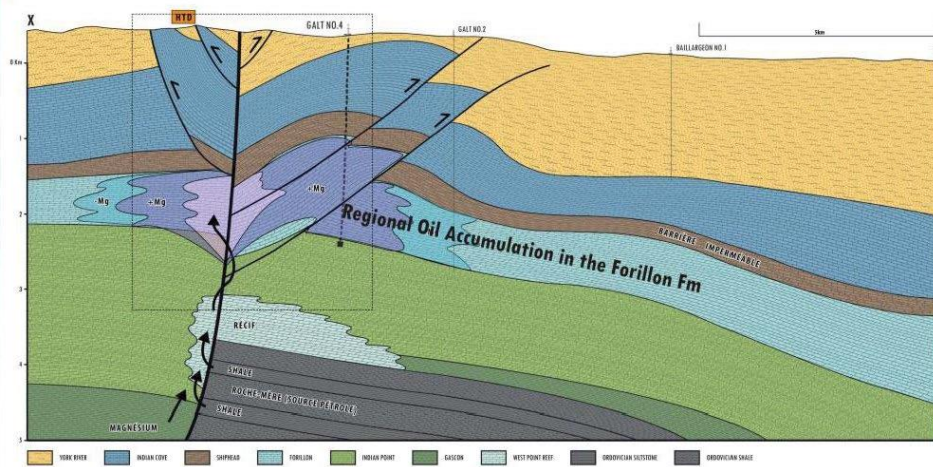
- **Canadian junior oil company, owns majority of field**
- **557 MMBO in place , 71 MMBO Recoverable unrisks prospective oil**
- **modern horizontal drilling using their own rigs**
- **Galt #4 horizontal well, drilled in 2014, yielded 7200 barrels light sweet oil at 100-300 bbl/day.**
- **Successful DST of oil in the Galt #5 (8200 ft test)**
- **Large 3D processed in November 2015.**

Junex Oil Discovery- Galt Field

- Devonian-age low porosity reservoirs exploited by modern horizontal drilling using their own rigs
- Structural trap is a complicated strike-slip flower structure. 3D was required for well placement.

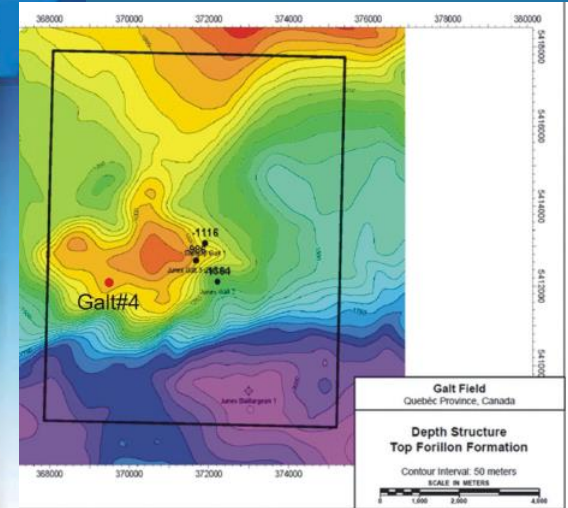
Exploration Model

JUNEX

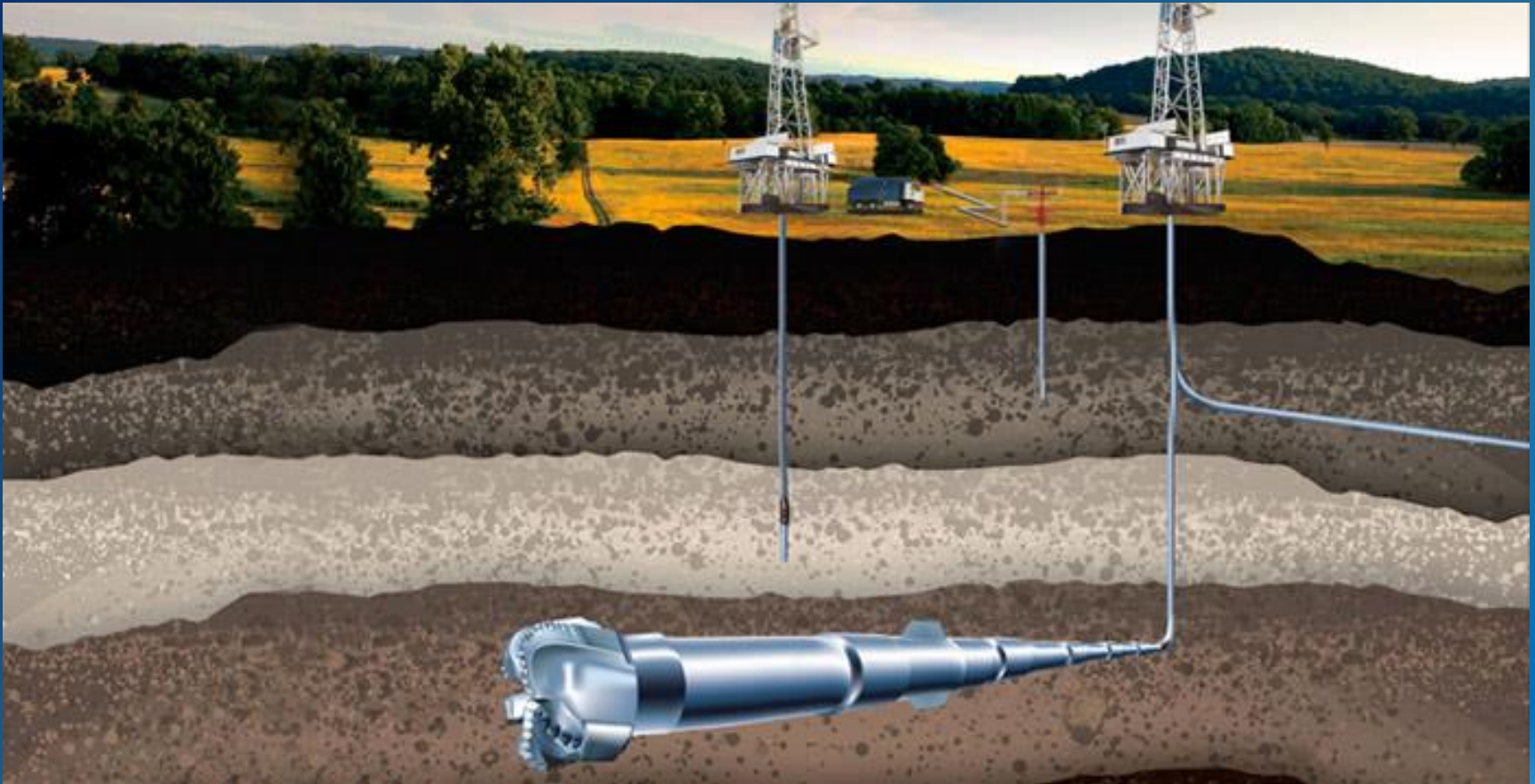


HTD

The presence of hydrothermal fluid that circulated through some rocky horizons is an encouraging increase in porosity in the formation.



