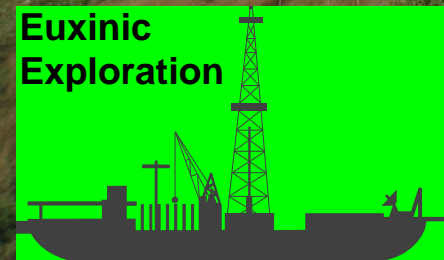


Petroleum Exploration Opportunities in Anticosti Basin, Offshore Western Newfoundland and Labrador - Call for Bids NL11-01

Dr. Michael E. Enacheseu,
P Geoph, P Geo
Euxinic Exploration

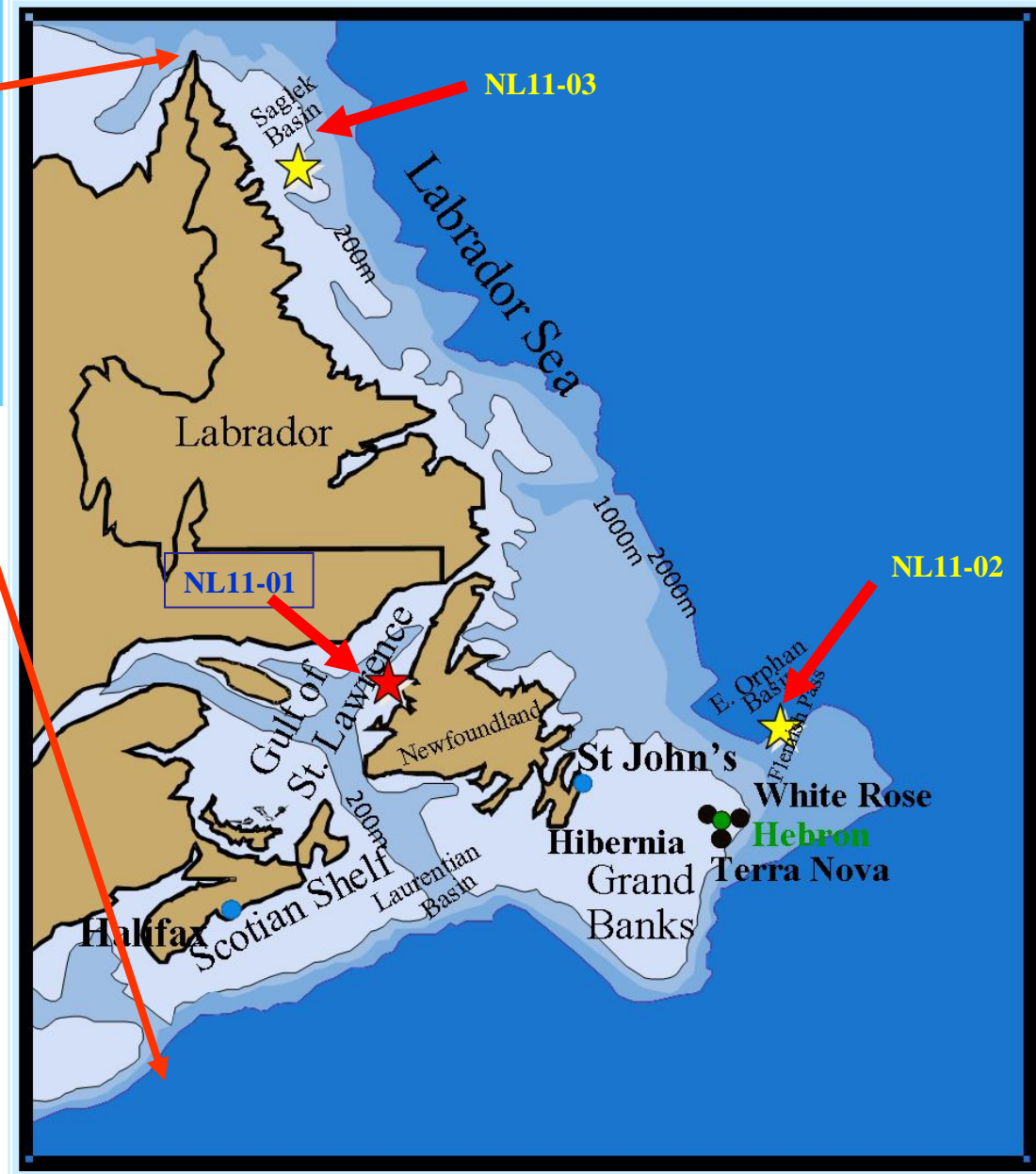
**On Behalf of NL DNR
September 2011**





Acknowledgements

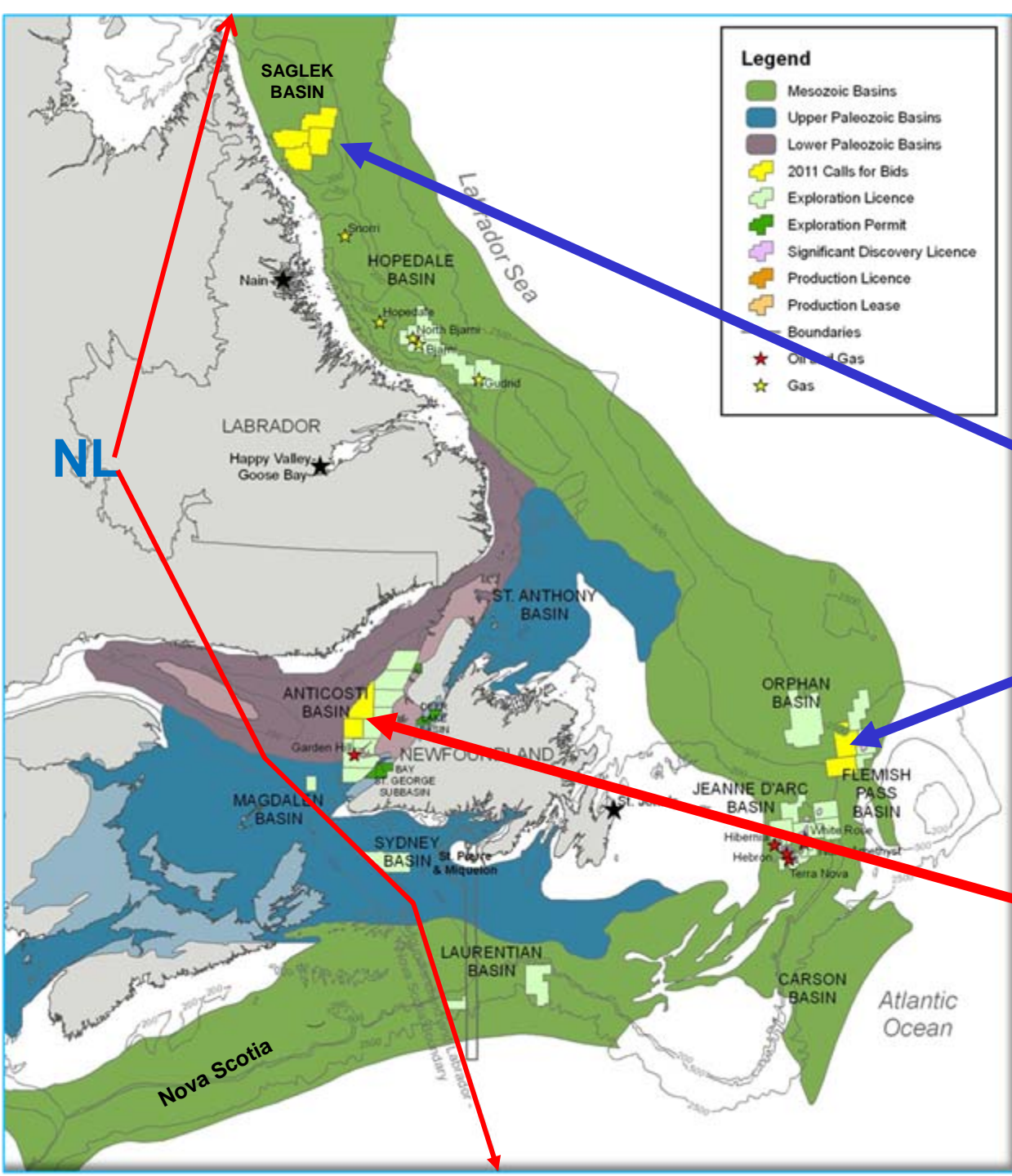
- Wes Foote, David Middleton, Lori Cook, Darrell Spurrell, Brad Kendell, Jillian Owens, Larry Hicks of the NL Department of Natural Resources;
- Ian Atkinson, Phonse Fagan;
- Dianne Noseworthy of C-NLOPB;
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- Bridget Ady and Richard Whittaker of GeoArctic
- This work could not have been performed without valuable information provided by CNLOPB and Government of Newfoundland and Labrador Department of Natural Resources.



★ = position of CFB NL11-01 parcels

Presentation Content

- 1. Introduction**
- 2. Exploration and Development Background**
- 3. Regional Geology of the Western
Newfoundland Basins**
- 4. Petroleum Geology of the Anticosti Basin**
- 5. Petroleum Potential Call for Bids**
 - NL11-01 Parcel 1**
 - NL11-01 Parcel 2**
- 6. Discussions**
- 7. Conclusions**



