

Shale Gas and Oil in Canada: Current Development and Exploration Targets in a North America Context*

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Search and Discovery Article #80275 (2012)**

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Editor's note: Please refer to a related article by the author; it is entitled "Lower Paleozoic Shale Gas and Shale Oil Potential in Eastern Canada: Geological Settings and Characteristics of the Upper Ordovician Shales," [Search and Discovery Article #80242 \(2012\)](#).

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Abstract

Over the last few years, development of shale gas and oil has significantly changed the energy outlook of North America. From years of slow decline in production volume of conventional resources, the input of unconventional hydrocarbons has positively impacted on the overall energy independence to foreign sources. The development of shale gas and oil in the US has been hectic in the last decade or so; conversely, Canada, given its large reserves of conventional hydrocarbons has been lagging behind. Recent evaluations from Canadian industry and government regulators indicate the potential presence of over 1500 TCF of gas-in-place. Production from Devonian and Triassic shale gas and Devonian-Carboniferous shale oil in western Canada is now rapidly ramping up.

The Geological Survey of Canada (GSC) research on source rocks of conventional hydrocarbon systems led to identification of potential shale targets for oil and gas. In eastern Canada, fundamental research and pre-production drilling and completion have identified the Upper Ordovician and Carboniferous shales as the next targets to be developed for their natural gas potential. Lesser known Middle Ordovician and Devonian shales are longer-term potential targets for resource appraisal.

From Ohio in the US to the Gulf of St. Lawrence in eastern Canada, the regional Upper Ordovician Utica Shale has various thermal maturation domains and preliminary results indicate that large areas have oil potential (Ohio and Anticosti Island). Further to the east, Lower Ordovician shales of the Green Point Formation in western Newfoundland are tested for their oil potential.

For decades, fundamental research of the GSC has been concerned with all aspects of conventional hydrocarbon systems; new research projects on the unconventional systems are now being developed in response to the increasing demand of geoscience data. On-going activities range from development of resource-reserves evaluation to geoscience approaches for continuous accumulations, evolution of pore space in diverse types of organic matter during burial, methodology for assessing geological integrity of shale cap-rock, and new chemostratigraphic approaches for sweet spots identification.

Moreover, in response to societal concerns on groundwater and environmental matters, research on water management issues and the potential for induced seismicity from well completion techniques are in progress.

Selected References

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Lavoie, D., N. Pinet, J. Dietrich, and P. Hannigan, 2009, Petroleum resources assessment, Paleozoic successions of the St. Lawrence platform and Appalachians of eastern Canada: Geological Survey of Canada, Open File 6174, 273 p.

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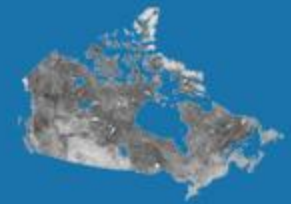
Selected Websites

Corridor Resources, Inc., 2011, Corridor reports independent Macasty Shale resource assessment for Anticosti Island: Web accessed 10 December 2012.

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EIA, 2011, Shale Gas and the Outlook for U.S. Natural Gas Markets and Global Gas Resources: Web accessed 10 December 2012.

<http://photos.state.gov/libraries/usoeed/19452/pdfs/DrNewell-EIA-Administrator-Shale-Gas-Presentation-June212011.pdf>



SHALE GAS AND OIL IN CANADA: CURRENT DEVELOPMENT AND EXPLORATION TARGETS IN A NORTH AMERICAN CONTEXT

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Outline of the presentation

1. Shale gas and oil, the situation in North America
2. Research projects of Natural Resources Canada
 - Resource characterization and evaluation
 - Environmental - hazard potential impacts
3. Defining the shale unconventional potential in eastern Canada frontier basins.
4. Conclusions



Shale gas / tight oil in the US

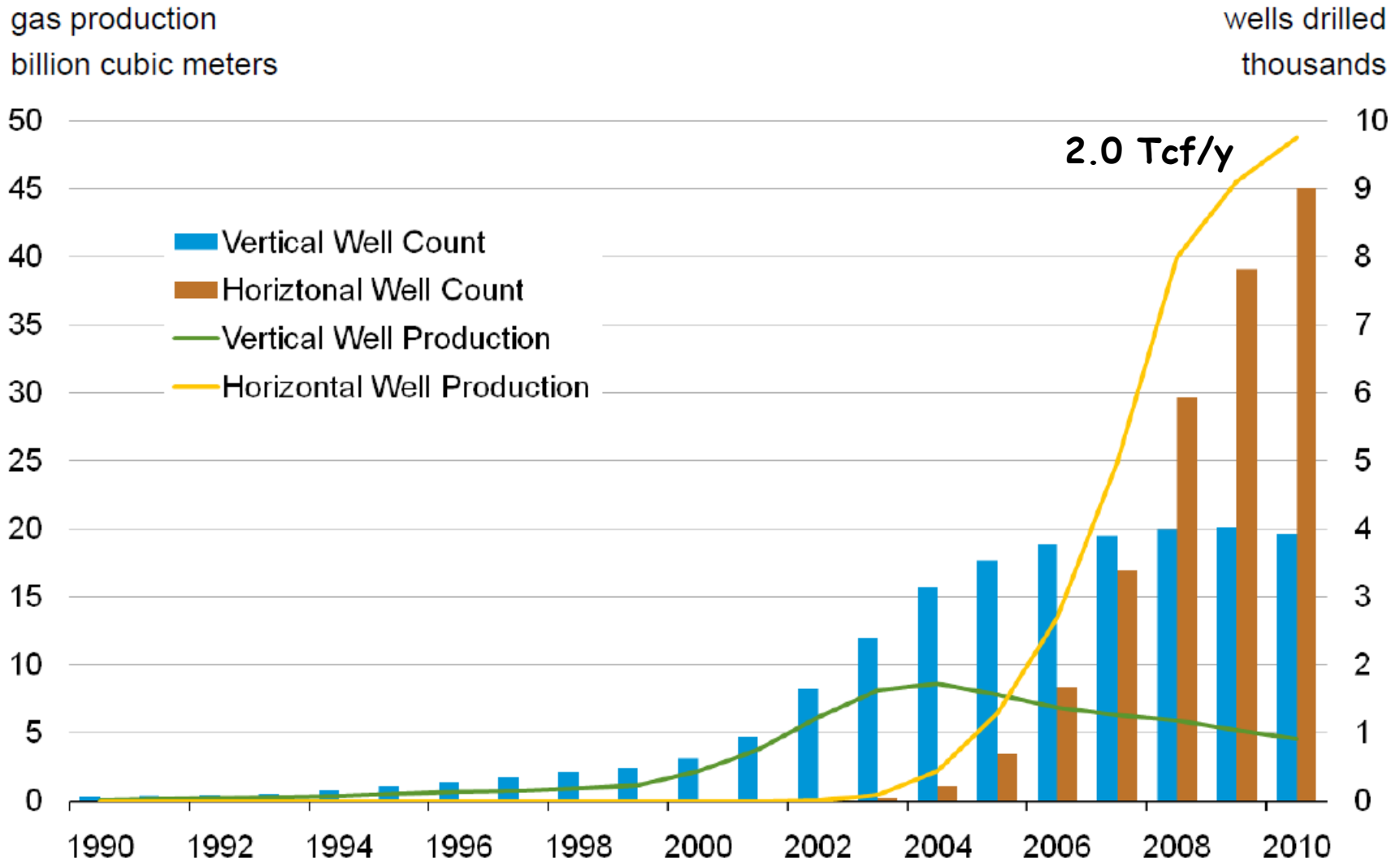
Towards energy independence



Shale Gas and Shale Oil Plays, Lower 48 States



Shale gas production in USA



Source: EIA



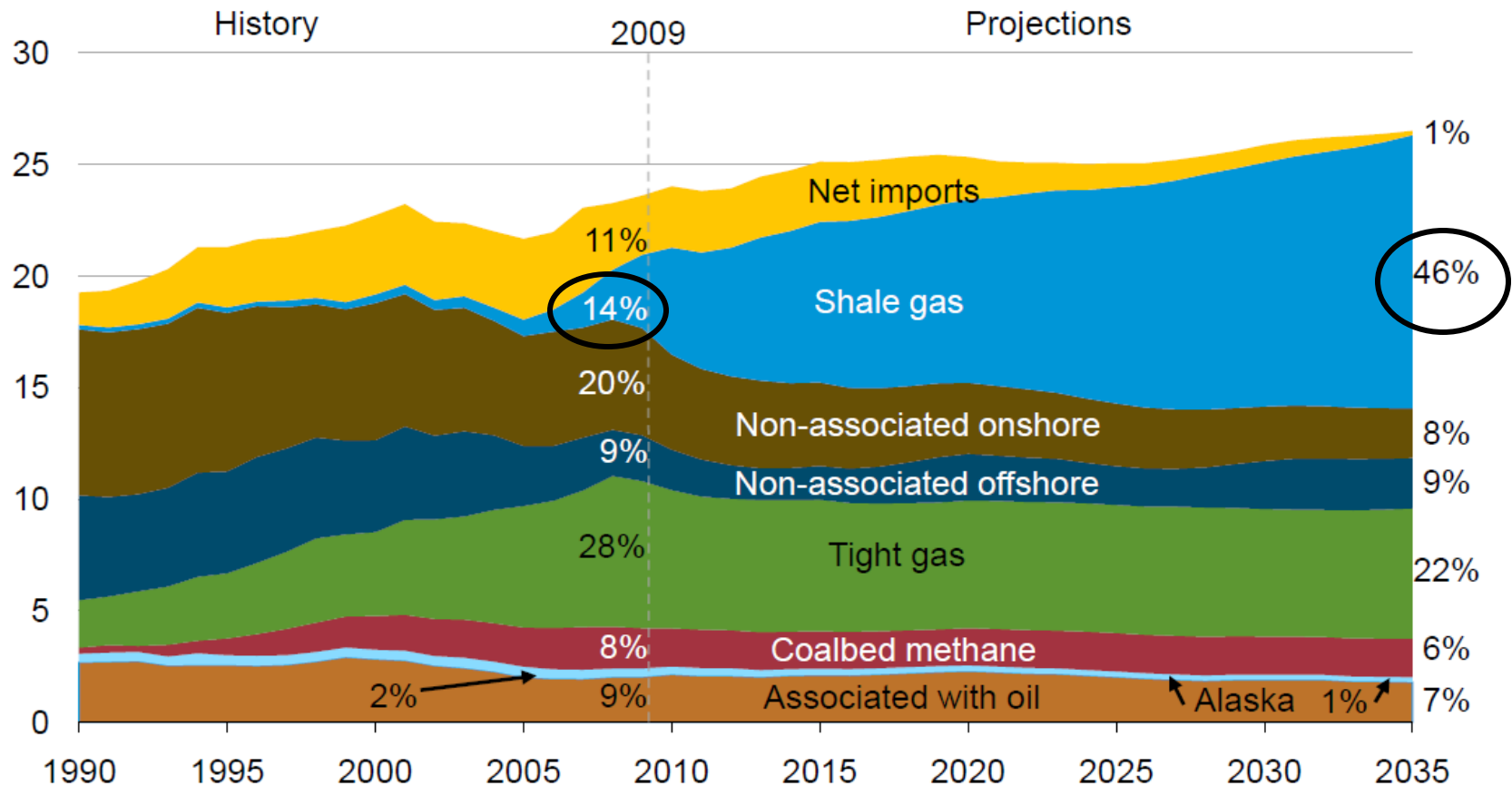
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US natural gas 25 years outlook