Horizontal Drilling is the key to Gaspe production



Its important to intersect natural fractures

Geologic Setting

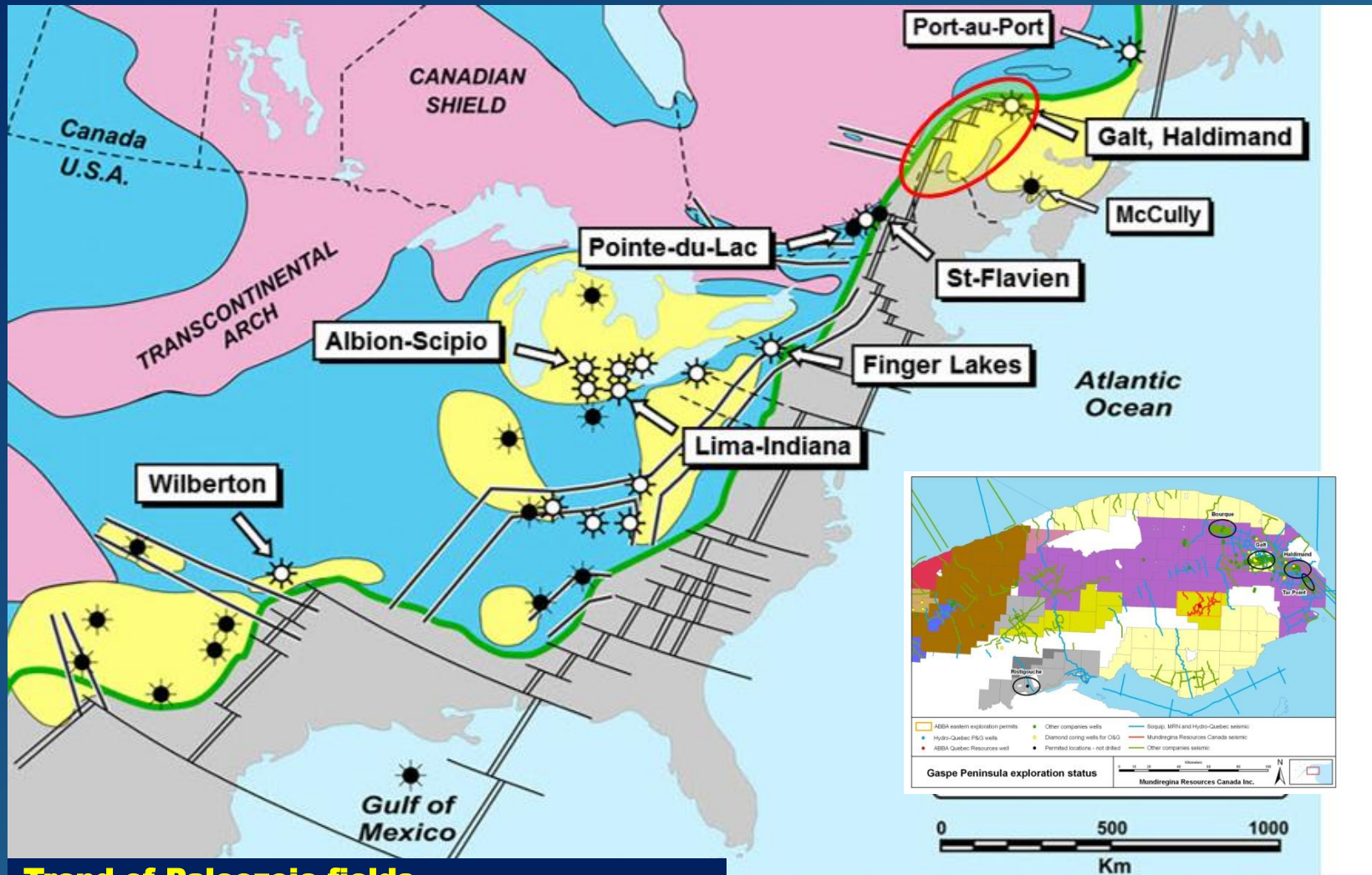
**Drilling History
1860-present**

**Stratigraphic Column:
Canada and the US**

Gaspe is a Continuation of U.S. Paleozoic Trends

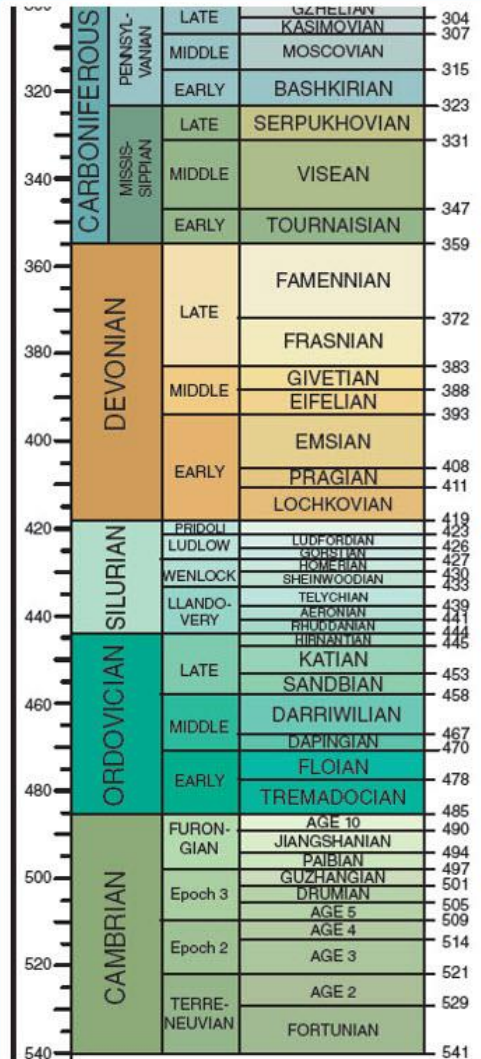


Trend of Paleozoic Fields



**Trend of Paleozoic fields
Cambrian, Ordovician, Silurian-Devonian**

Ordovician to Devonian Rocks



STRATIGRAPHIC COLUMN

NEW YORK USA	GASPE CANADA	SOURCE RX	RESERVOIR	Tectonic Events
EROSION	EROSION			341 --Alleghanian
Catskill Delta Red beds			sandstone	
Catskill shales Tully Limestone				Stronger impact
MARCELLUS SHALE	Battery Point Sands			402 Acadian Orogeny
MARCELLUS SHALE	York River Shale		sandy shales	
Oriskany Sandst	Indian Cove Lmst		fractured lime	volcanic intrusions
Helderberg Lmst	West Point Reefs		bioherms	
Lockport Dolomite	Gascon Limestone			
	Laforce shales			
	Whitehead Limestone		fractured lime	
Queenston Delta	Pabos Shale			
UTICA SHALE	MACASTY SHALE			464 Taconic Orogeny
Trenton Limestone	Limestones??		fractured lime	
Blackriver shale	Garin Sandstones		tight sandstone	
Knox Group	?? Equivalent??			
Potsdam Sandstone	Metamorphosed Cambrian			

Gaspe Drilling History

1836- first reports of seeping oil in Gaspe Peninsula

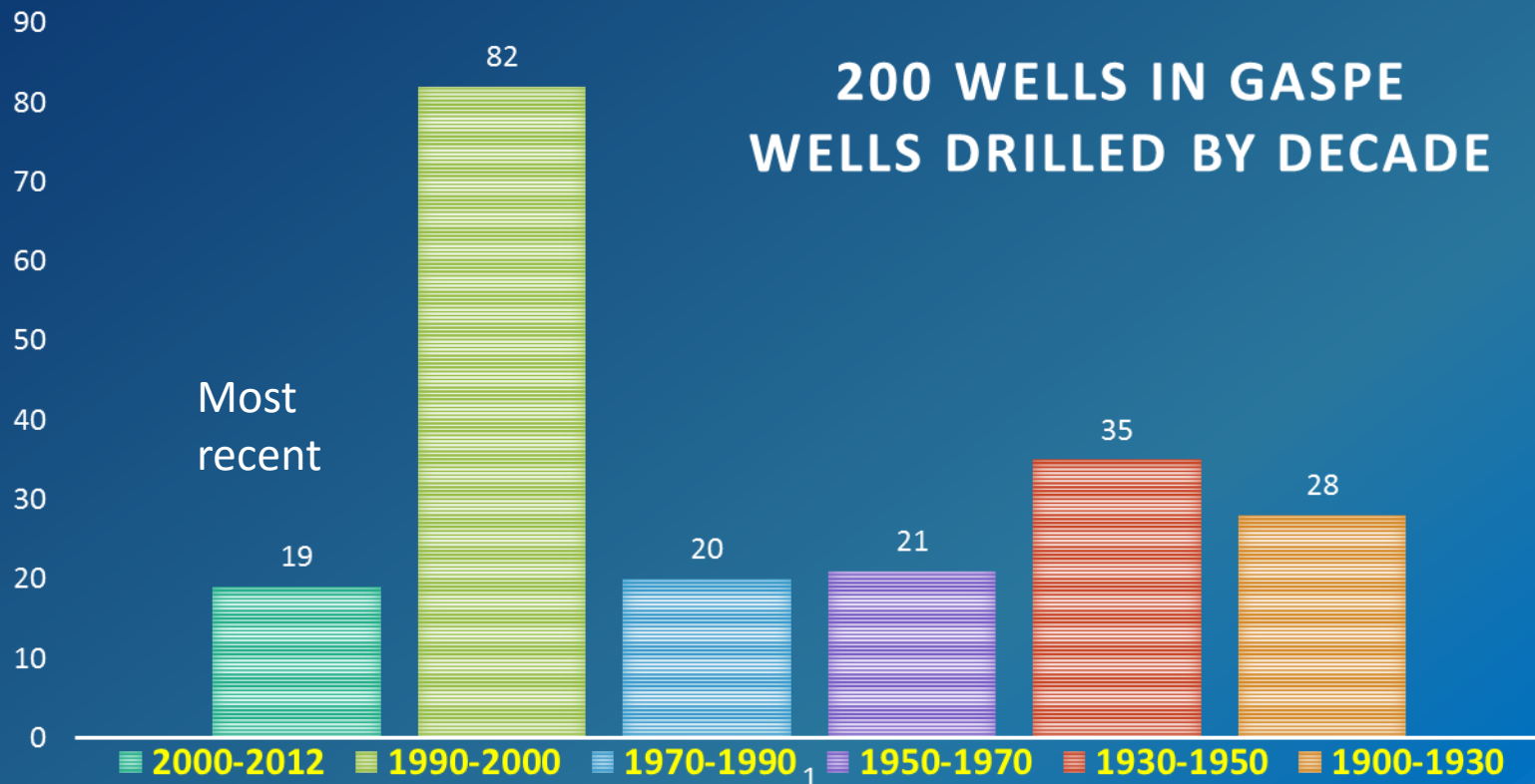
1860- first shallow drill holes

1897- first oil collected

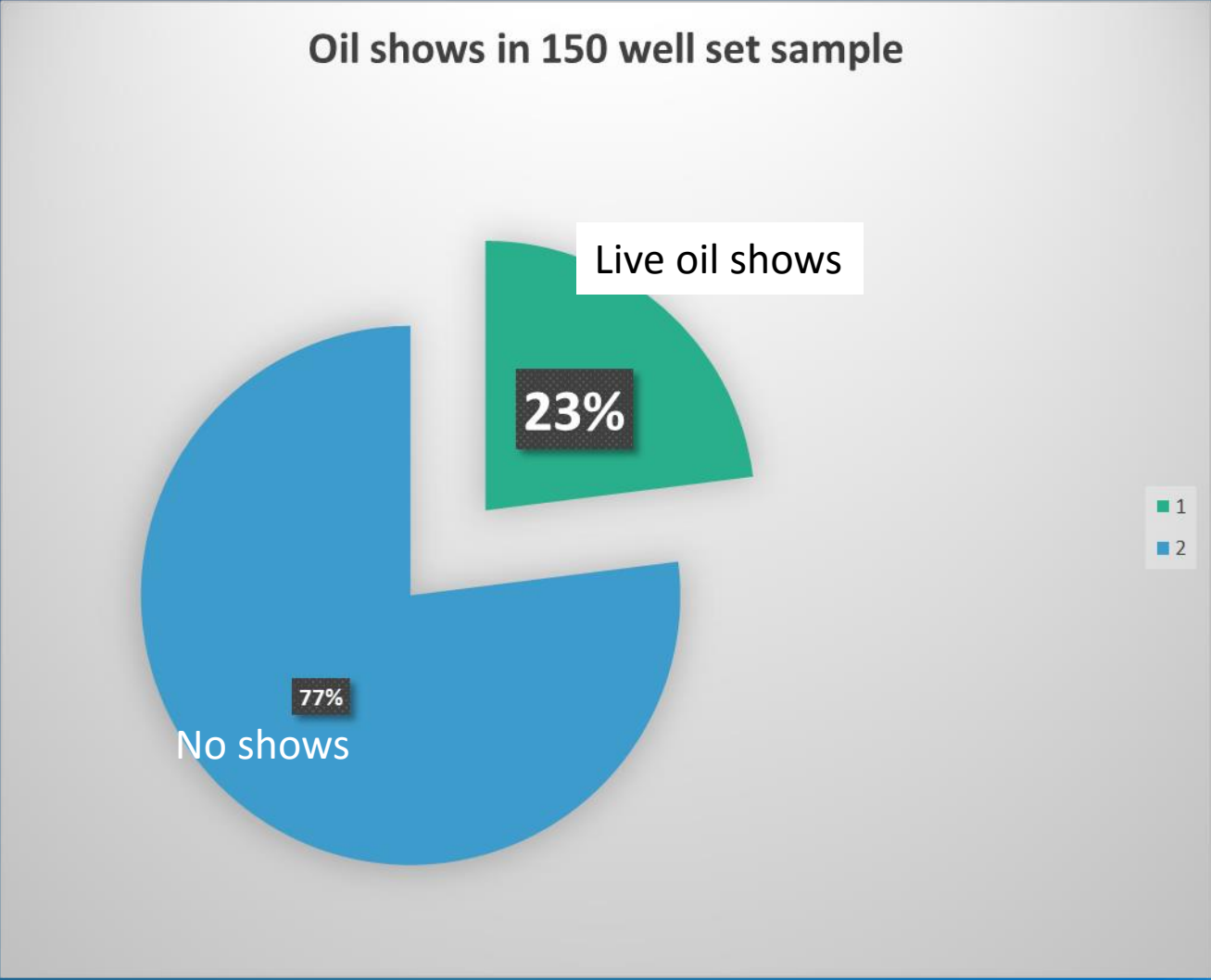
1990-2000- Government-encouraged increase in drilling