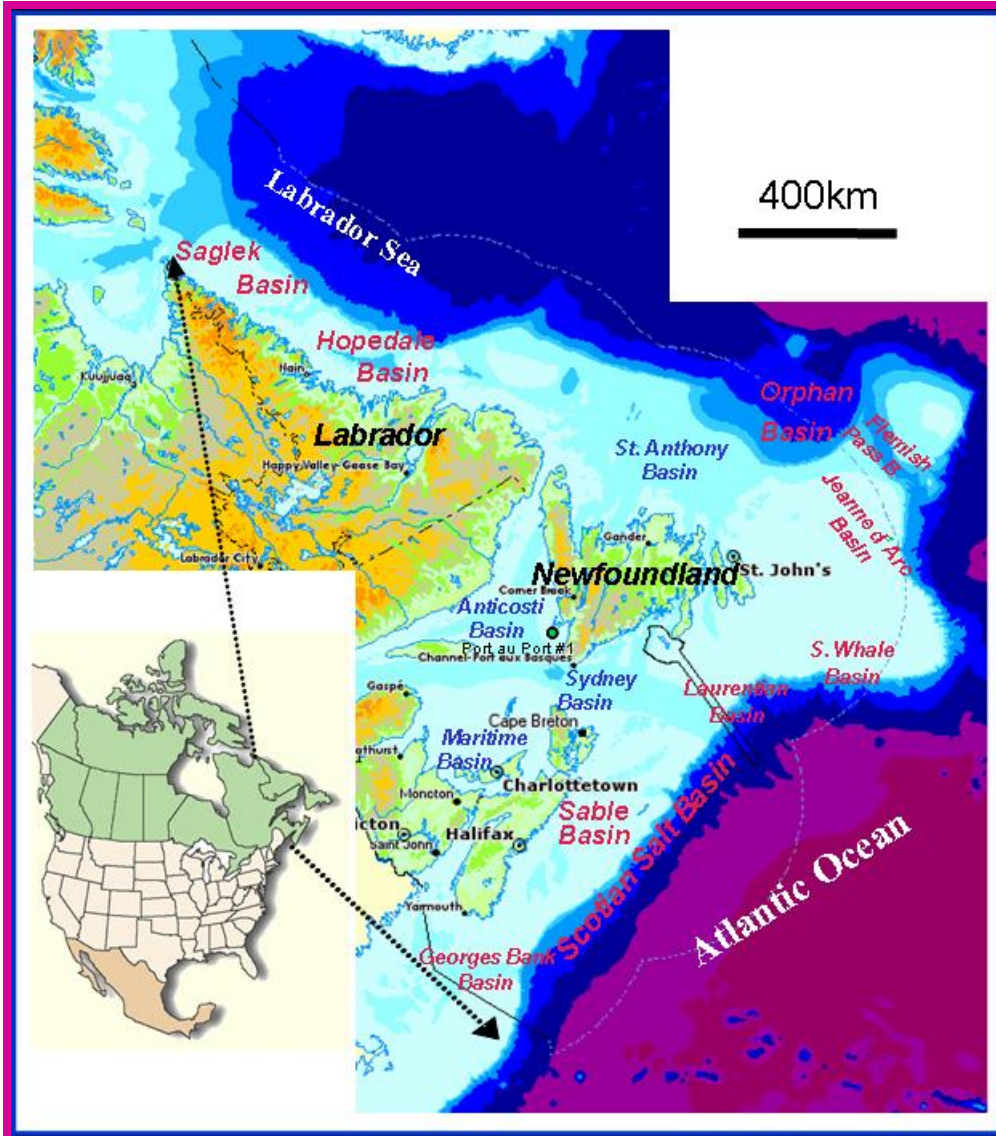
NL CFB 2011: Three CFB in four basins

- CFB NL11-03
Saglek Basin

- CFB NL11-02
Flemish Pass/
Orphan/Central Ridge

- CFB NL11-01
Anticosti Basin

Atlantic Canada Offshore Basins



Blue Text: Paleozoic Basins

Magenta Text: Mesozoic Basins

NL Paleozoic Basins

- Sydney Basin
- Maritime (Magdalen) Basin
- Anticosti Basin
- St. Anthony Basin

Blue writing above: Paleozoic basins with ongoing exploration

1. Introduction

- CFB offered parcels NL11-01-01 and - 02 are two of the few remaining unlicensed offshore blocks along the western coast of Newfoundland
- Parcels are situated just north of the Port au Port Peninsula where light oil and gas were tested at significant flow rates from the Port au Port #1 (PAP) well in 1995. The PAP well is referred to as the Garden Hill South discovery and the Production Lease 2002-01 is held by PDI Production Inc. (PDIP)
- The parcels are located adjacent to several active offshore Exploration Licenses (ELs) where ongoing exploration activity includes the acquisition of 3D and 2D seismic reflection data, integrated geological studies, collection of aeromagnetic data and exploration drilling

Observations

- References introduced in this presentation are listed in associated reports and presentations posted on the website:

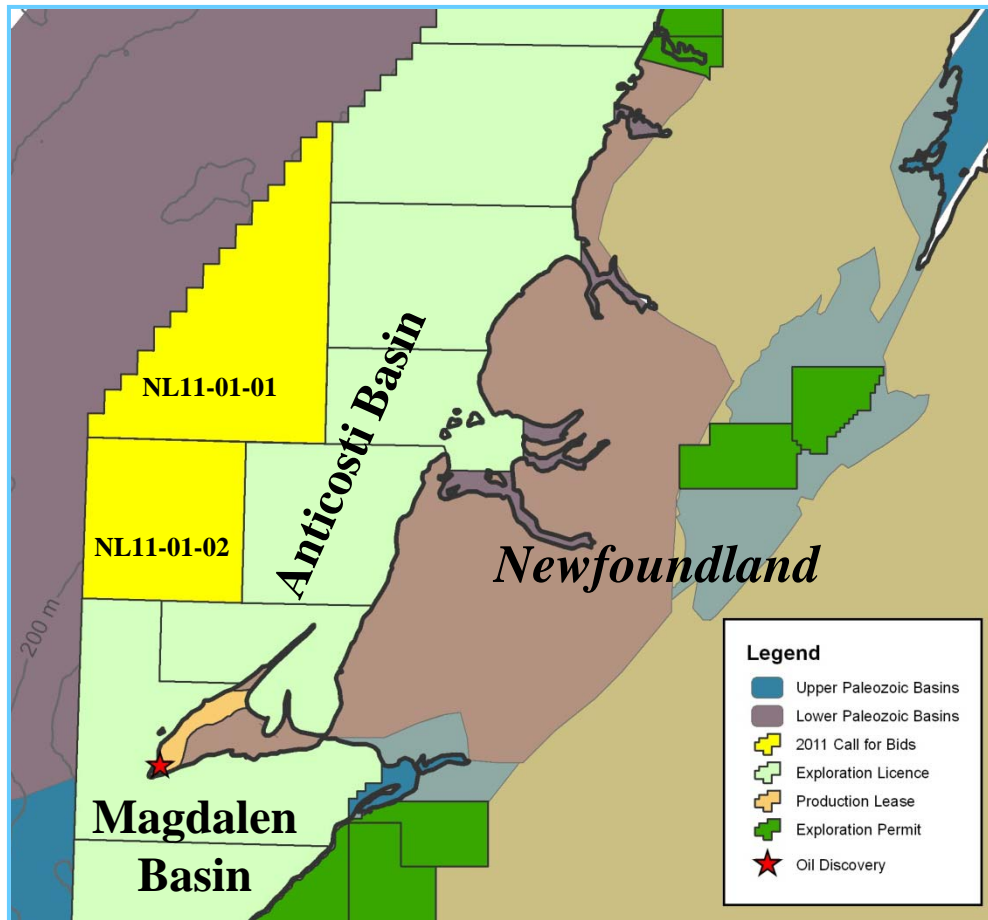
<http://www.nr.gov.nl.ca/mines&en/oil/>

- Certain parts of this presentation are repeats or updates of text and illustrations contained in the power point and report produced by Enachescu & Foote, 2009 and available at:

http://www.nr.gov.nl.ca/nr/invest/callforbidsnl09-03_1.pdf

<http://www.nr.gov.nl.ca/nr/invest/callforbidsnl09-03.pdf>

Western Newfoundland and Labrador 2011 Call for Bids

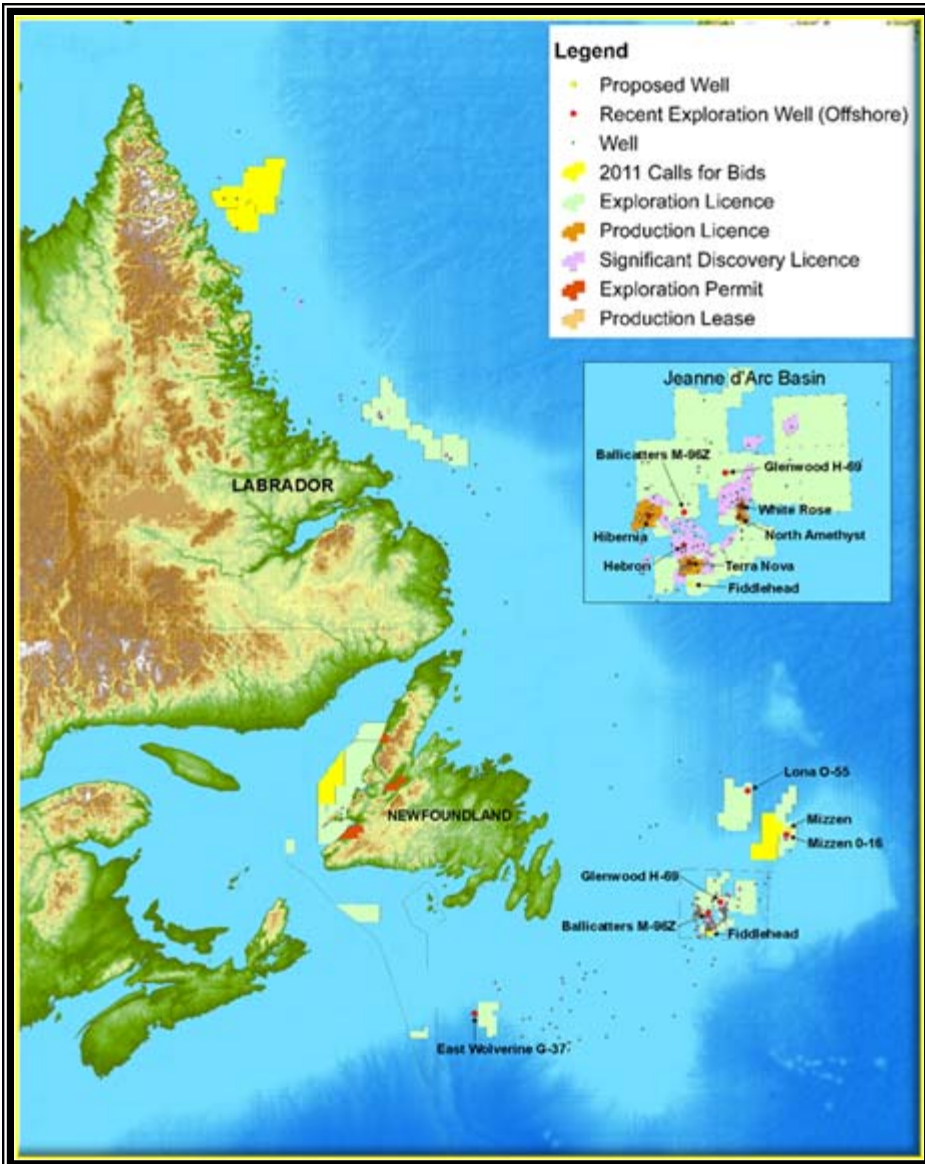


- **CFB NL11-01** consists of two large parcels located in shallow waters of the Gulf of St. Lawrence
- **Call for Bids closes November 15, 2011 at 4 p.m. NL time**

2. Exploration and Development Background

- **NL Historic E&P Activity**
- **NL Petroleum Production**
- **Participation of Nalcor Energy**
- **Large Paleozoic Offshore Under Explored Basins**
- **Recent E&P Activity in Atlantic Paleozoic Basins**
- **West Coast Newfoundland Exploration History**
- **Recent Western NL Offshore Call for Bids and Exploration Results**

NL Historic E&P Activity



Wells Drilled

Exploration (Total)	231
Offshore	147
Onshore	84
Delineation	52
Development	170

Discoveries

Oil	20
Gas	7

Current Holdings

Exploration Licences (ELs)/Permits (EPs)	42
Significant Discovery Licences (SDLs)	52
Production Licences (PLs)/Leases	11

NL Petroleum Production

- **1.25 Bbbls** produced to date mainly from three fields - Hibernia, Terra Nova and White Rose developed in the Mesozoic Jeanne d'Arc Basin, on the East Coast of Newfoundland. A fourth field, North Amethyst, started producing in 2010
- These fields have produced in the range of 250,000 to 360,000 barrels per day of light crude (30 to 35° API) from Mesozoic sandstones in each of the past 5 years; Currently NL produces between **250-300,000 bopd** monthly
- Over 100 MMbbls produced in 2010; daily average of **275, 866 bopd**
- NL production represents 12.5% of Canada's total oil production, 35% of Canada's light oil and more than 80% of Atlantic Canada petroleum output
- NL is the second largest hydrocarbon producing province in Canada
- Production to date is from the Jeanne d'Arc Basin only; more than **1.8 Bbbls** proven remaining recoverable reserves/resources exists
- Jeanne d'Arc Basin developments are the only producing offshore oilfields on the Atlantic coast of North America
- A fifth large field, Hebron, estimated to contain 581 MMbbls recoverable reserves/resources (C-NLOPB) will be developed starting in 2012 with first oil expected in 2017. Additional 150 Mbbls recoverable reserves are associated with Ben Nevis/West Ben Nevis fields
- Satellite fields are now adding to production of Hibernia and White Rose fields

Participation of Nalcor Energy

- Legislation to create the province's energy corporation, Nalcor Energy, wholly owned by the Government of NL
<http://www.nalcorenergy.com/>
- Through Nalcor, the Province negotiated equity positions in several offshore fields: White Rose Growth Projects (including North Amethyst, West White Rose, South White Rose Extension) (5%), Hebron (4.9%) and Hibernia Southern Extension (10%)
- On 31 May 2010 Nalcor obtained first oil production from its 5% participation in the North Amethyst field, establishing the company as an emerging provincial-owned upstream oil and gas player in the Atlantic continental margin
- Energy Plan provided a framework for a price based Offshore Natural Gas Royalty Regime and introduced the concept of a “pioneer project”

Participation of Nalcor Energy

- During 2009, Nalcor Oil and Gas acquired an average of 67 per cent working interest in three onshore exploration permits in the Parsons Pond area on the Great Northern Peninsula
- In 2010, Nalcor completed the drilling of two onshore exploration wells in the Parsons Pond area, Seamus and Finnegan, and completed testing of the Seamus well
- Seamus well drilled to an onshore record depth of 3,160 metres
- Non-commercial natural gas was encountered in both wells
- The results of drilling and testing of these wells and seismic analysis have greatly advanced the understanding of Western NL petroleum geology
- The extensive datasets gathered from the wells can be extrapolated to several of the offshore exploration licences
- Nalcor Energy-Oil and Gas continues to pursue other investment opportunities and supports the province's efforts to promote exploration