U.S. dry gas
trillion cubic feet per year



Source: EIA, Annual Energy Outlook 2011



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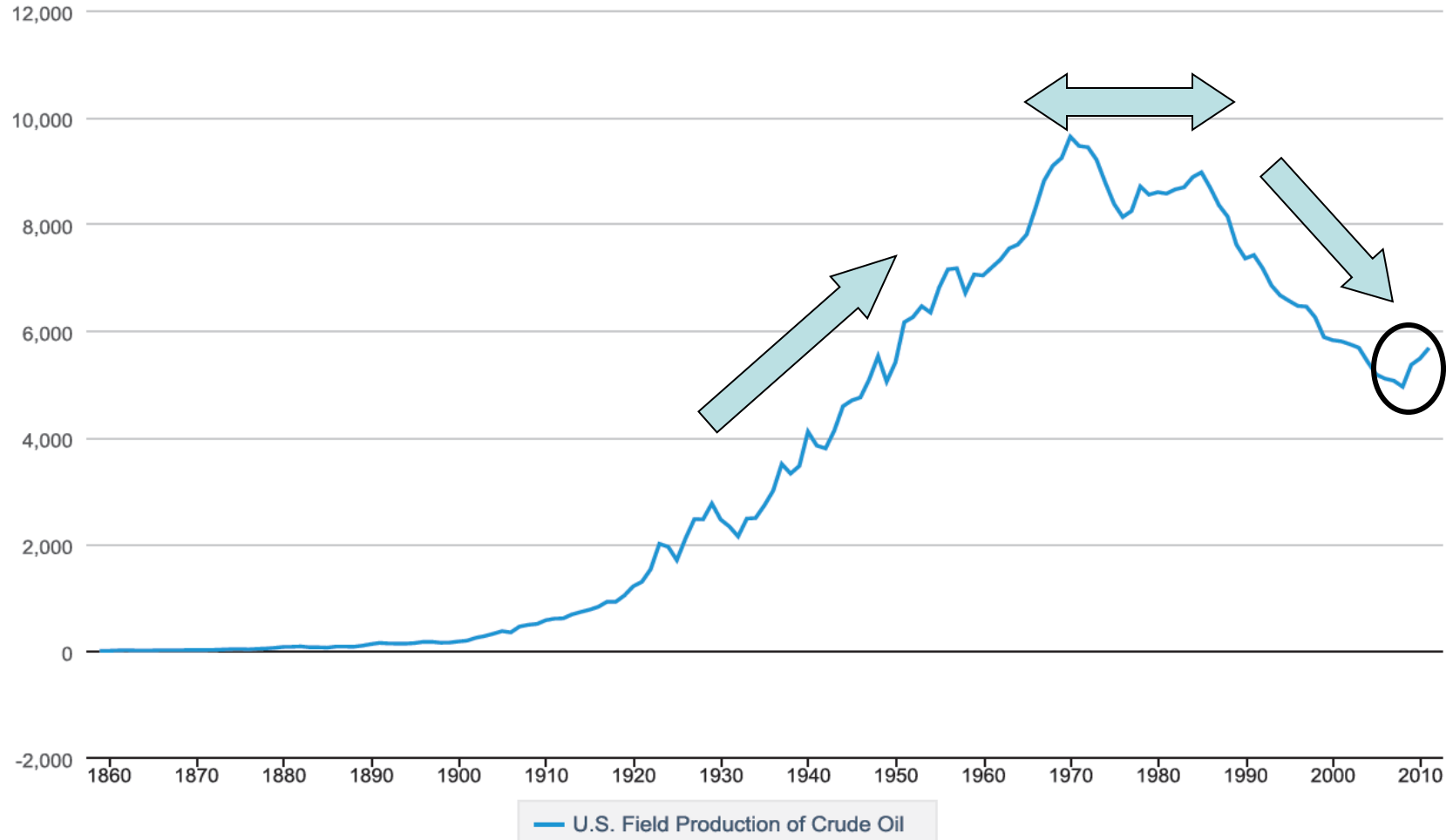
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Oil production in the USA

Stopping the decline

Crude Oil Production

Mbbl/d



Source: U.S. Energy Information Administration



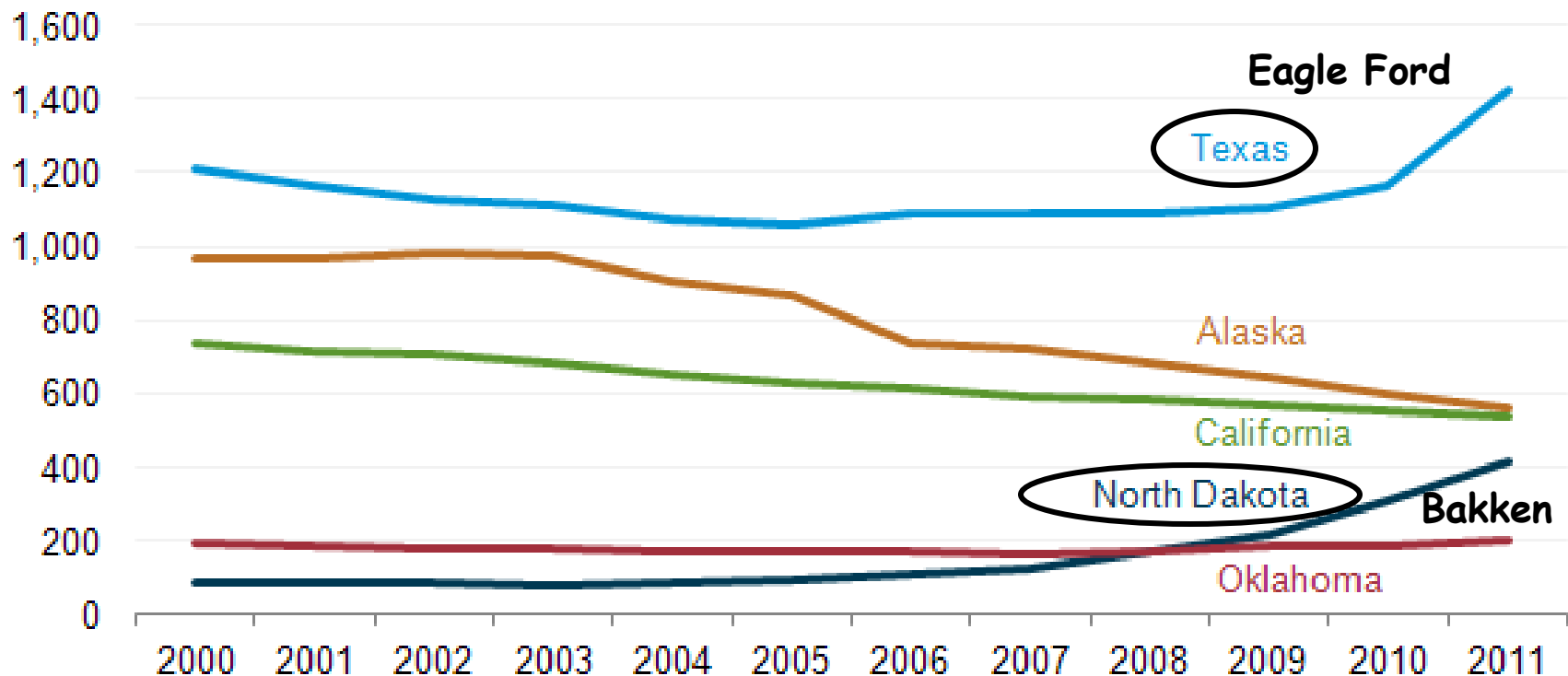
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A new era; from conventional to tight oil

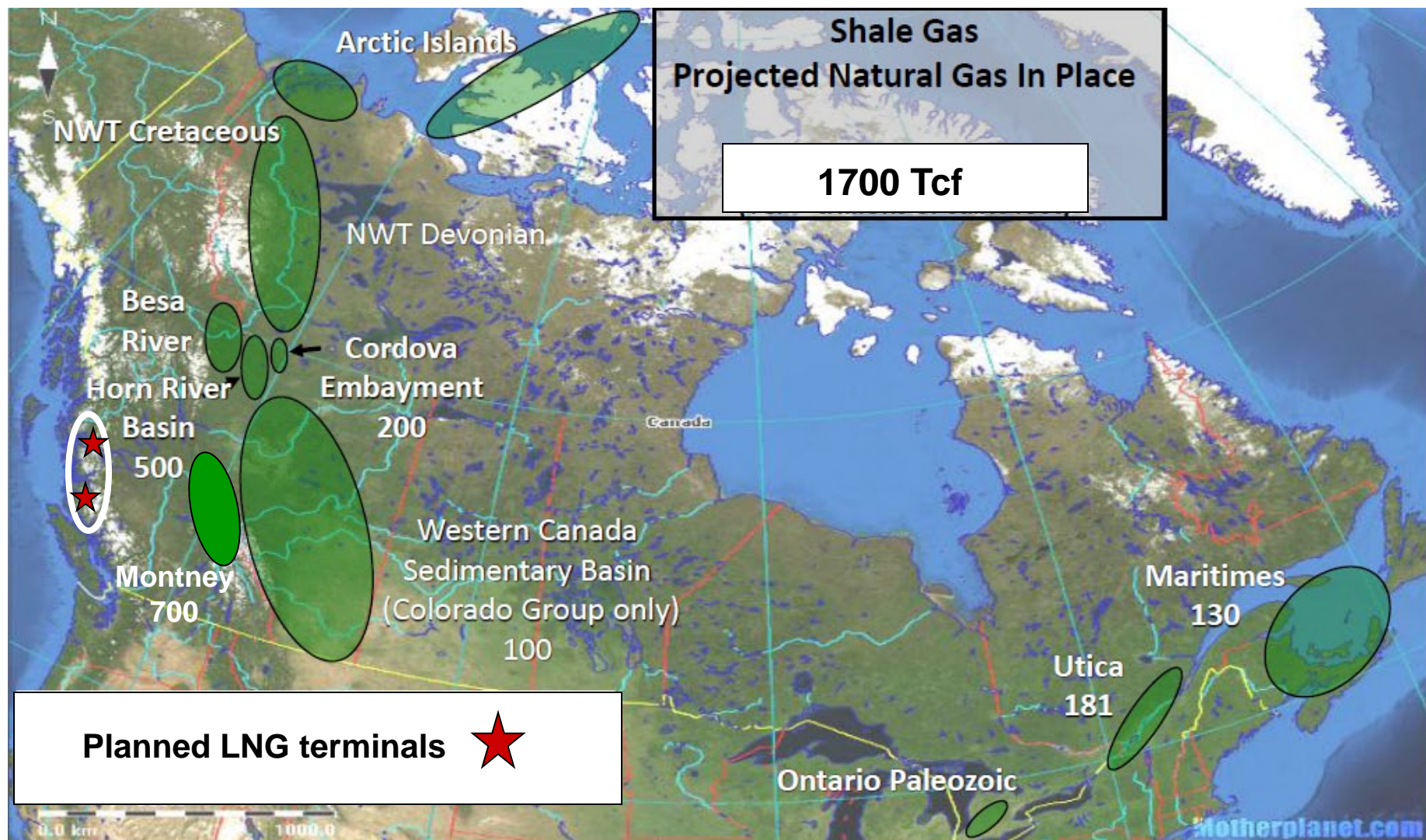
Annual crude oil production, 2000-2011
thousand barrels per day