2014- Horizontal technology brought in

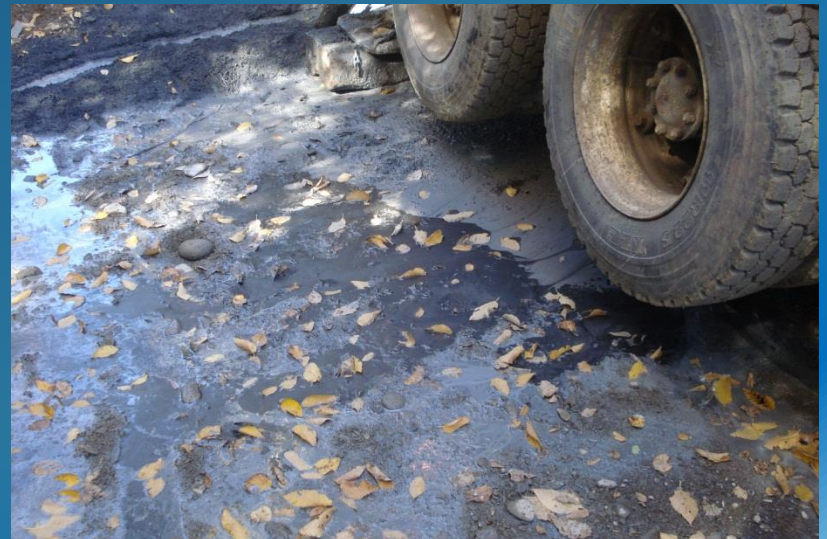
2009-present - commercial oil production



23% of wells in Gaspe have oil and gas shows



Oil Seeps at the Surface near large undrilled structures



6/21/2016

Reservoir Rocks in Gaspe

Middle-Lower Devonian host rocks are low porosity limestones (2-6%) interbedded with silt

Silurian reservoirs include the Sayabec Fm which has >10% porosity.

High porosity hydrothermal dolomite found in fractures

High Permeability Reefal Bioherms

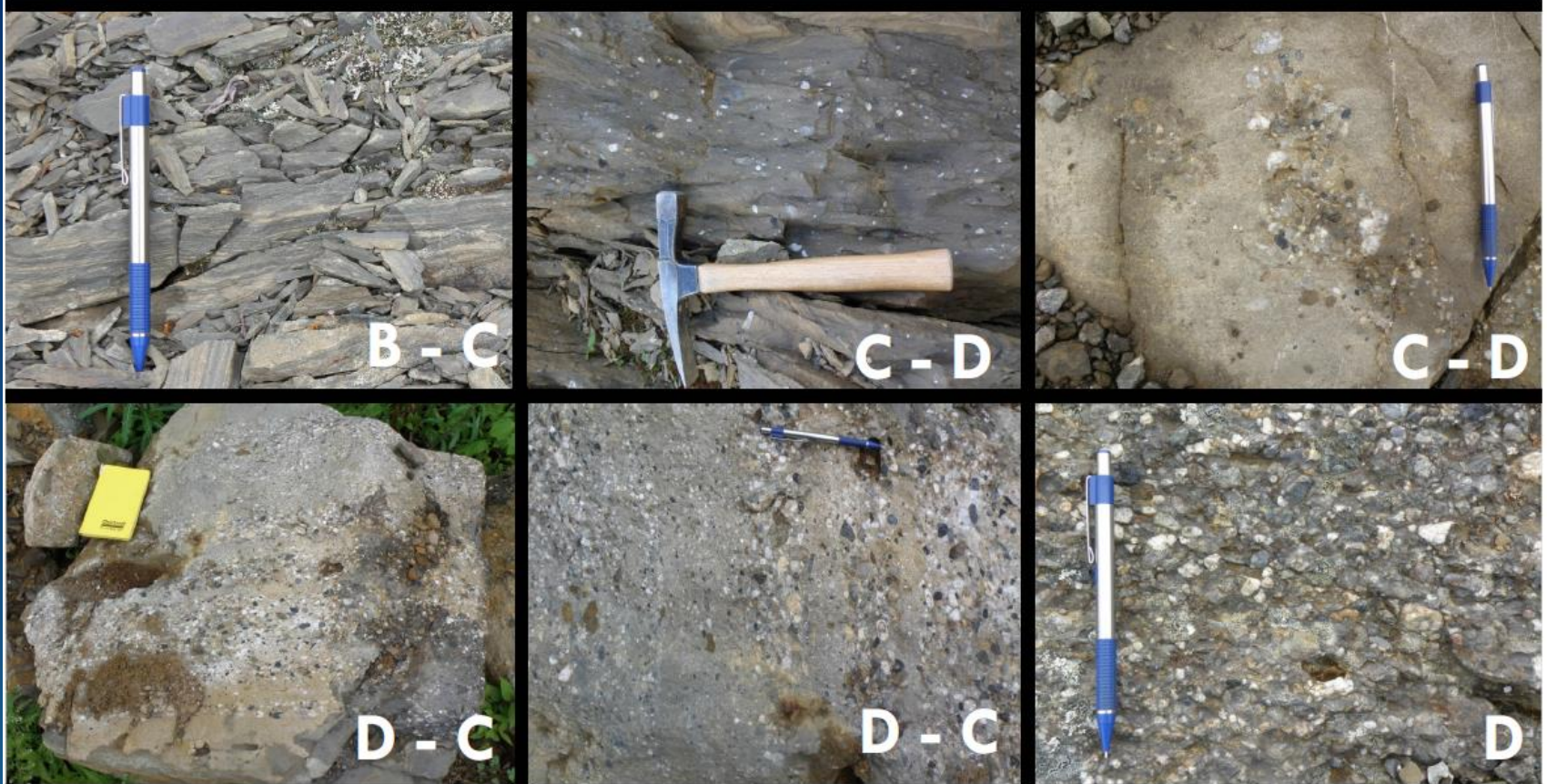
Field observations

Lower Devonian

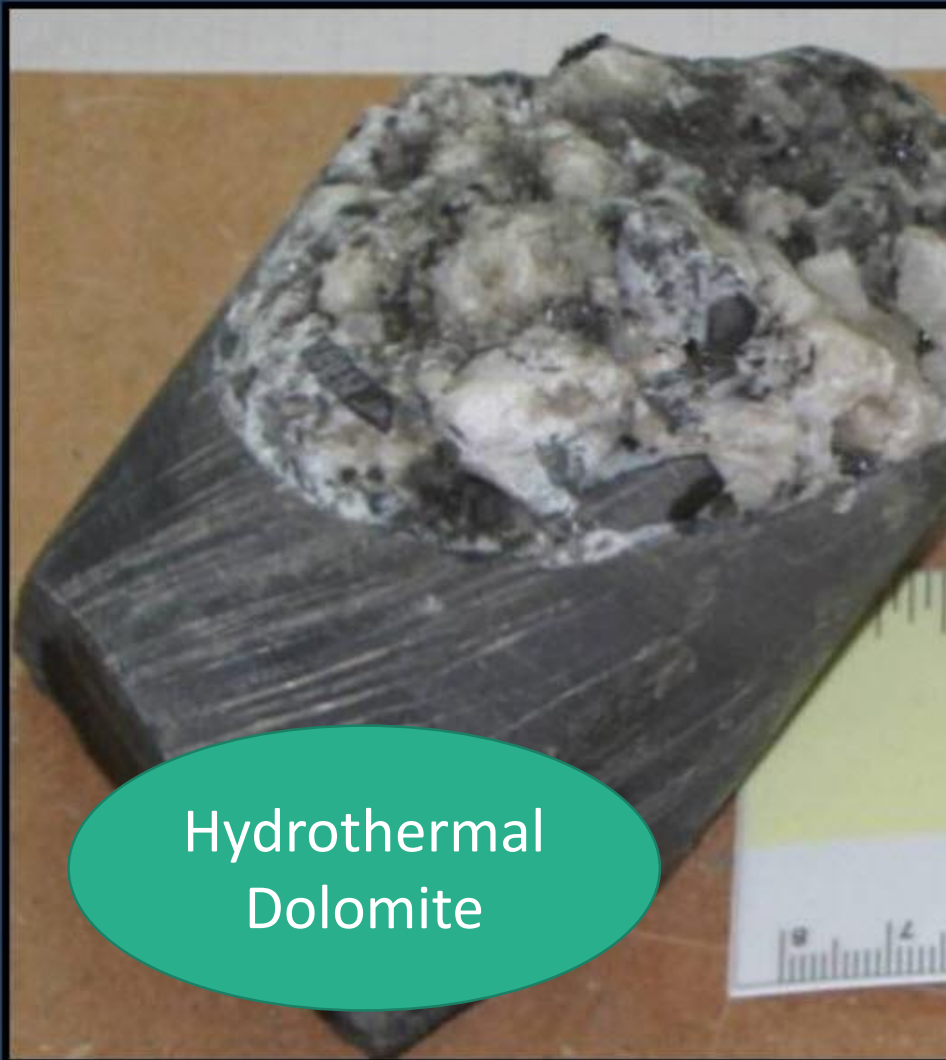
Fortin Group Facies B: Siltstone, \pm calcareous, high fissibility.