Western Newfoundland Research and Exploration (R&E) Projects

- Several large R&E projects are jointly administered by Nalcor and NL Department of Natural Resources through programs such as Petroleum Exploration Enhancement Program (PEEP) and Offshore Geoscience Data Program (OGDP)
- PEEP is a \$5million, multi-year program initiative of the Energy Plan and is focused on improving geoscience knowledge of Western Newfoundland onshore Paleozoic basins. The program is based on collaboration of Industry, Government and Academia. Funding to this program was extended to 2011-2012
- Among other geophysical and geological studies, PEEP financed in 2008-9 a regional aeromagnetic survey over Western Newfoundland onshore; resulting maps are publicly available
- Government of NL also provided \$20 million to fund the Offshore Geoscience Data Program (OGDP)

Western Newfoundland Research and Exploration (R&E) Projects

- In 2010-11 an offshore NL regional oil seep mapping and interpretation study was funded by OGDPA and awarded to Astrium/Infoterra. Mapping natural oil seeps at sea allows judicious targeting of new seismic data acquisition, minimizing the geologic uncertainty and reducing overall exploration risk. The study results are available for licensing to oil companies
- A gas hydrate study involving the shelf, slope and deepwater was recently initiated
- A Plate Tectonic Kinematic Model for North Atlantic regions project was initiated in 2010 by Nalcor/DNR in collaboration with PIP/PAD of Ireland and awarded to GeoArctic. The resulting study and kinematic animation will be available to funding agencies and also for licensing to oil companies

Aeromagnetic Survey, Western NL

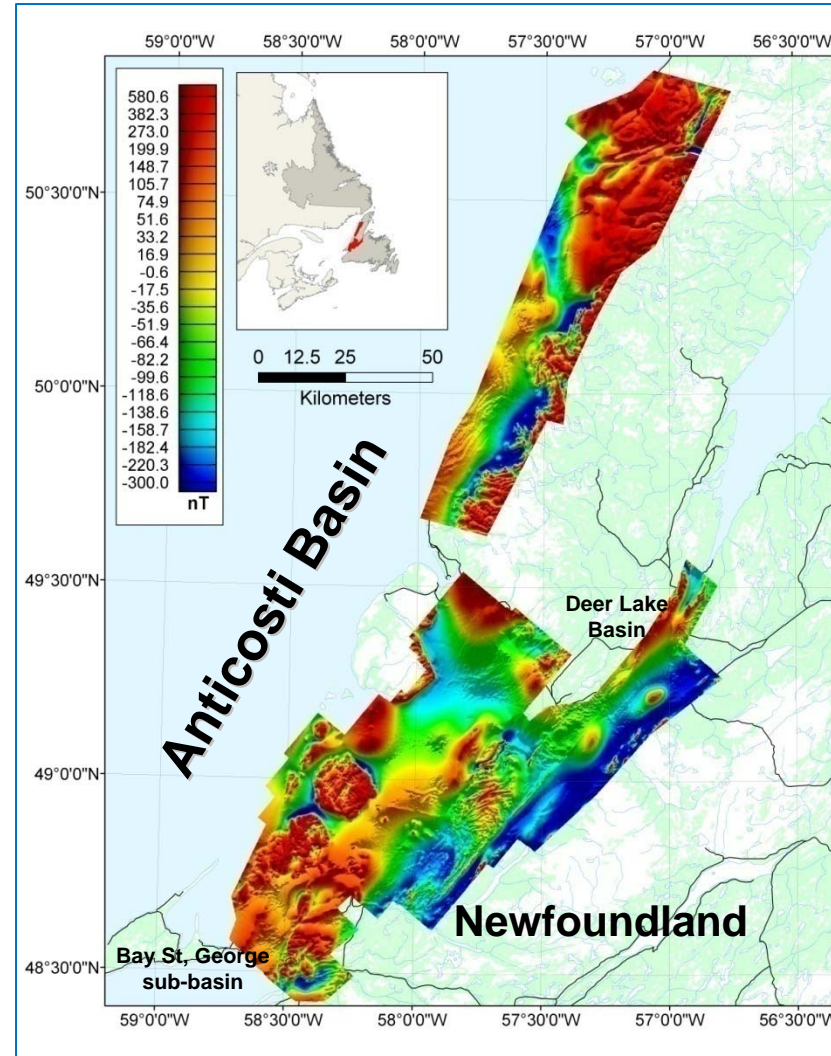
Key Features

- Collaboration between Geological Survey of Newfoundland and Labrador/Energy Branch (DNR) and Nalcor Energy
- 63,000 line km; ~11,400 km² data coverage
- Residual Magnetic Field & 1st Derivative of RMF maps available
- 4 OPEN FILES (No Cost)
- 46 maps - 23 NTS areas, available online in pdf format.
- Links to data and GIS layers are available through NL DNR Geofiles Collection. Geofile Number 012B/0581, NFLD/3075, NFLD/3076:

http://www.geosurv.gov.nl.ca/airborne/disp_airborne.asp?SURVEY_ID=DN09906
http://www.geosurv.gov.nl.ca/airborne/disp_airborne.asp?SURVEY_ID=DN09907
http://www.geosurv.gov.nl.ca/airborne/disp_airborne.asp?SURVEY_ID=DN09908