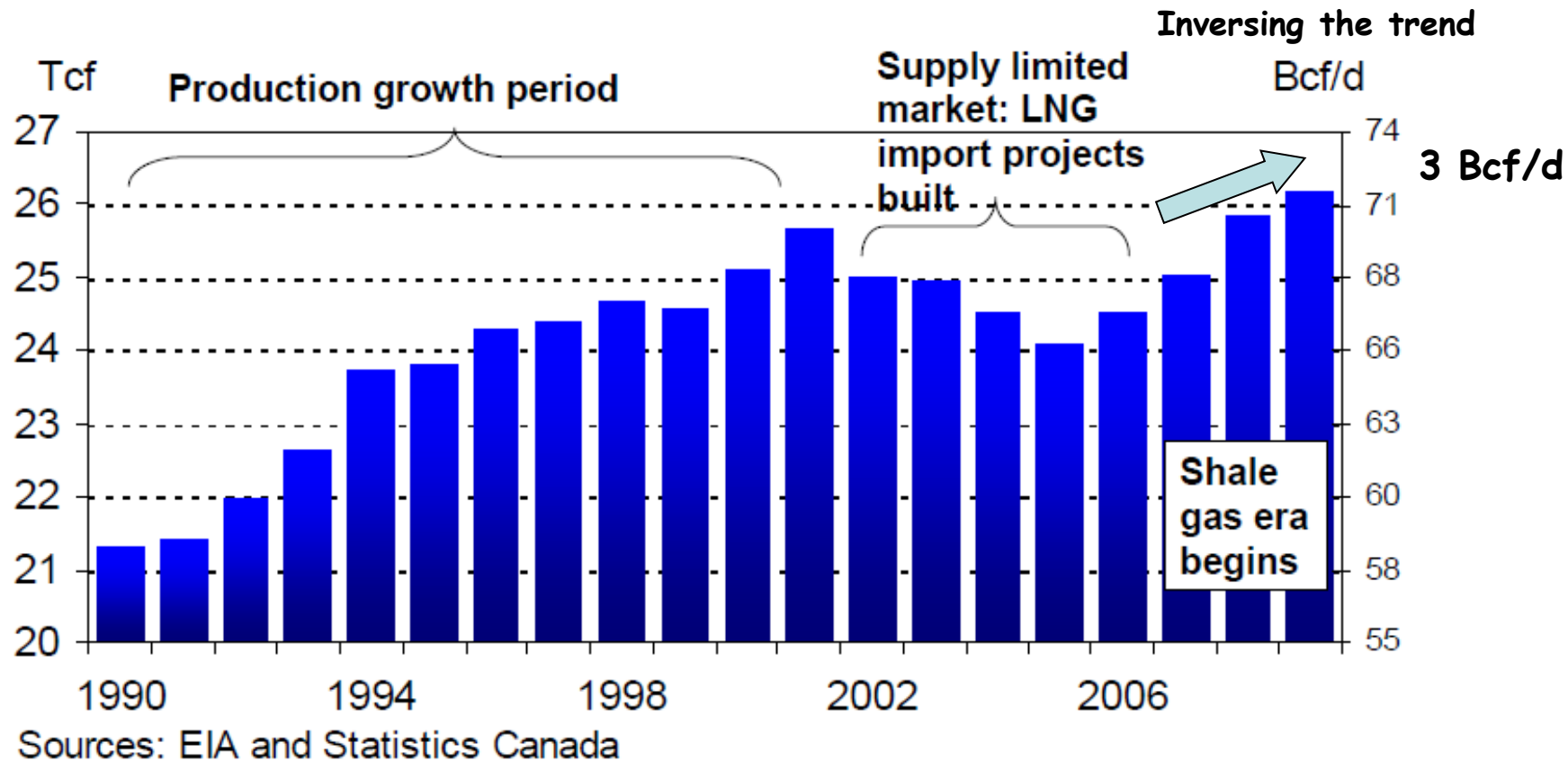
Shale gas / tight oil in Canada

A late start, but rapidly picking up



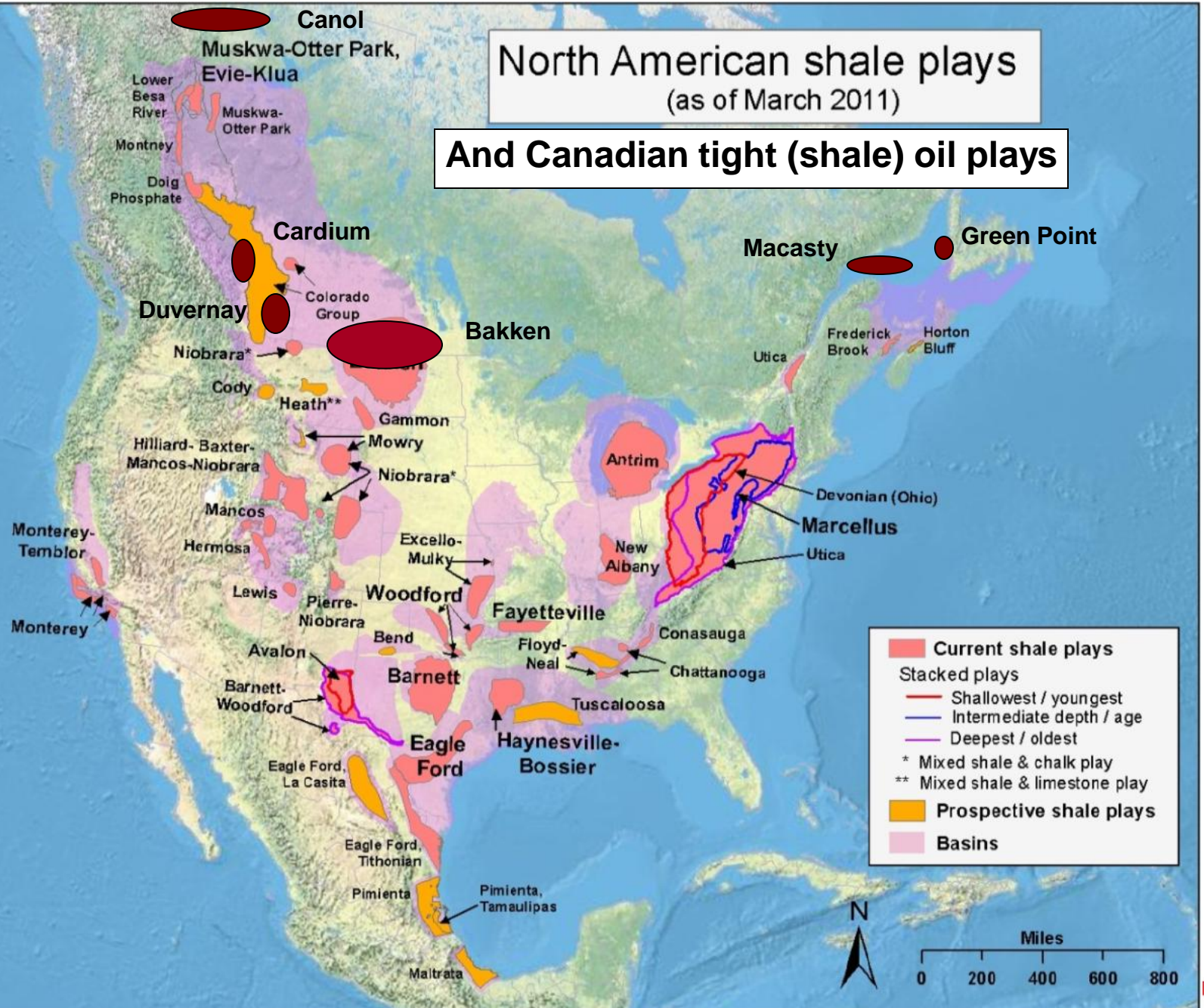


Shale gas production in Canada

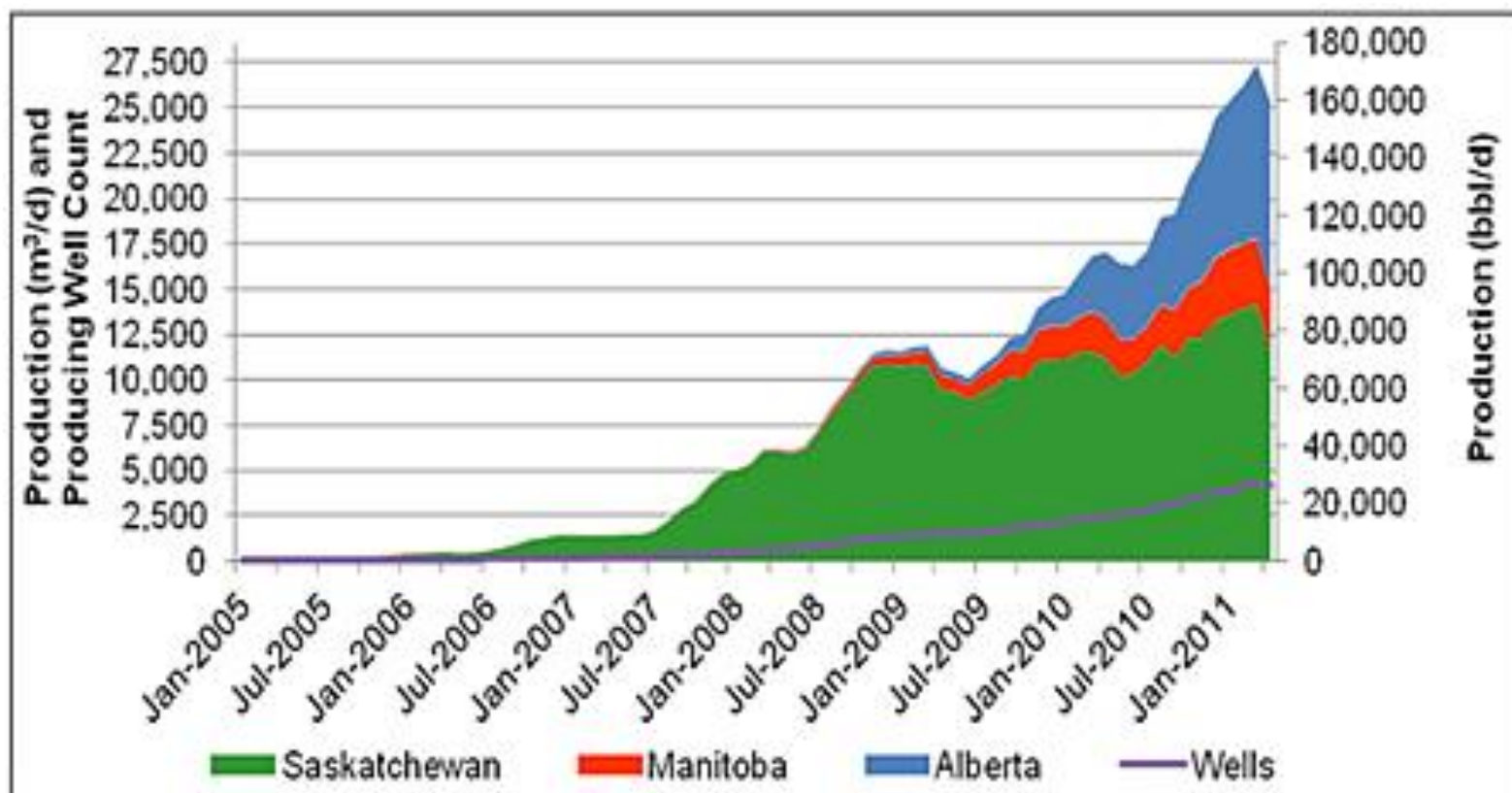


North American shale plays (as of March 2011)