Facies C: Sandstone, \pm homogeneous.

Facies D: Polymict conglomerat, well to poorly sorted.



Junex Lemaire H-Q, Galt No 3 Well



Hydrothermal breccia at 2248 mkb

- saddle dolomite, barite
- oil and gas shows

→ ~ 415 barrels of oil
recovered in 2004 and 2005
(200 mcf/day of gas, Galt No 1)

Hydrothermal
Dolomite

Photo provided by J.-S. Marcil

Recent well results



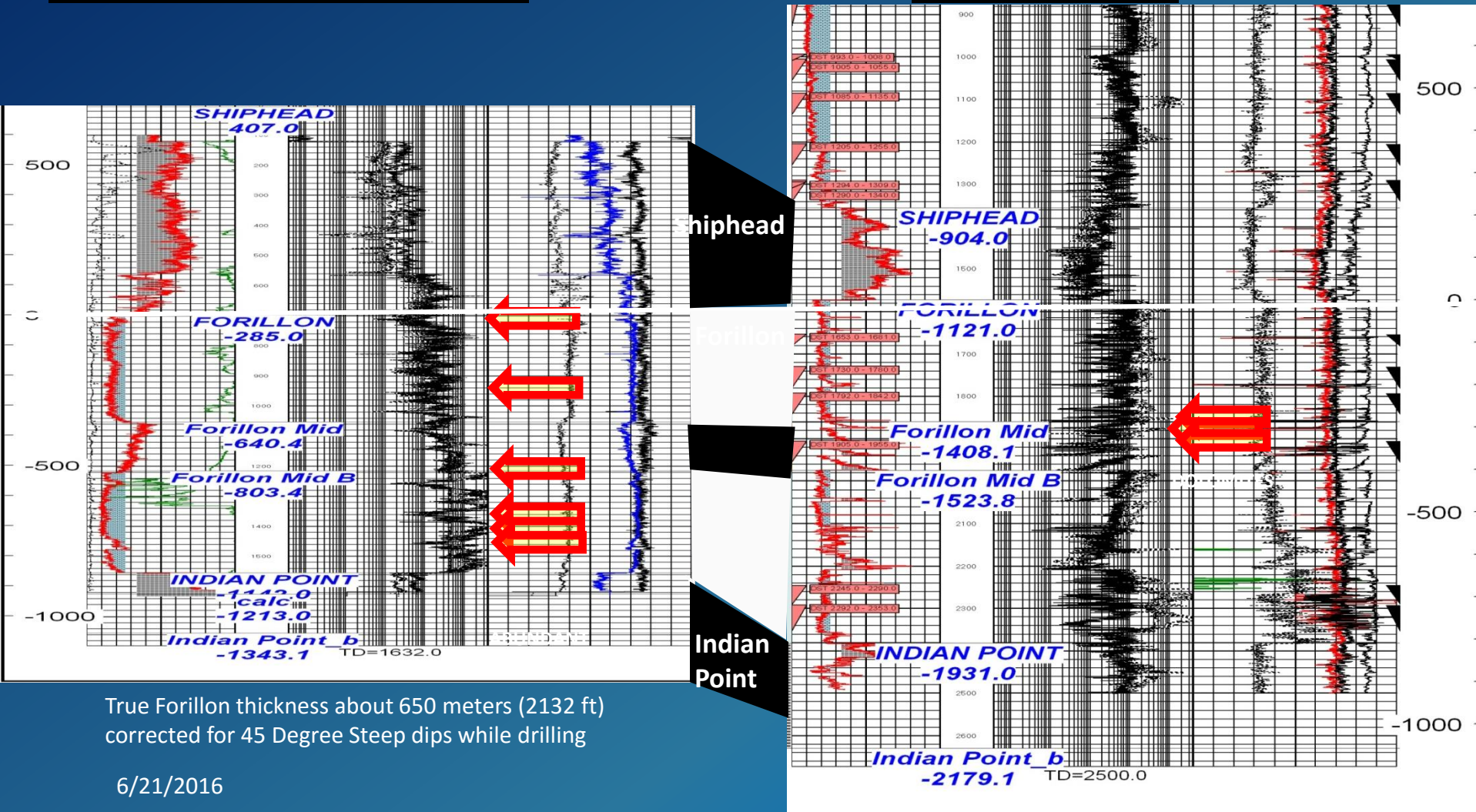
**Mundiregina Resources
Mont-Alexandre #1 (2008)**

Well log correlation

50 KM

MT ALEXANDER WELL #1

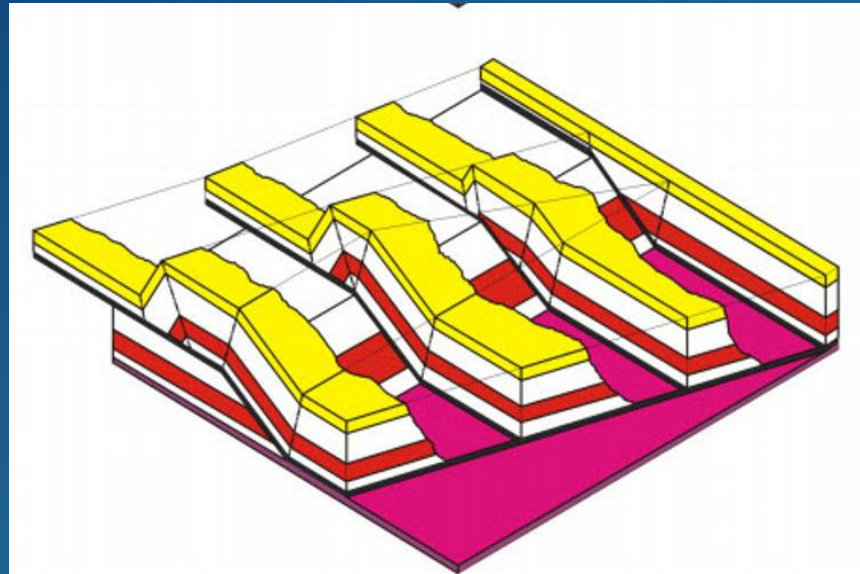
GALT 1 WELL



True Forillon thickness about 650 meters (2132 ft)
corrected for 45 Degree Steep dips while drilling

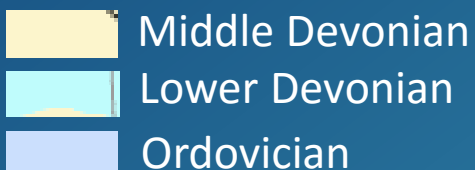
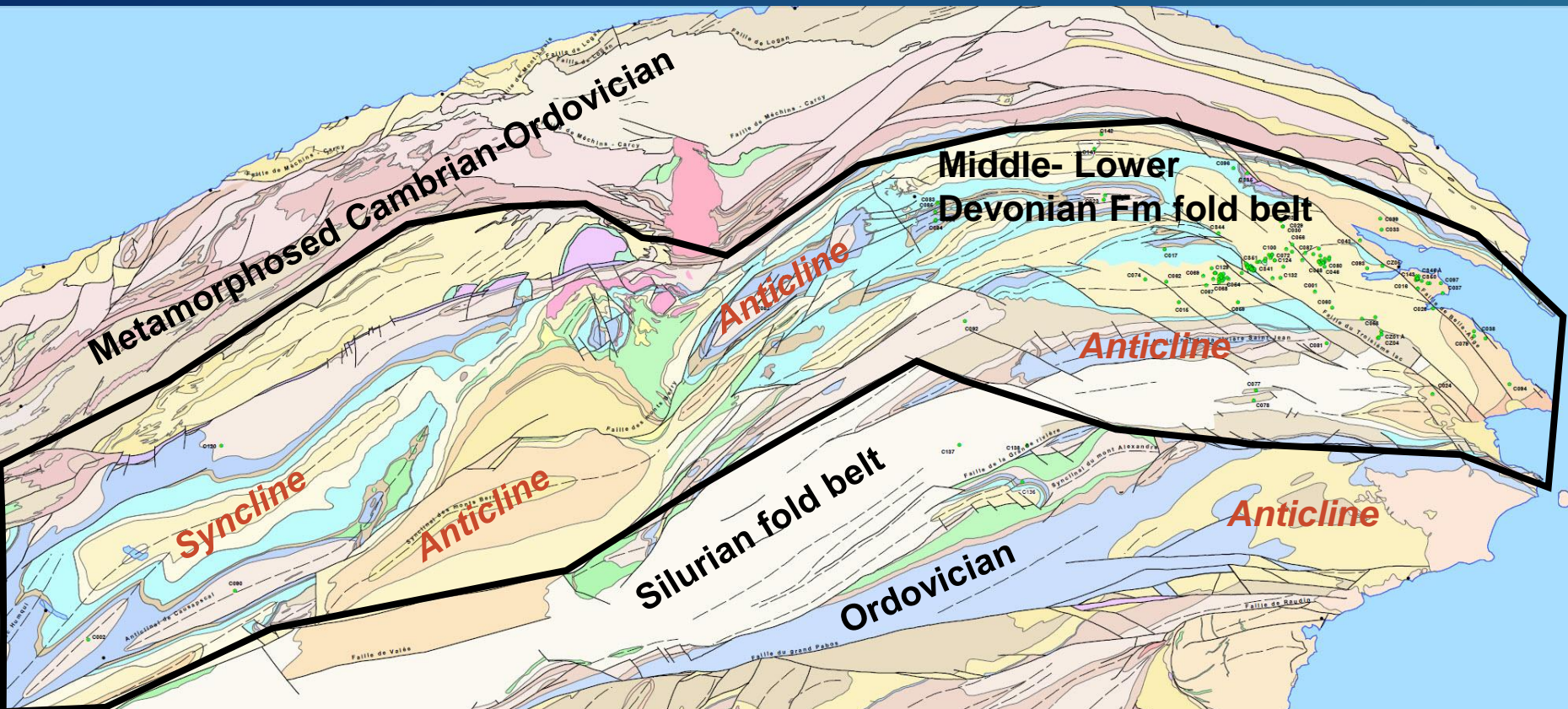
6/21/2016