Survey Objectives

- Understanding of basement structure, significant terrane boundaries
- High-resolution mapping of major crustal lineaments, large-scale faulting
- Delineation of areas of increased hydrothermal dolomite potential for reservoir development
- Ongoing plans to extend into offshore area, to give complete coverage for Western Newfoundland



Regional oil seep mapping and interpretation study offshore NL

Key Features

- Part of the OGDG program; Nalcor contracted the GEO-Information division of Astrium Services on a non-exclusive basis
- Cost-effective, de-risking tool used to evaluate exploration potential for both under-explored and mature offshore basins and locate new seismic grids
- Study covered offshore areas of NL totaling approximately 1.5 million km² and was linked to SW Greenland
- Mapping and classifying of offshore oil slicks based on satellite data from various providers
- Data can be licensed by oil companies and is delivered as a “plug and go” GIS product

Survey Objectives

- Hydrocarbon screening of frontier basins (e.g. Anticosti, Laurentian, East Orphan, Flemish, Saglek basins)
- Risk-ranking of basins and sub-basins prior to new exploration
- Monitoring spatial characteristics of the oil slick over areas of existing production
- Planning sea surface and sea-bottom geochemical programs
- Designing new 3D and 2D seismic programs and integration with older surveys
- Link geological and geophysical interpretation from onshore to offshore basins
- Environmental monitoring, environmental risk assessment, impact statement or full environmental baseline