And Canadian tight (shale) oil plays



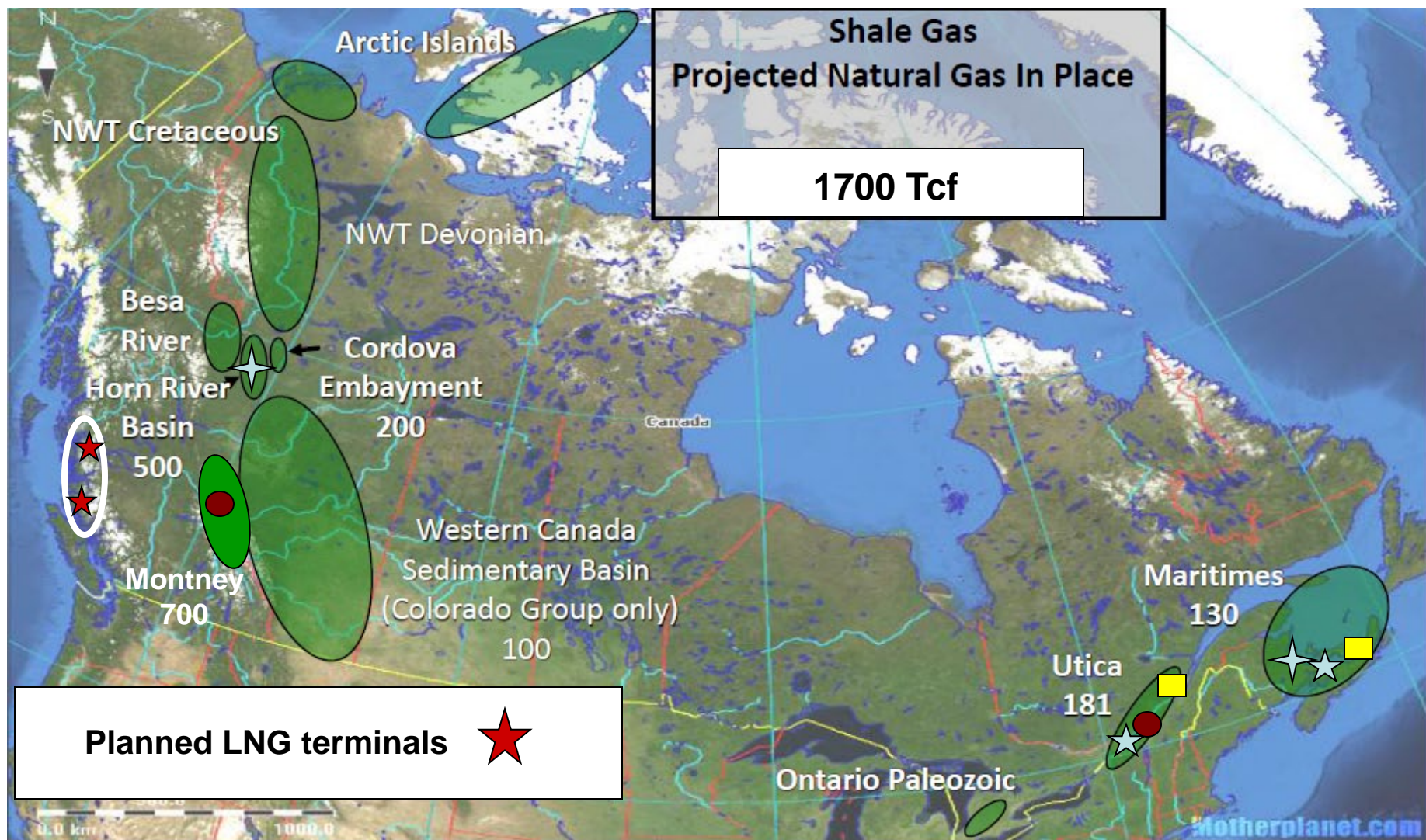
A recent significant increase in tight oil production