Structural Geology and Seismic Lines



Fault bend folds

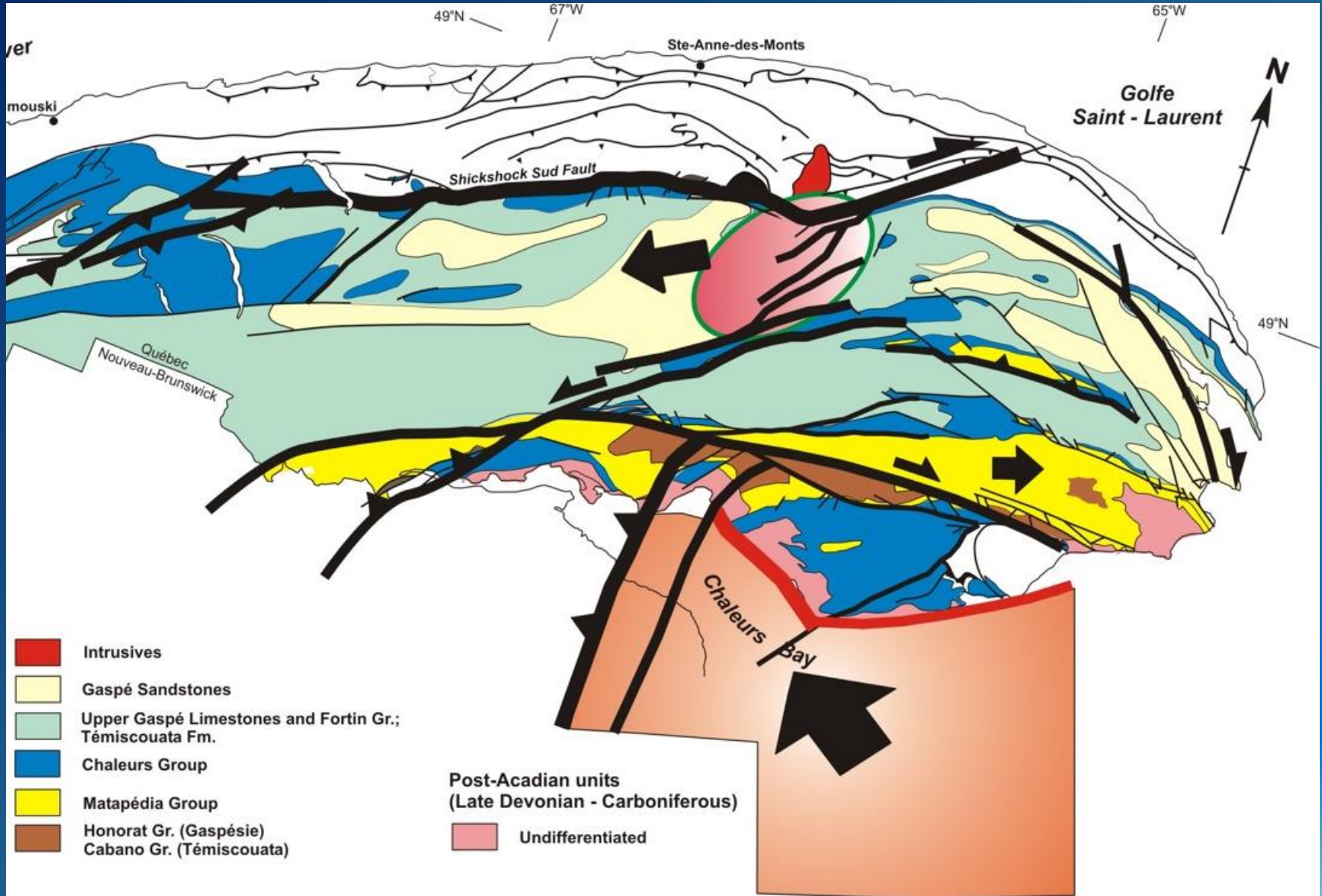
Surface Geological Map of Gaspe

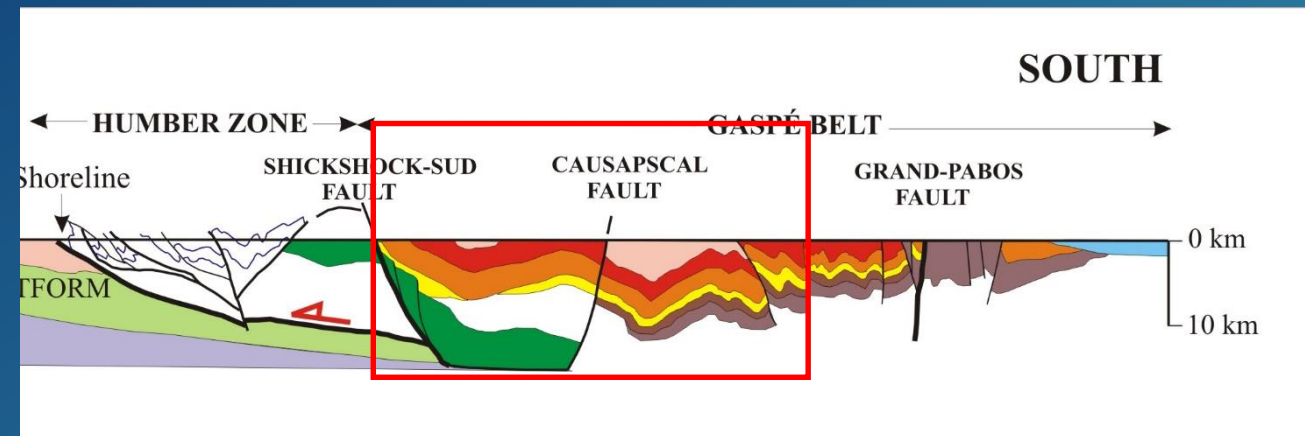
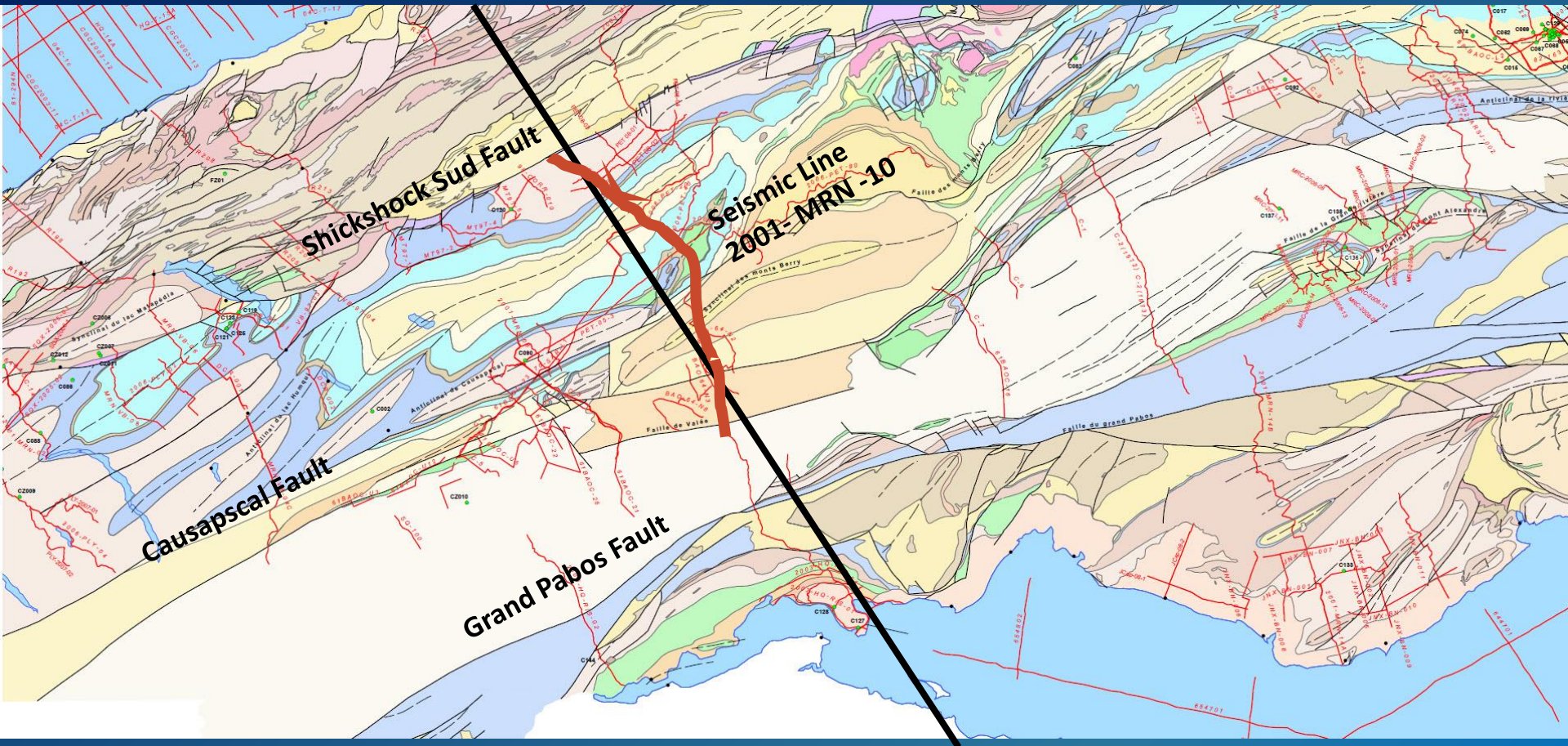


25 mile long anticlinal
Features !!!