Current research by Natural Resources Canada

Focusing on geological and environmental issues





Planned LNG terminals



Groundwater studies



Induced seismicity study



Resource evaluation studies

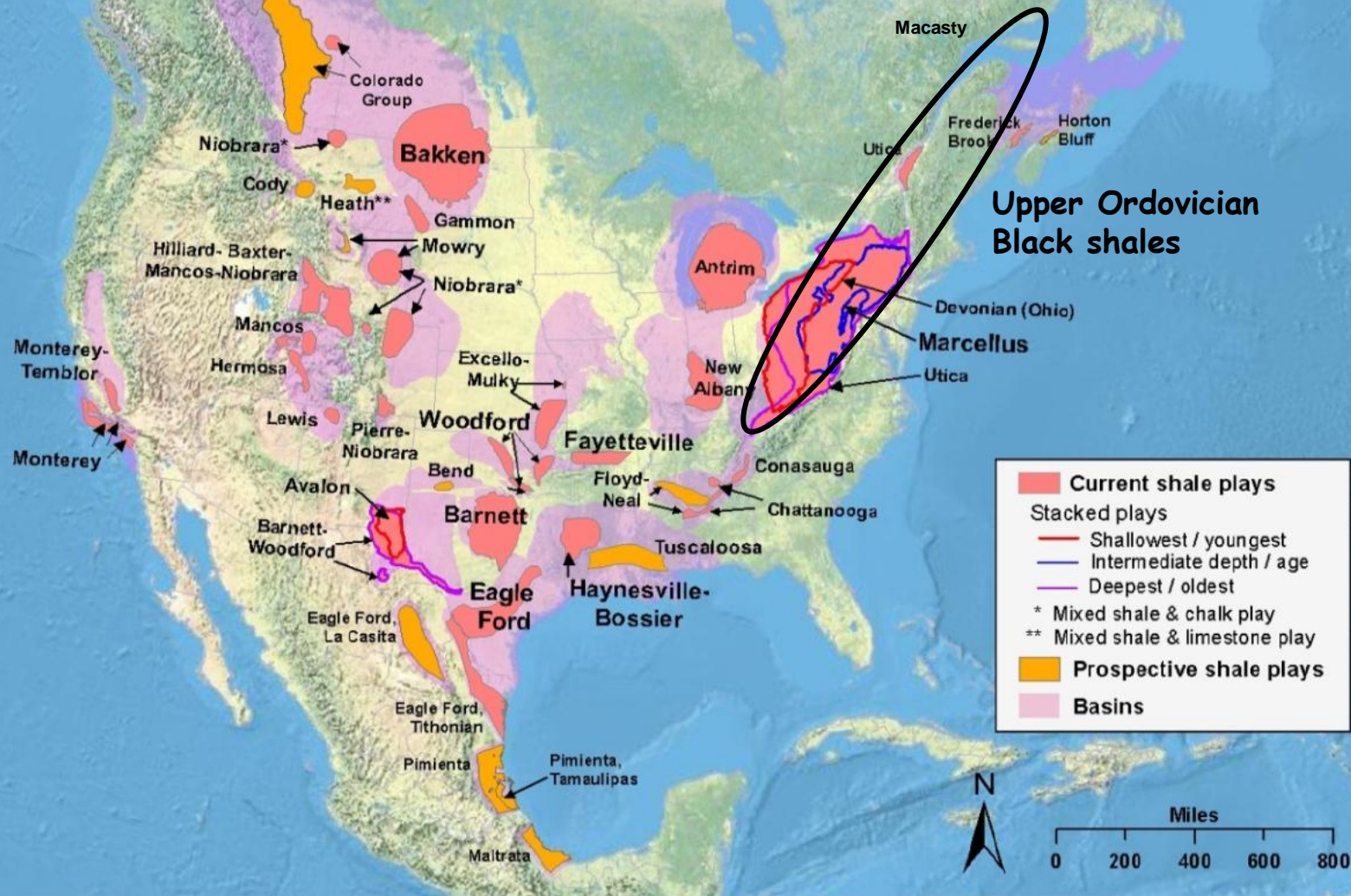


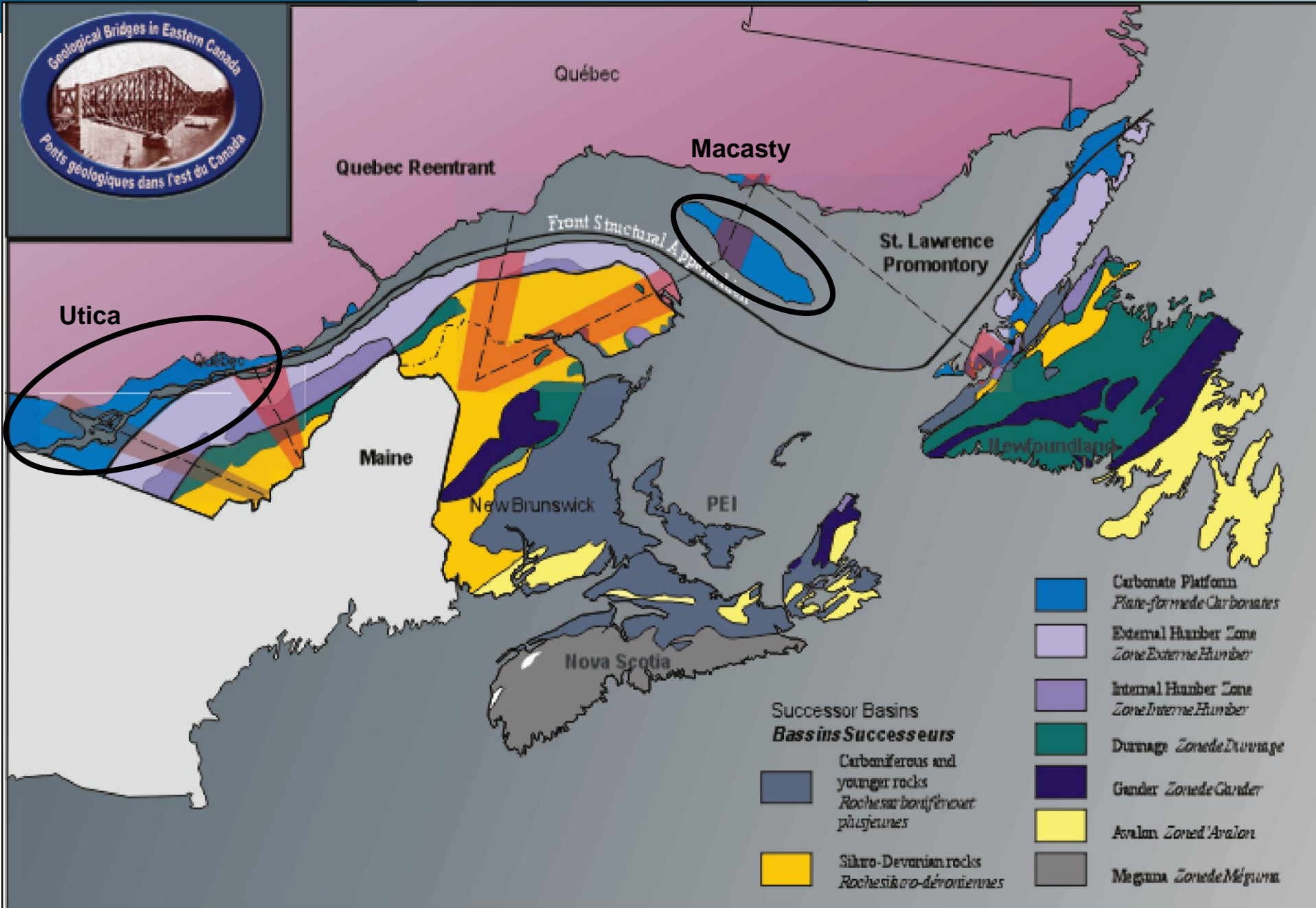
Cap rock integrity studies

Early definition of gas and oil potential of Ordovician shales in eastern Canada



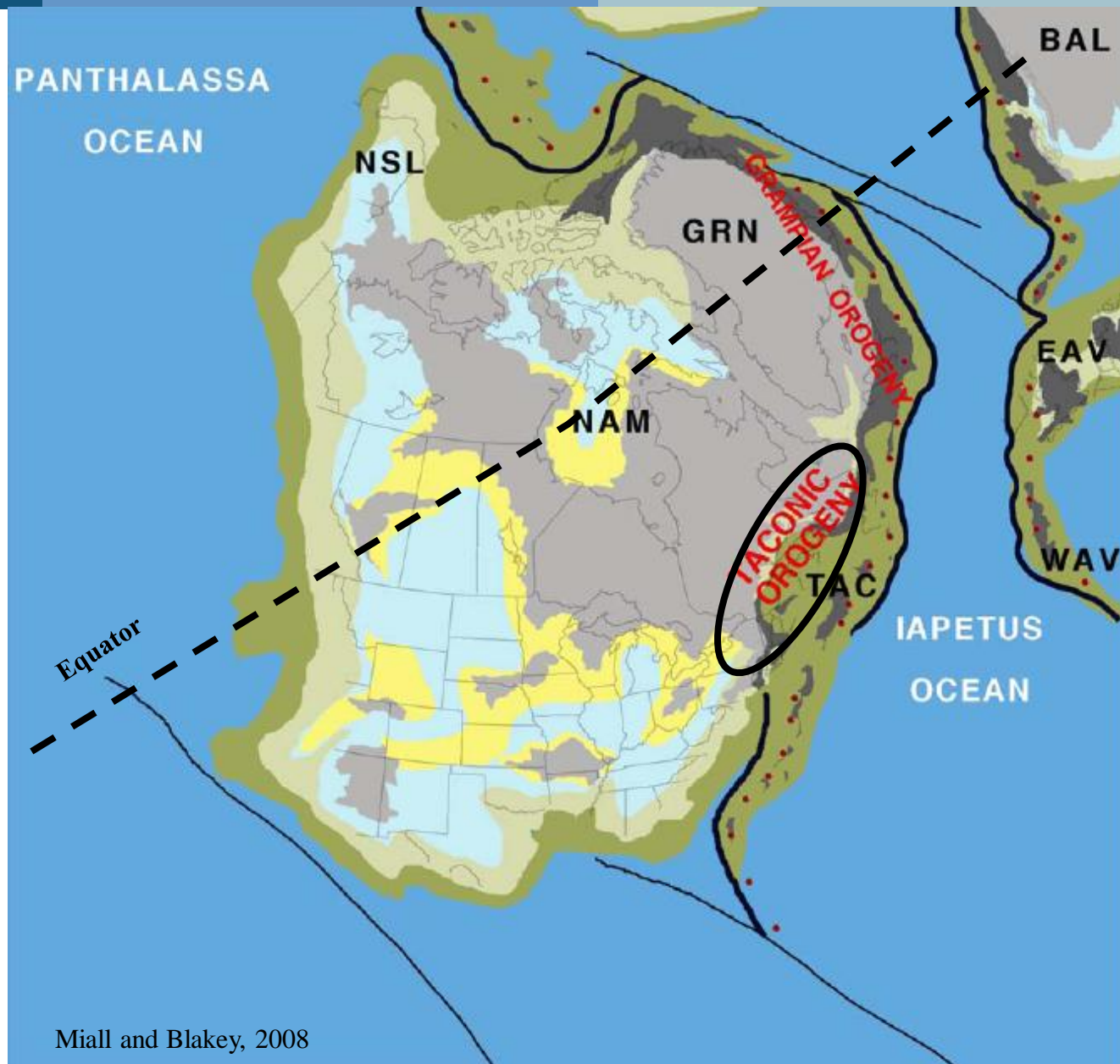
North American shale plays (as of March 2011)



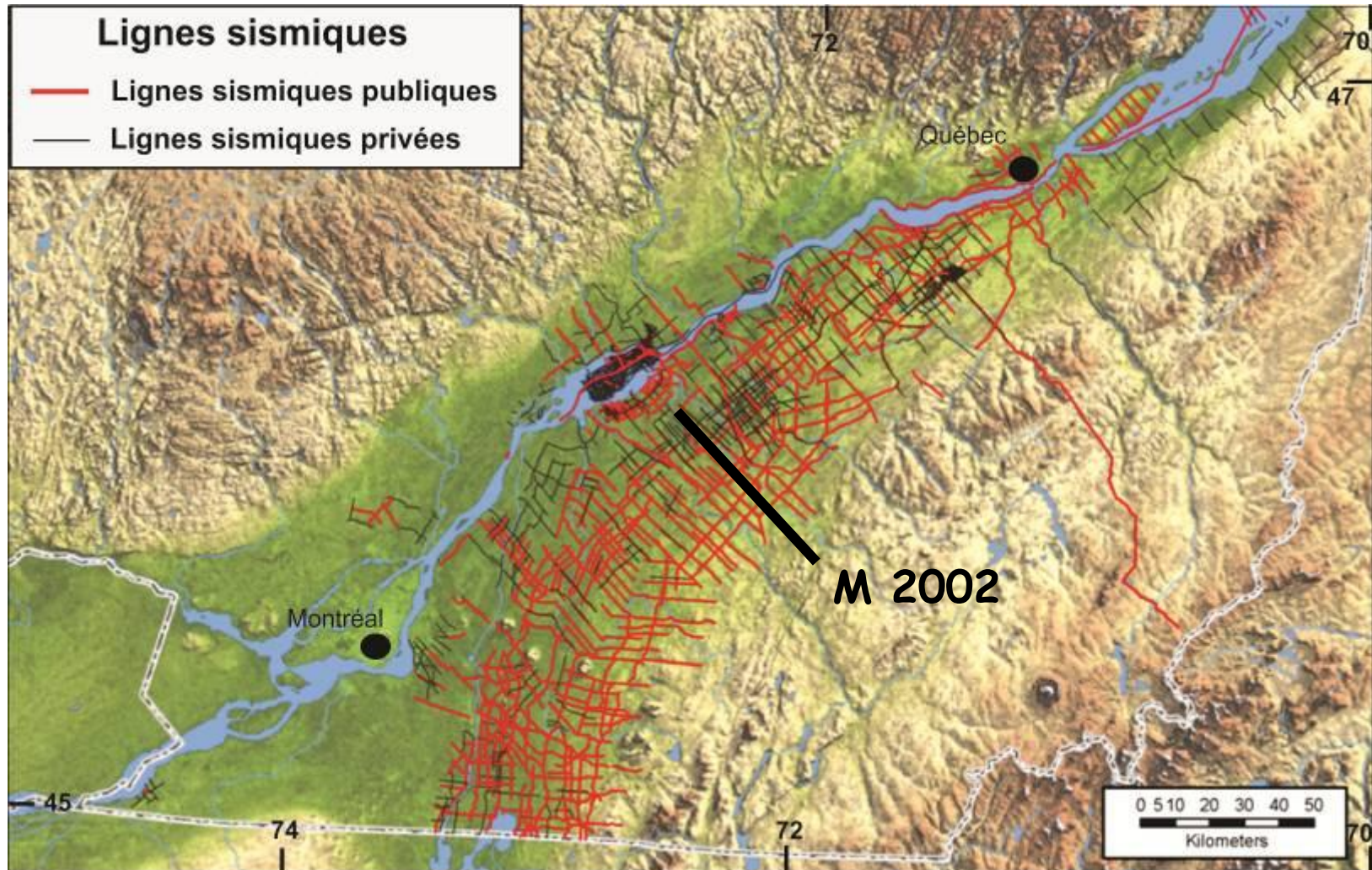


Mid- to Late
Ordovician

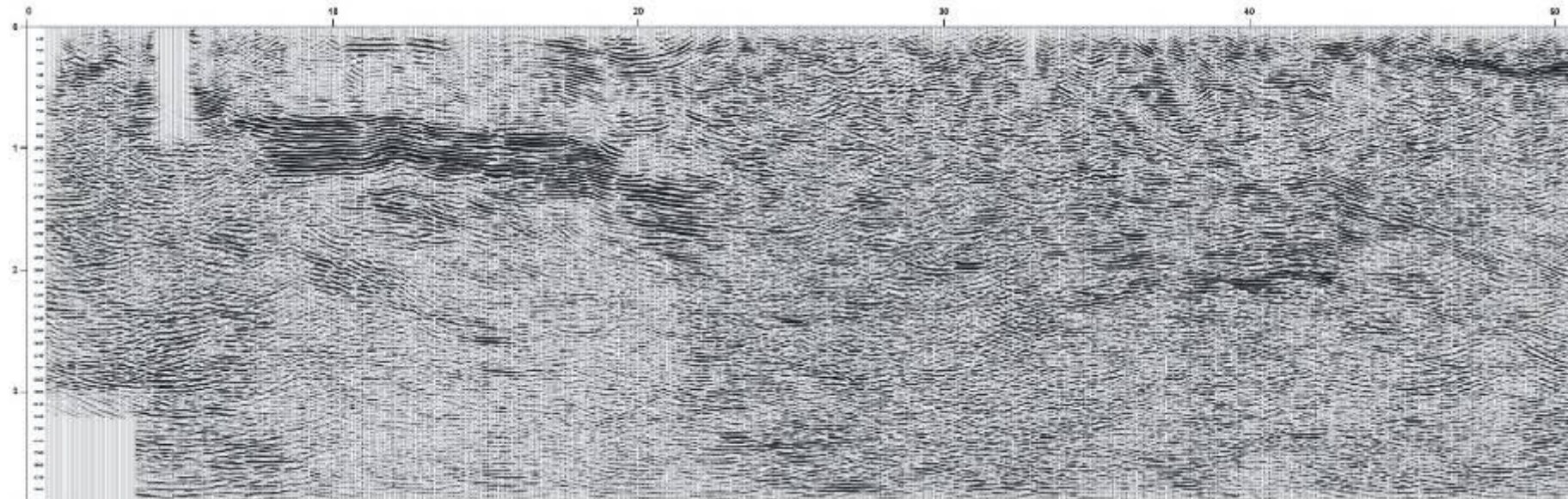
Formation of a
tectonic foreland
basin



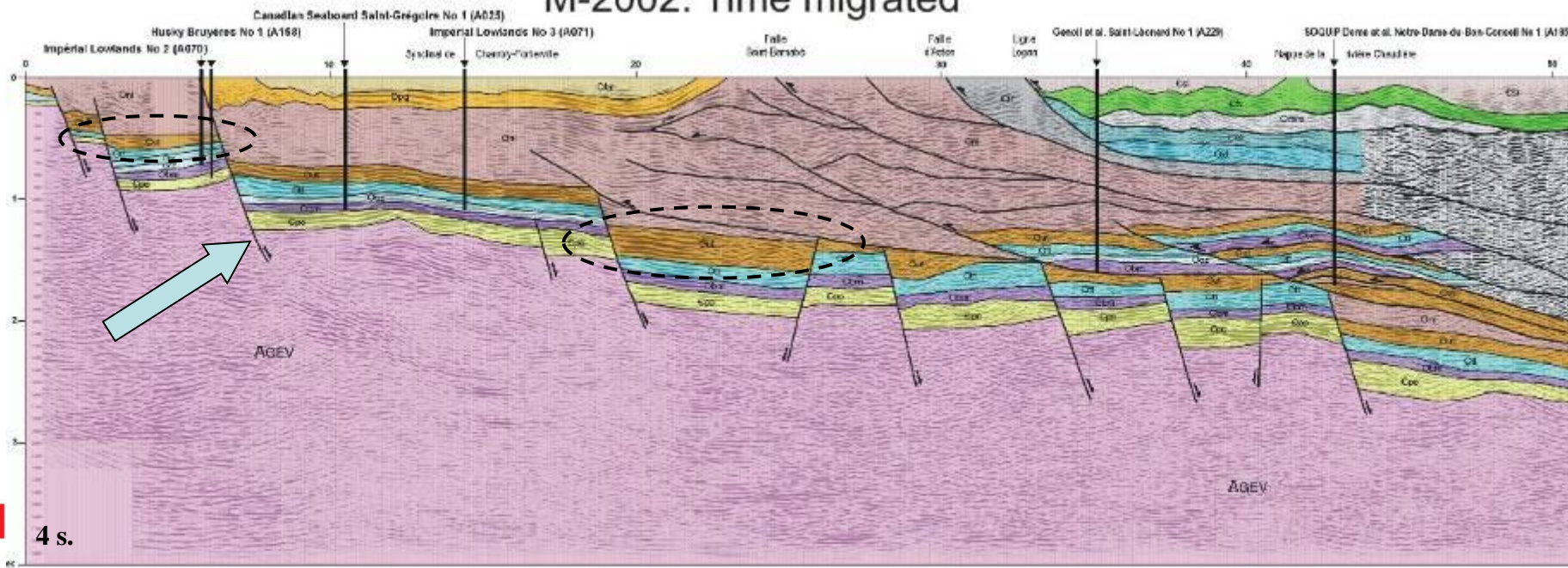
Seismic reflection and subsurface understanding

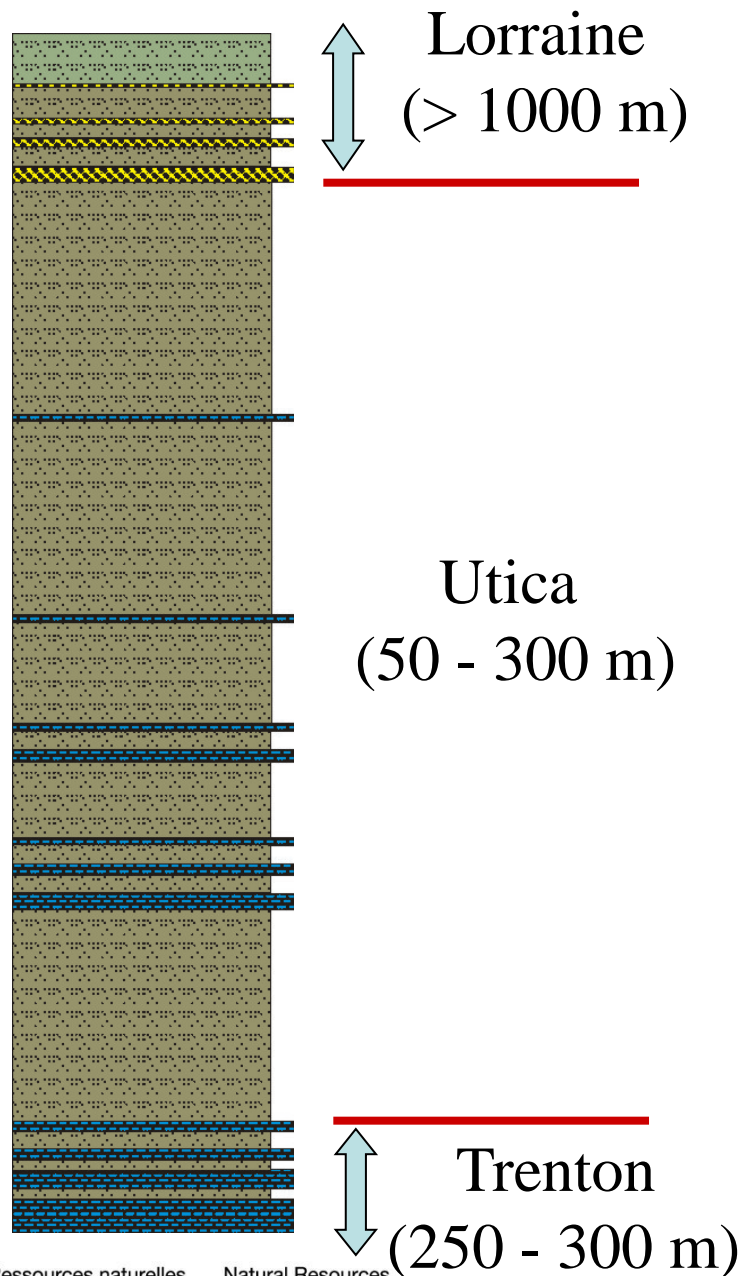


Seismic reflection and subsurface understanding



M-2002: Time migrated



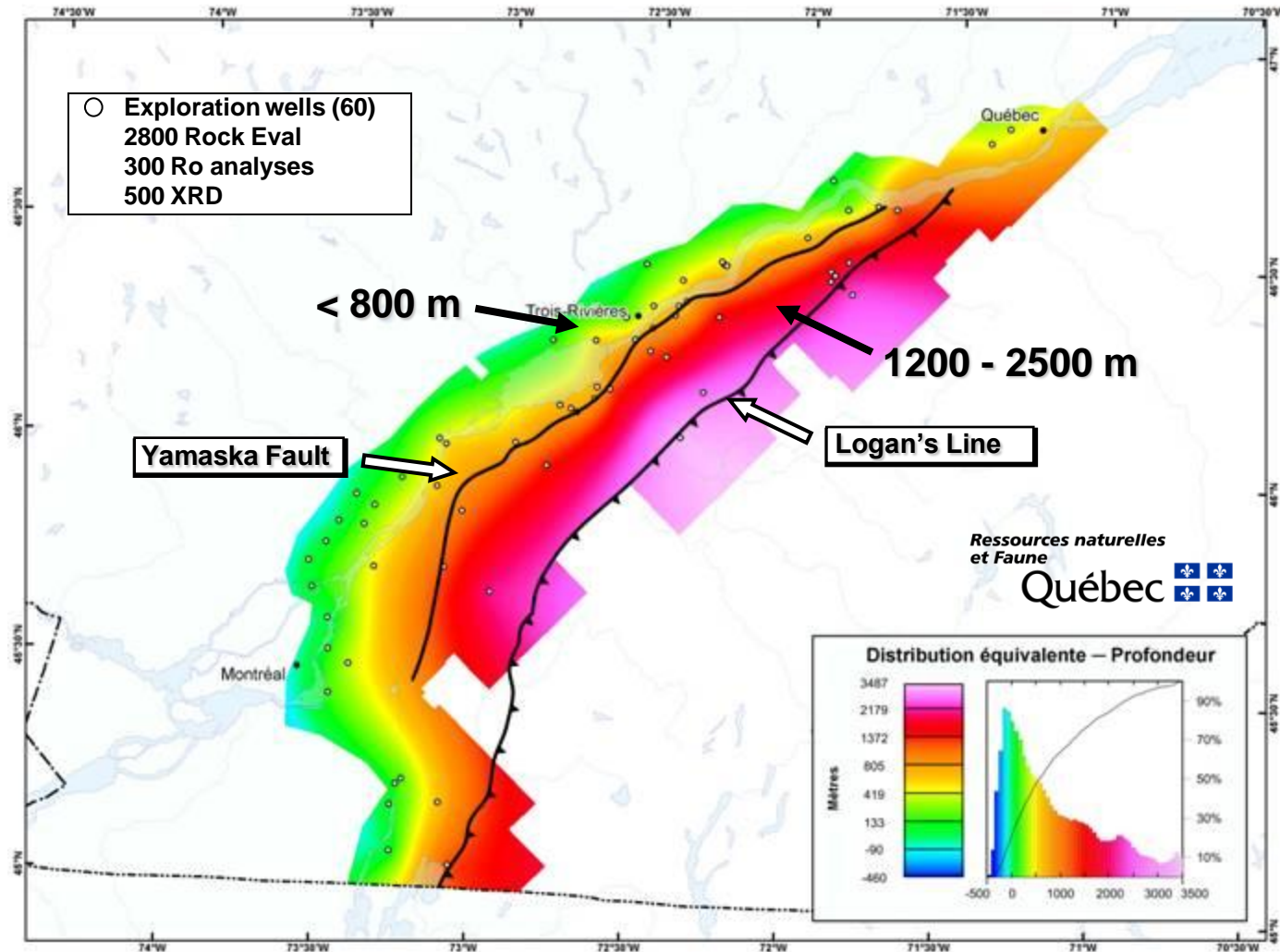


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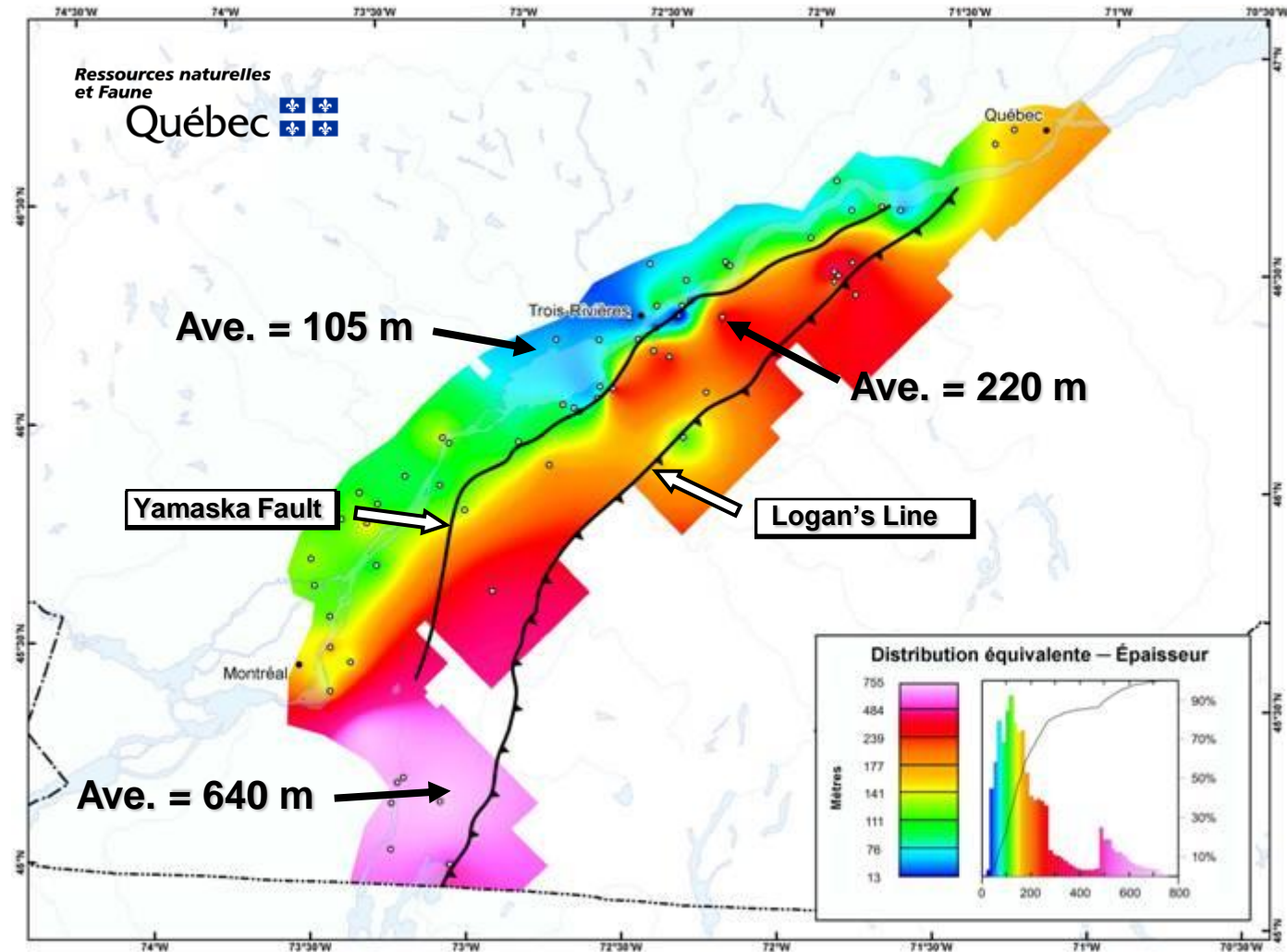
Natural Resources
Canada