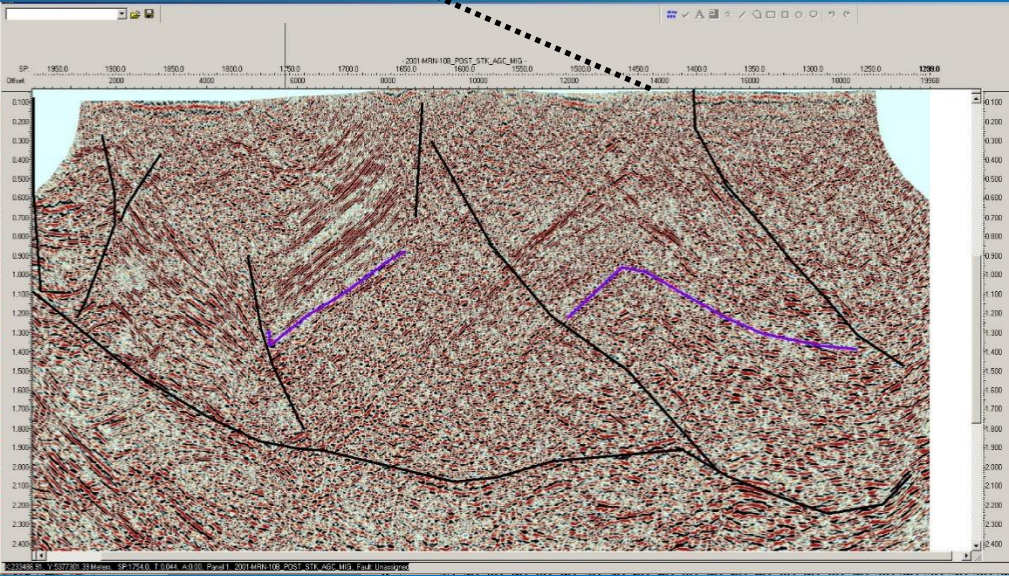
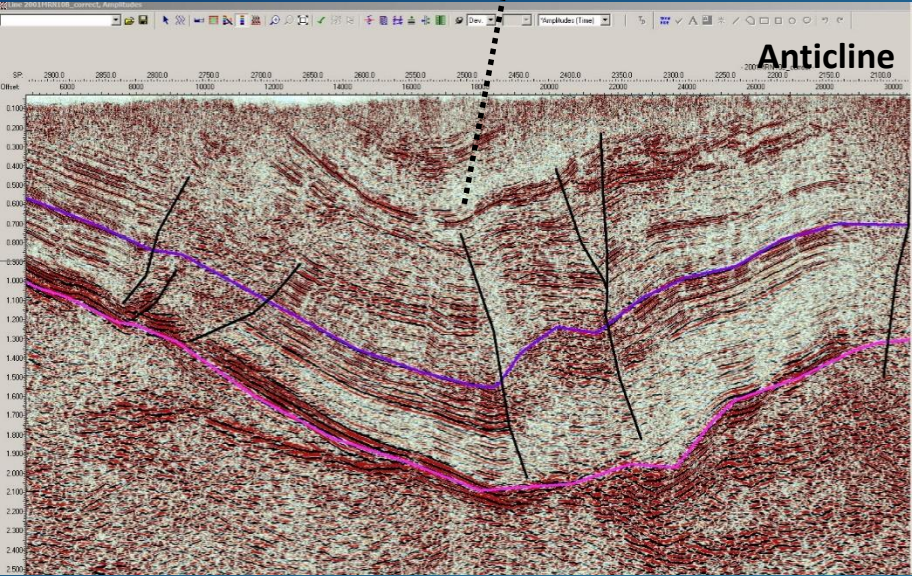
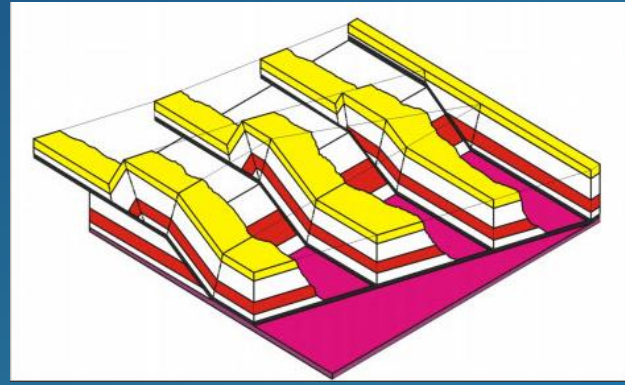
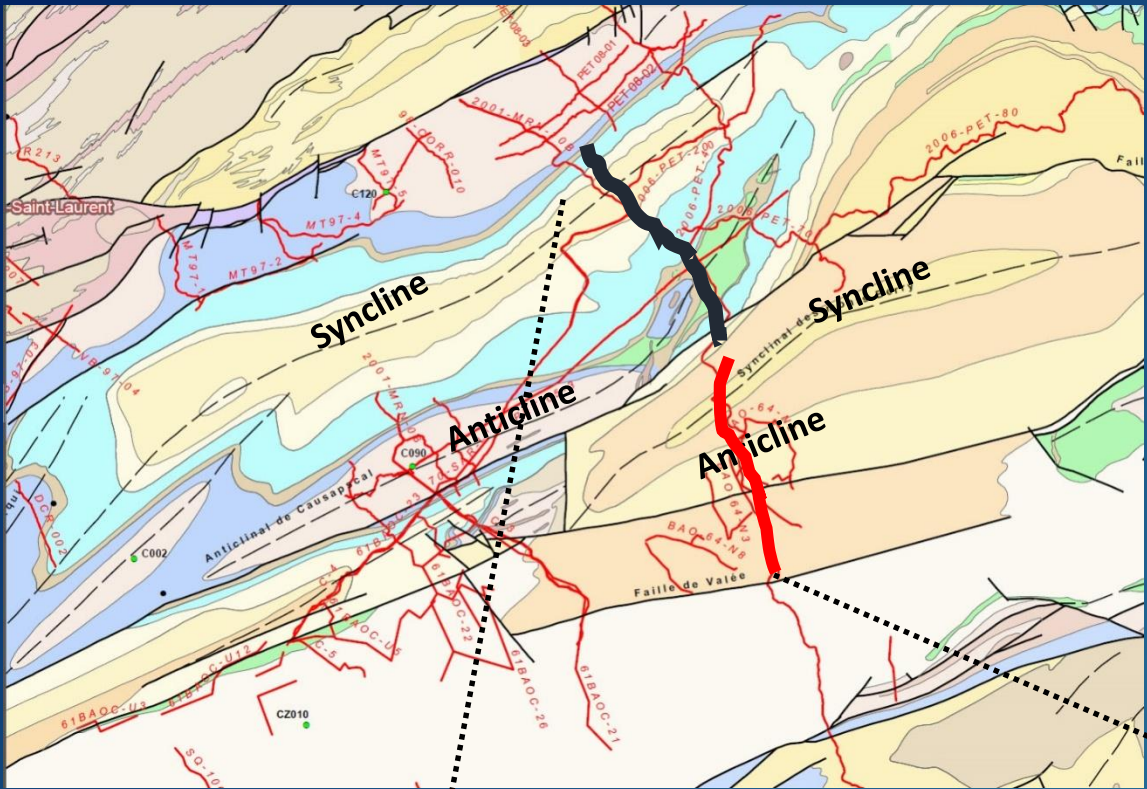
 20 kilometers
12 miles