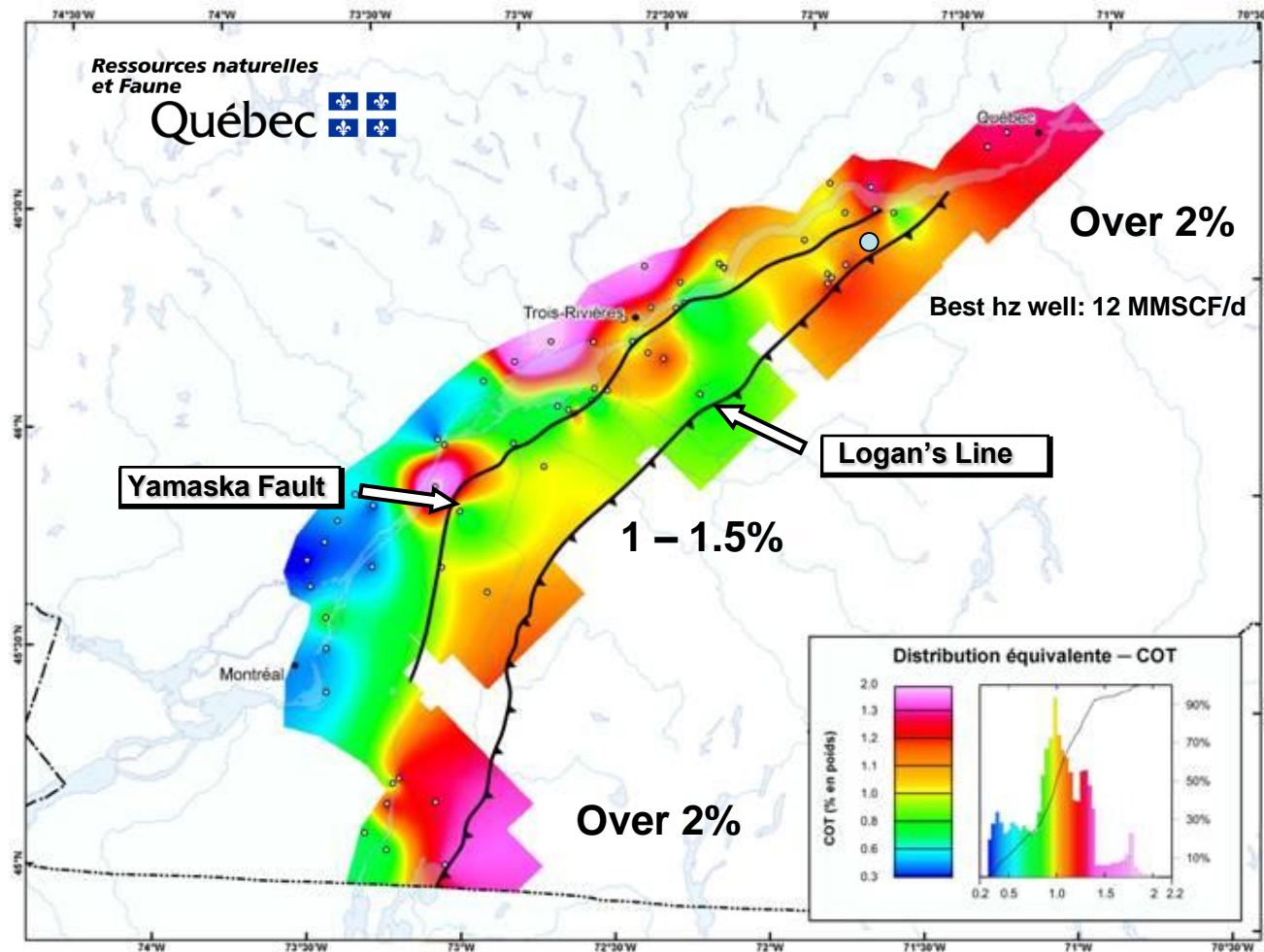
Depth to the top of the Utica Shale



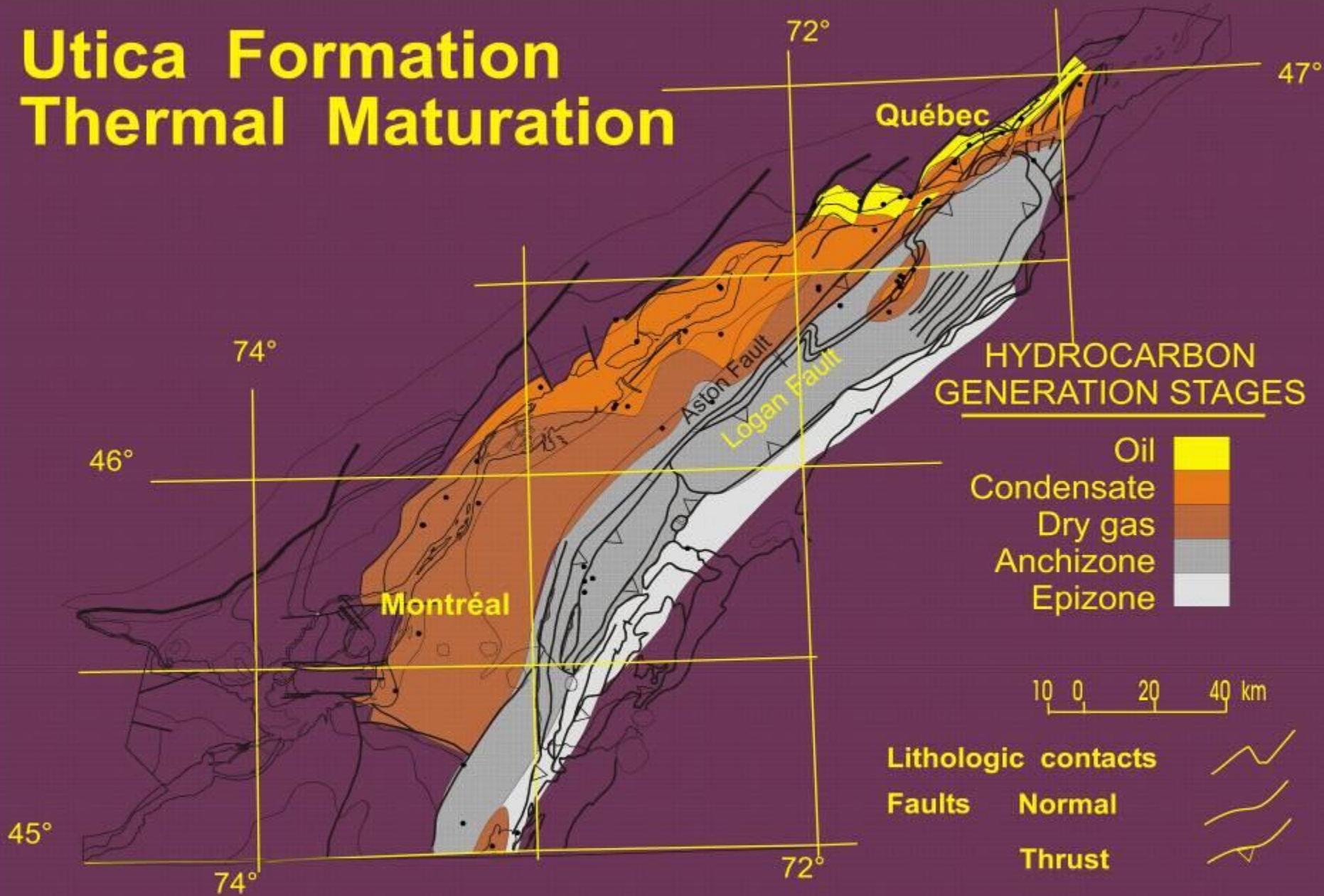
Thickness of the Utica Shale



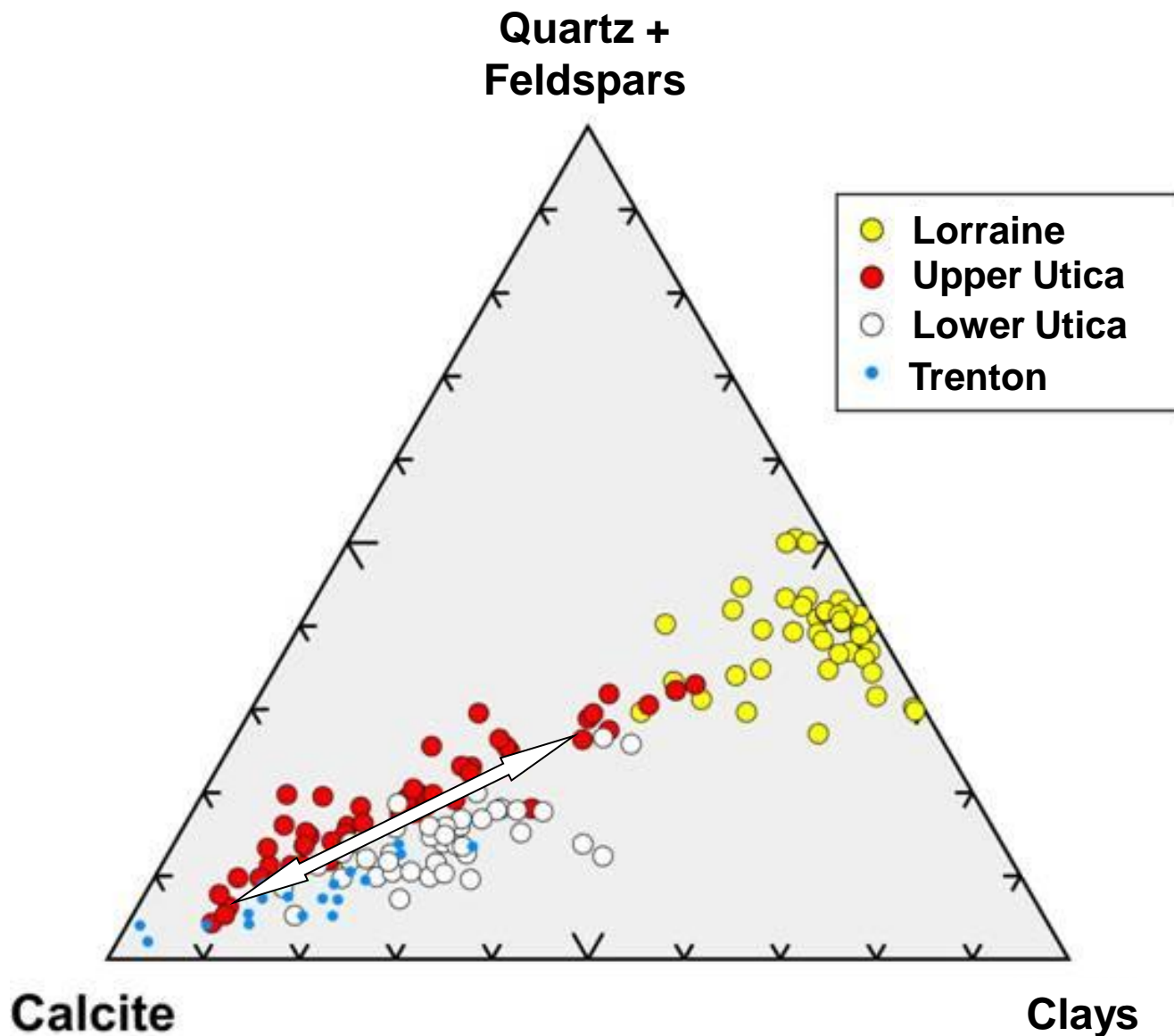
Total Organic Carbon (TOC)



Utica Formation Thermal Maturation



Mineralogy - X-Ray Diffraction

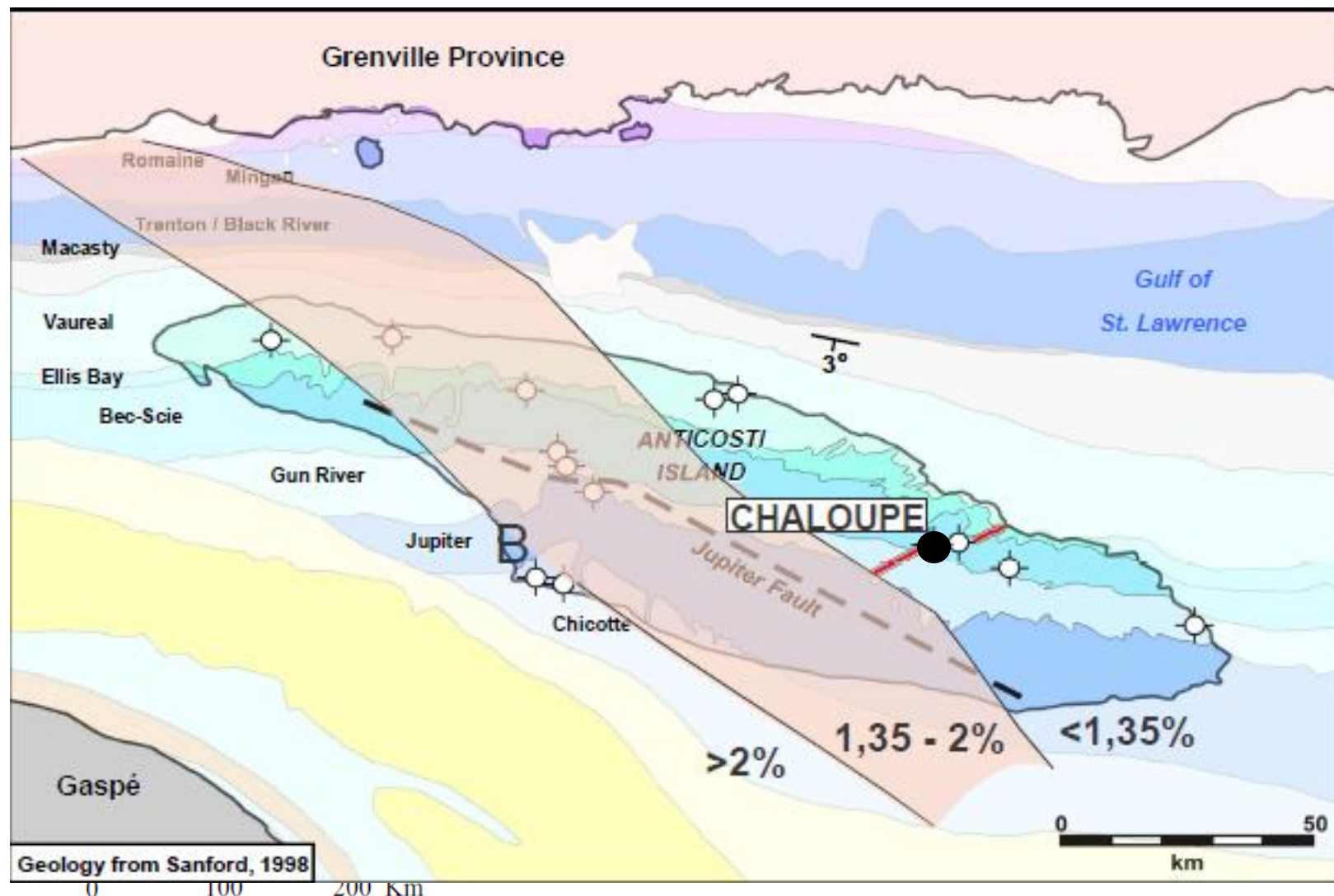


A new potential target Shale oil in Upper Ordovician shales on Anticosti Island

AGE	FORMATION	LITHOLOGY
Silurian	Chicette	Brick pattern
	Jupiter	
	Gun River	Horizontal dashed lines
	Bescie	
= Utica Ordovician	Ellis Bay	Brick pattern
	Vaureal	
	English Head	Horizontal dashed lines
	Macasty	
	Trenton	Brick pattern
	Black River	
	Mingan	Yellow band
	Romaine	Pink brick pattern
	Cambrian	Yellow band
	Pre-Cambrian	Red area with black crosses



Geological and thermal settings



Lavoie et al. (2009, GSC Open File 6174)



Macasty technical data

Low clay, high quartz and carbonate

TOC 2.4-5.7% average 4.3%

Type II kerogen within the oil window

Porosity 2.4-5.1% average 3.6%

Permeability: 200 to 740 nD average 480 nD

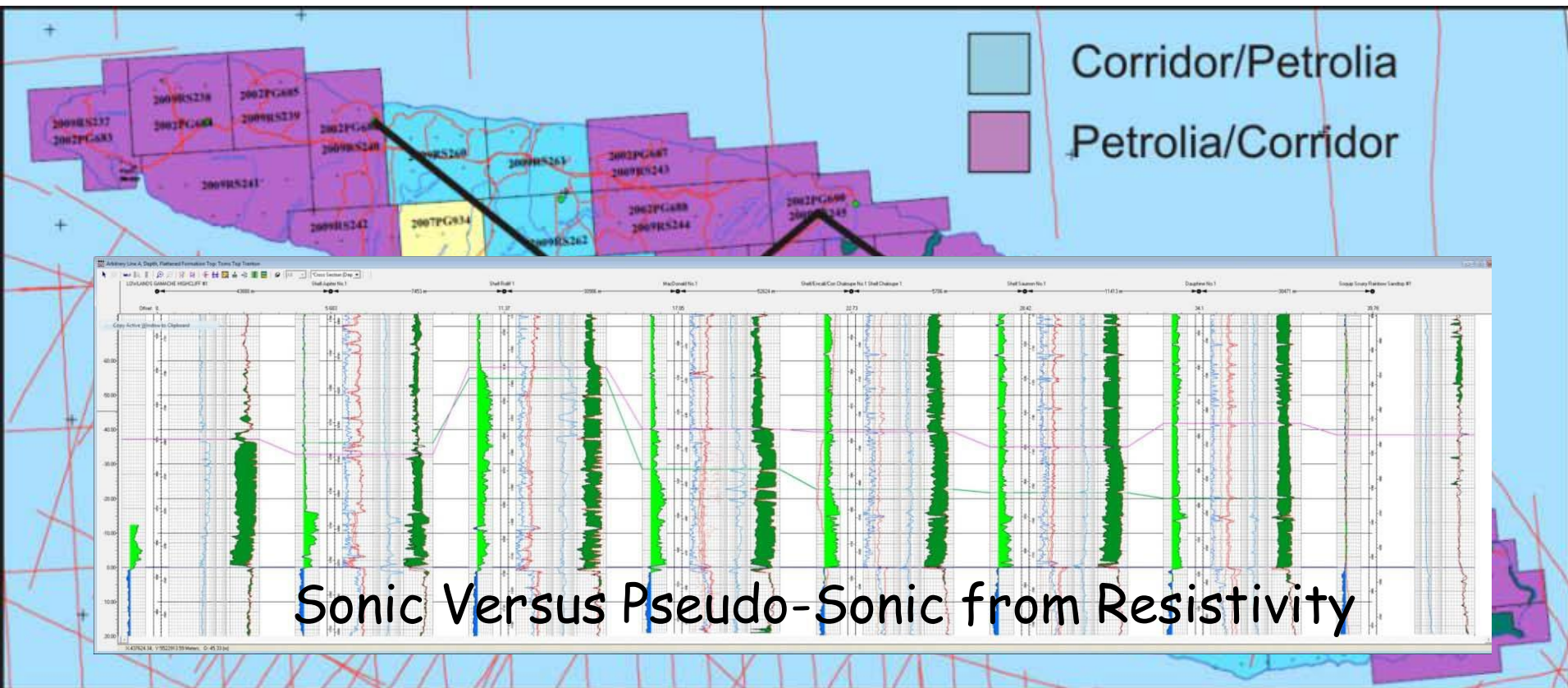
High oil saturation 27%; 35° API gravity

From Corridor Resources, 2011



A new potential target Shale oil in Upper Ordovician shales on Anticosti Island

P50 estimate of OIIP: 45 BBO



From Corridor Resources, 2011



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Conclusions...

Shale gas and tight oil are changing the hydrocarbon markets in North America

Production from unconventional reservoirs is rapidly picking up in Canada, stopping the multi-year production decline

Natural Resources Canada is currently carrying out fundamental research on resource evaluation / characterization as well as on potential environmental impacts on groundwater and risk of induced seismic activities in producing fields and frontier areas.



... Conclusions

1. The Upper Ordovician black shales in Quebec consist of the Utica and Macasty calcareous shales.
2. The Utica Shale has been successfully fractured in southern Quebec with the best IP of 12 MMcf/d
3. OGIP estimates range between 120 to 140 Tcf (P50)
4. The Macasty has not been tested yet; preliminary technical data indicate that the calcareous shale is oil saturated and in the oil window
5. Preliminary OOIP estimate is 45 BBO (P50)



Thank you !

*Utica Shale along the Jacques Cartier River
30 km southwest of Quebec City*



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