Devonian-age Strike Slip Faulting

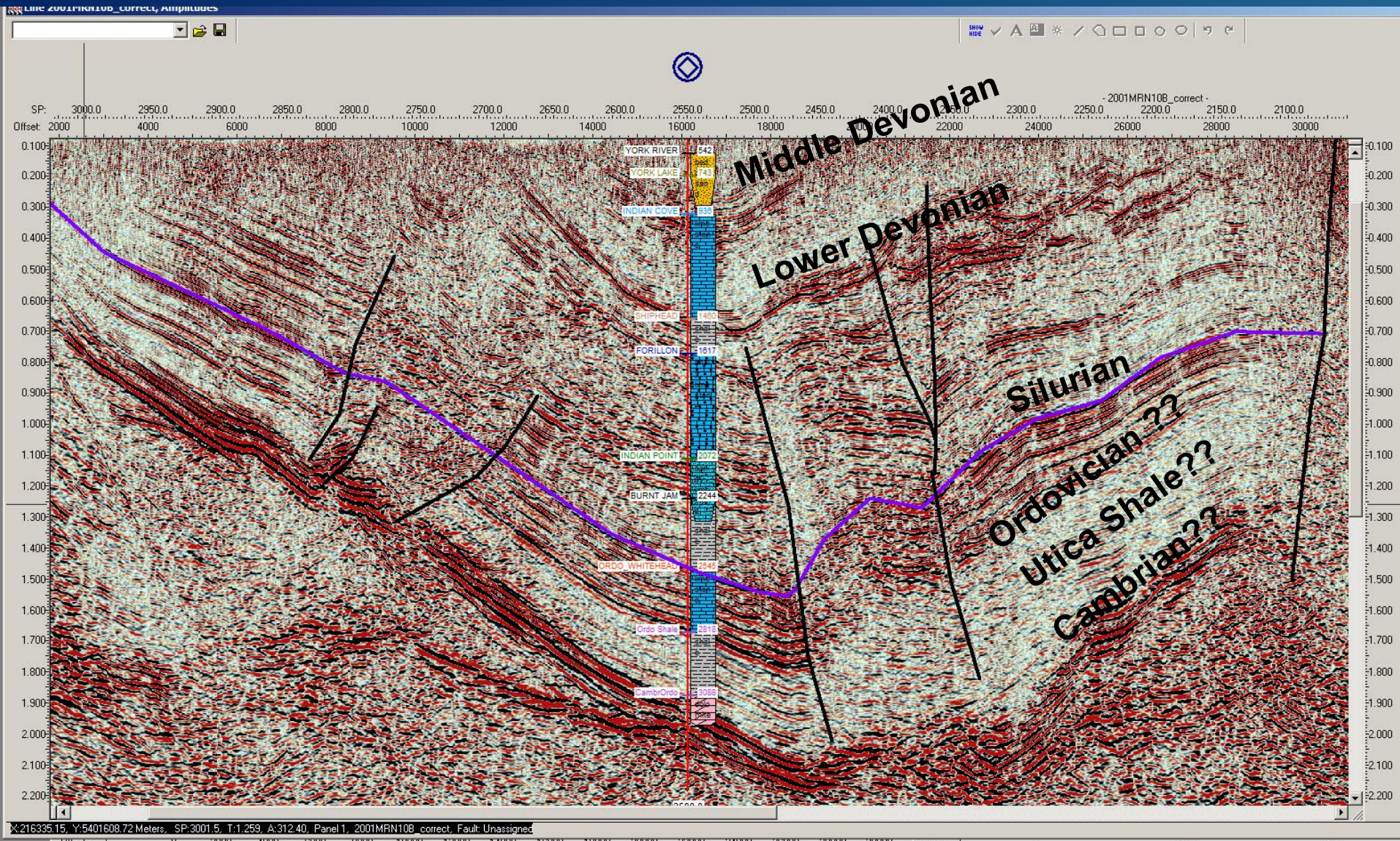




Central Gaspe fold belt

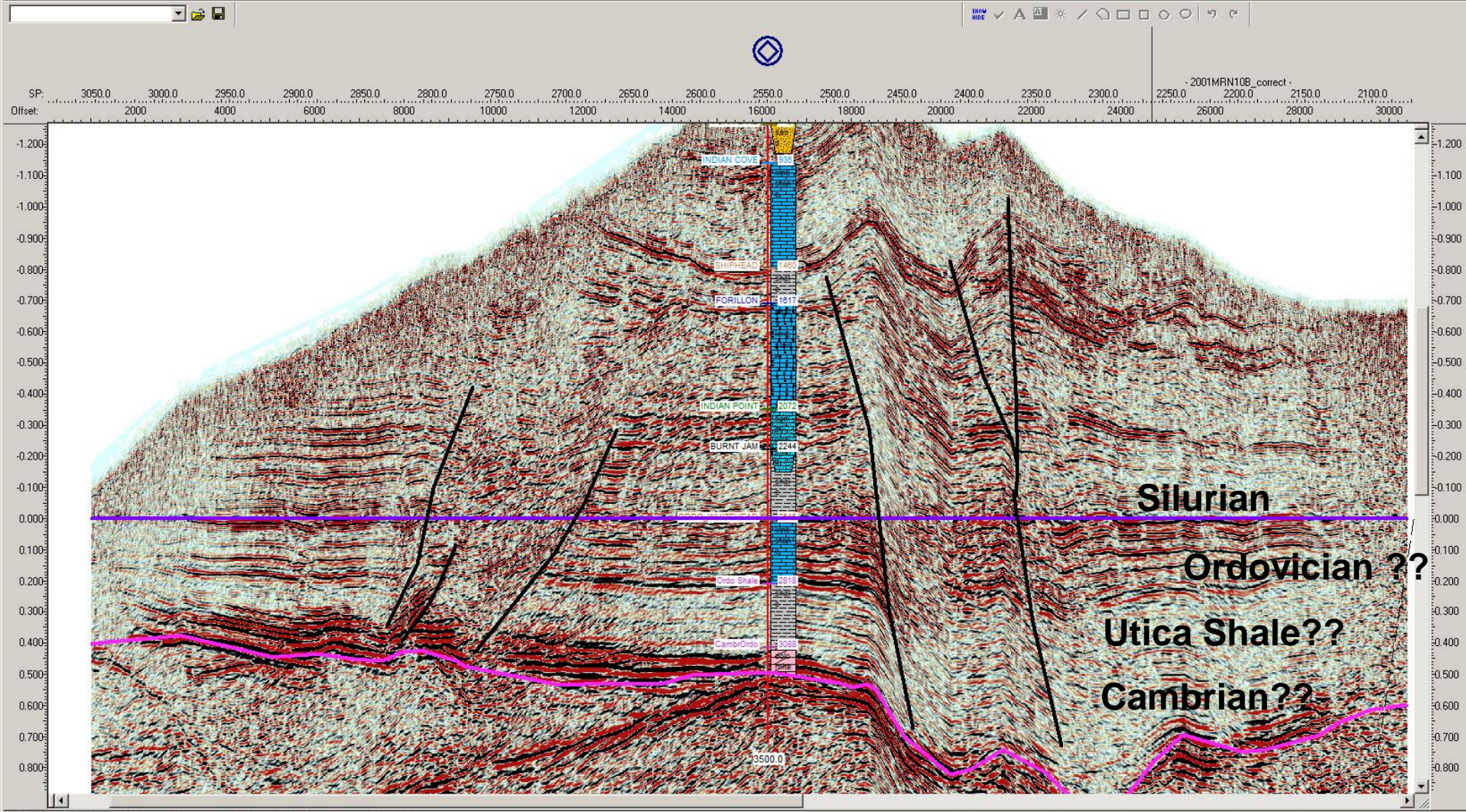


Interpreted Stratigraphy From Seismic Character



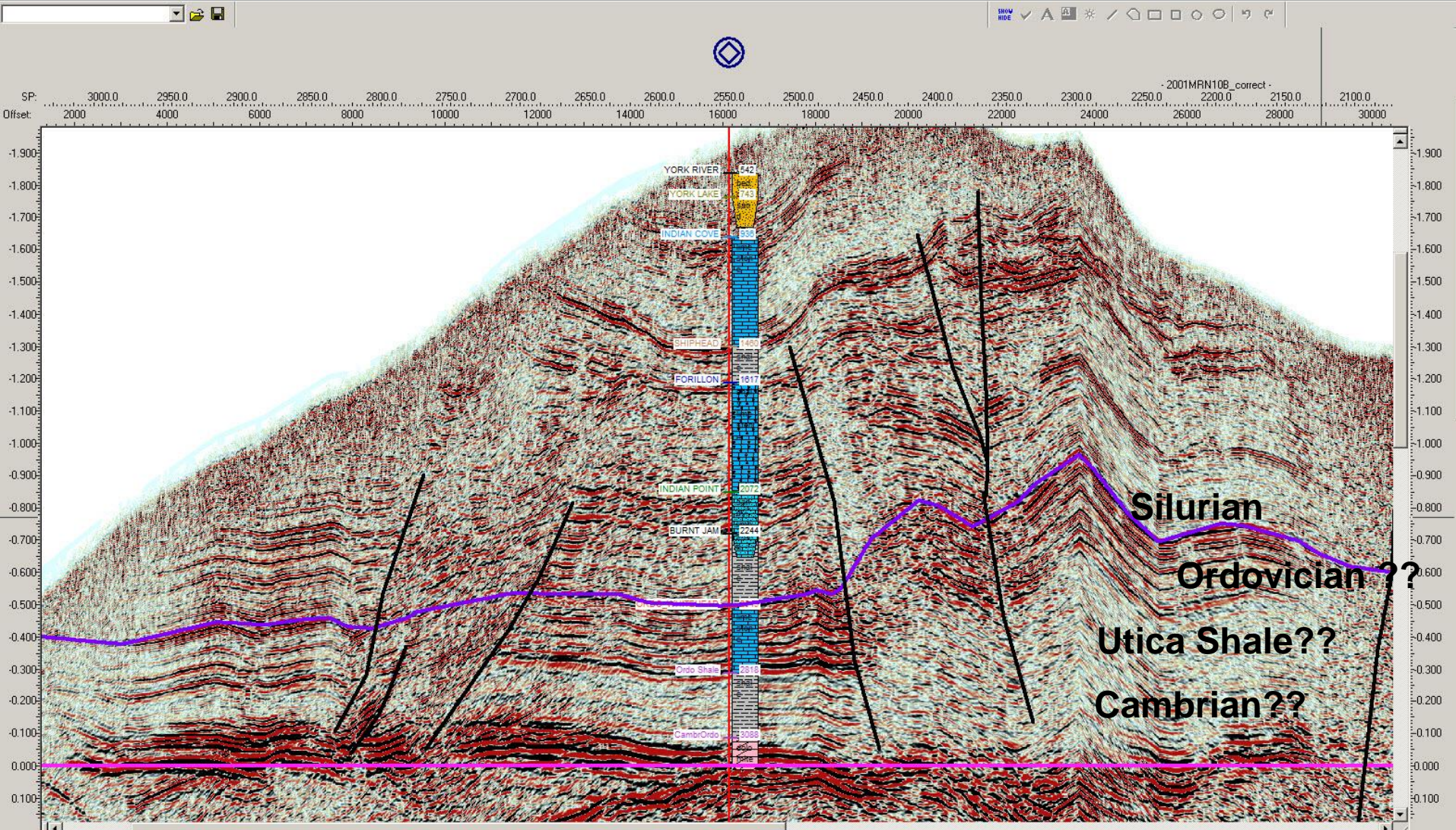
Flattened on the Silurian

Line 2001MRN10B_correct, Amplitudes, Flattened Horizon: 09_Whitehead

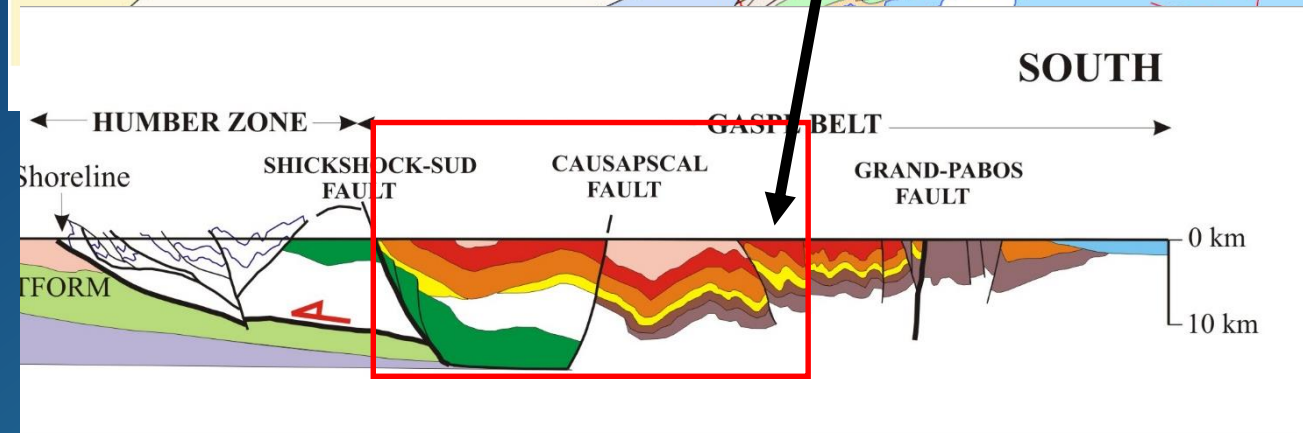
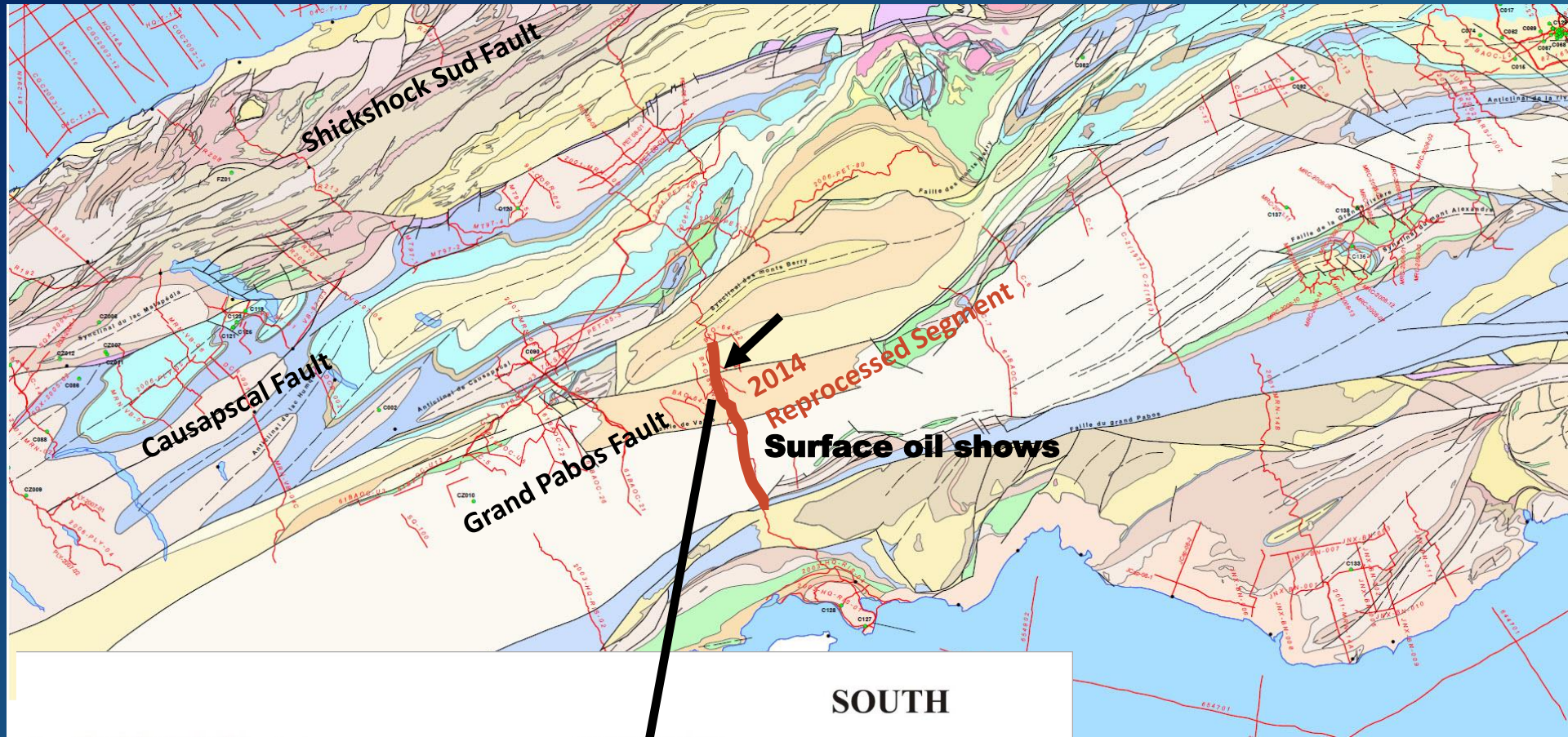


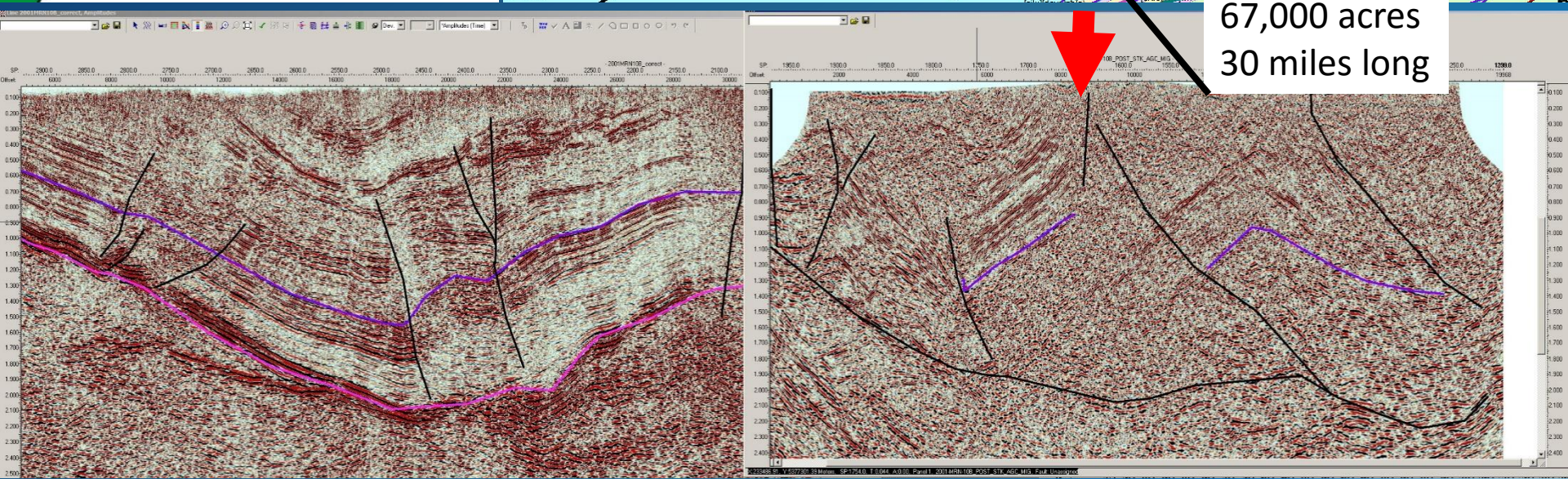
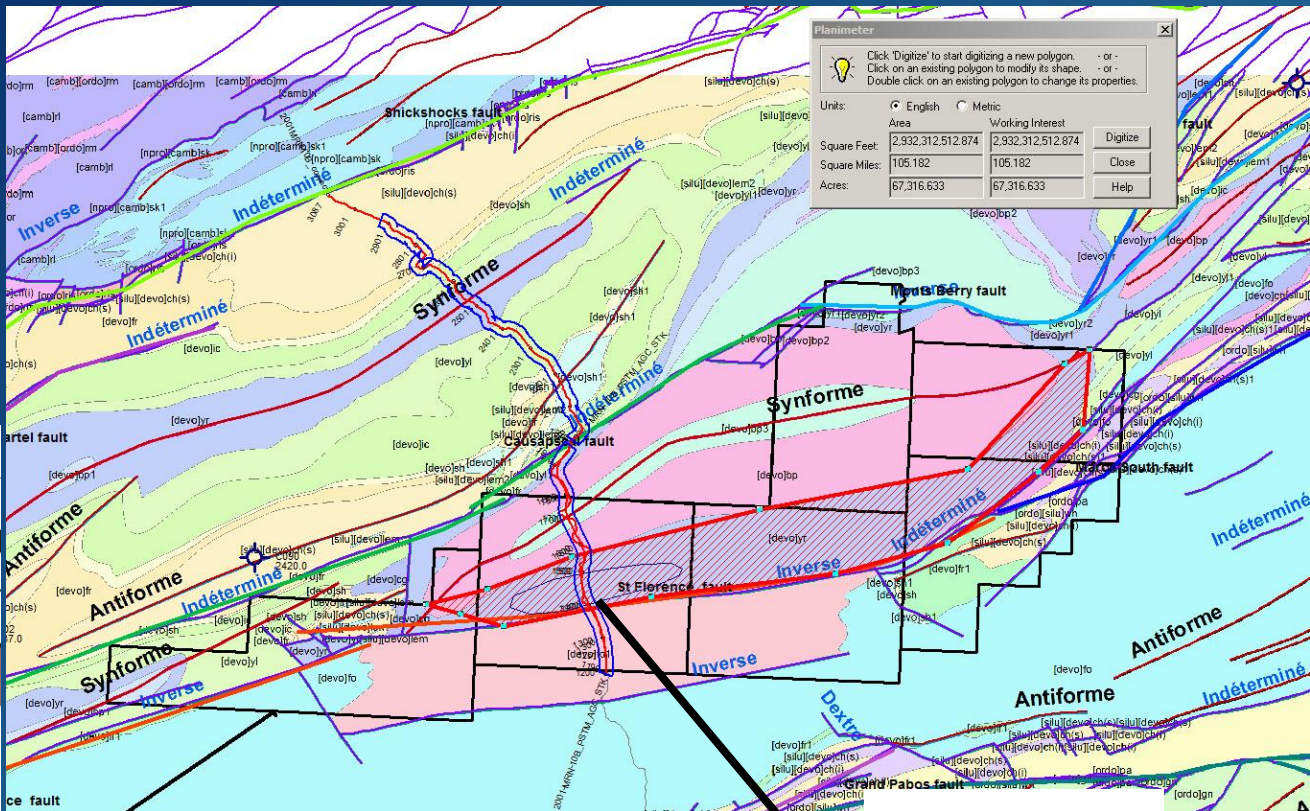
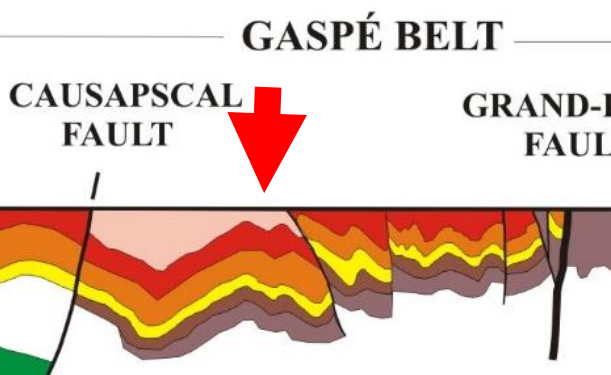
Flattened on the Detachment

Line 2001MRN10B_correct, Amplitudes, Flattened Horizon: test for flat



Champlain Prospect- Reprocessed 2D Seismic Segment





Conclusions

- **Light Oil Play- not a gas play**
- **Source rocks are Marcellus and Utica age equivalents**
- **Old straight holes poorly evaluated the light oil play**
- **New 2014-15 horizontal drilling at Galt field applied transformative technology**
- **Large undrilled structures**
- **Acreage will likely be coming available in future bid rounds**