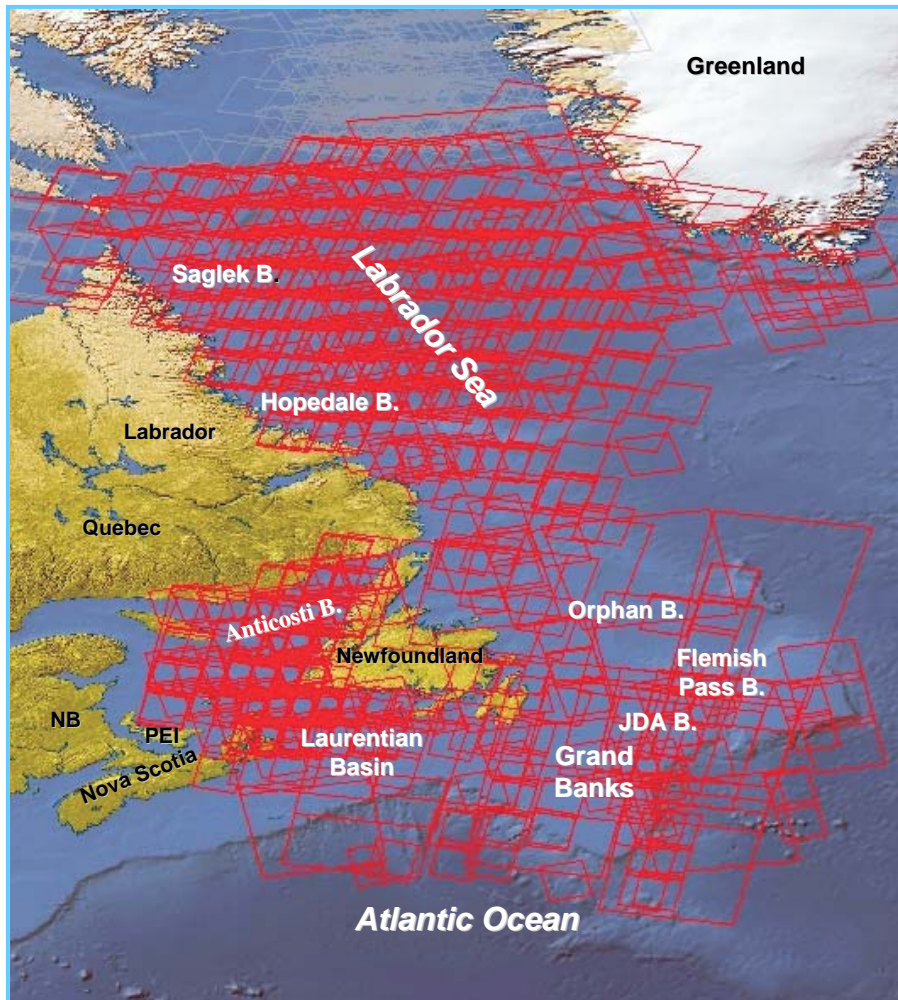


Plate Tectonic Kinematic Model

Project for North Atlantic Regions

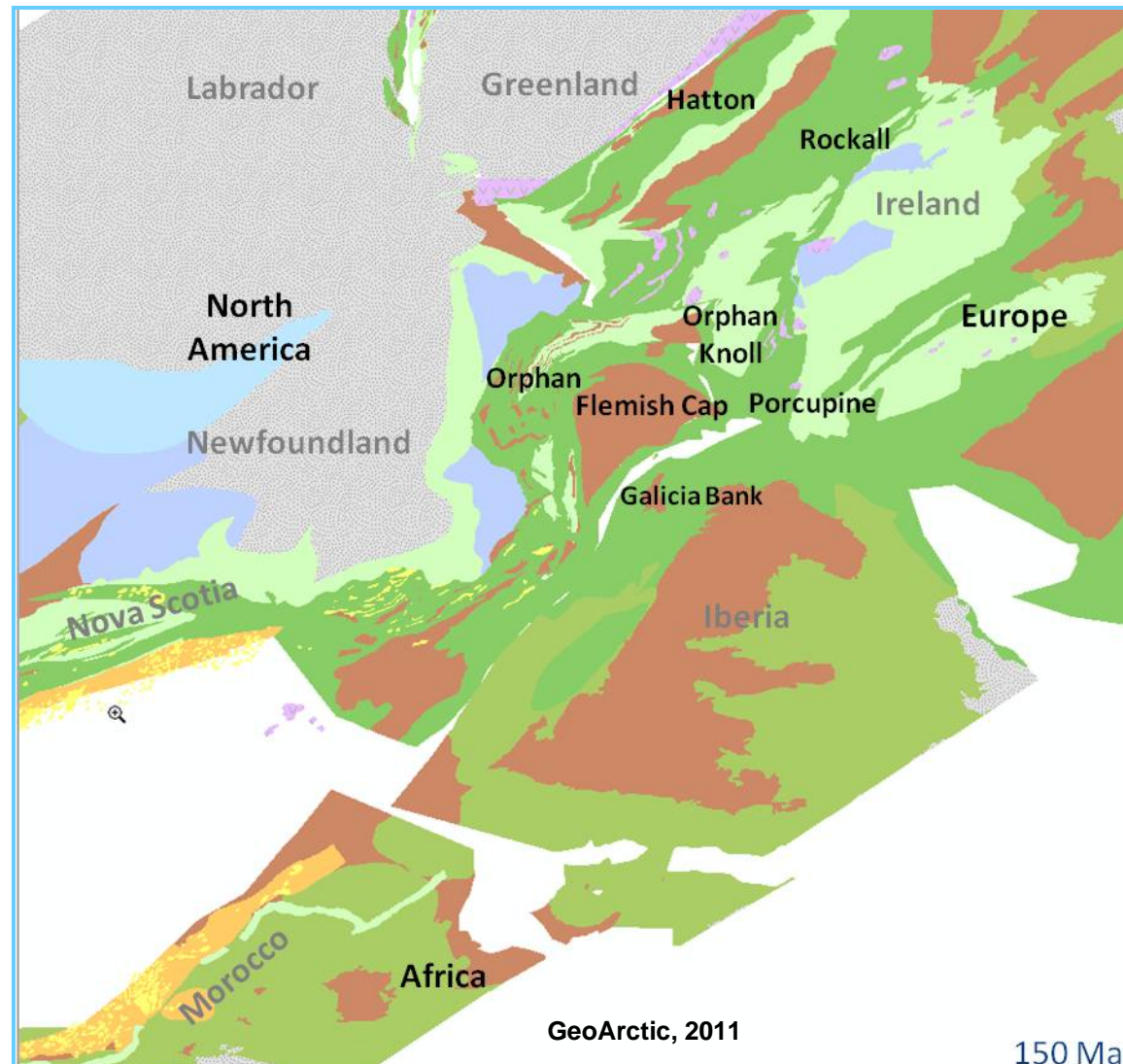
Key Features

- A joint research project funded by Nalcor/DNR and Irish Shelf Petroleum Studies Group (ISPSG-this group include oil companies active in Western Ireland offshore and the Irish Petroleum Affairs Directorate)
- To be managed and carried out by GeoArctic of Calgary
- Academic and technical input from the universities, industry and government scientists from Canada and Ireland
- Based on new acquired data and survey results as well as data donated by TGS and ION
- Final product to be a kinematic model of plate movement using modern deformable plate boundary techniques

Project Objectives

- Refit the prerift continental margins on both sides of Atlantic minimising overlaps and gaps
- Determine major controls/mechanisms for North Atlantic basin formation and evolution– crustal stretching, rifting, uplift
- Determine relationship of major basins and structural highs between Eastern Canada and Atlantic Ireland
- Determine effect of major fault systems along the NW-SE Labrador-Biscay trend on the evolution of adjacent basins
- Predict Jurassic sedimentation for Orphan, Flemish Pass, southern Rockall, Hatton and southernmost Porcupine basins with greater confidence
- Evaluate prominent highs such as Flemish Cap and Orphan Knoll as possible sediment sources for the southern Porcupine and Rockall basins
- Evaluate potential for Palaeozoic reservoirs and source rocks in the region

Plate Tectonic Kinematic Model for North Atlantic Regions

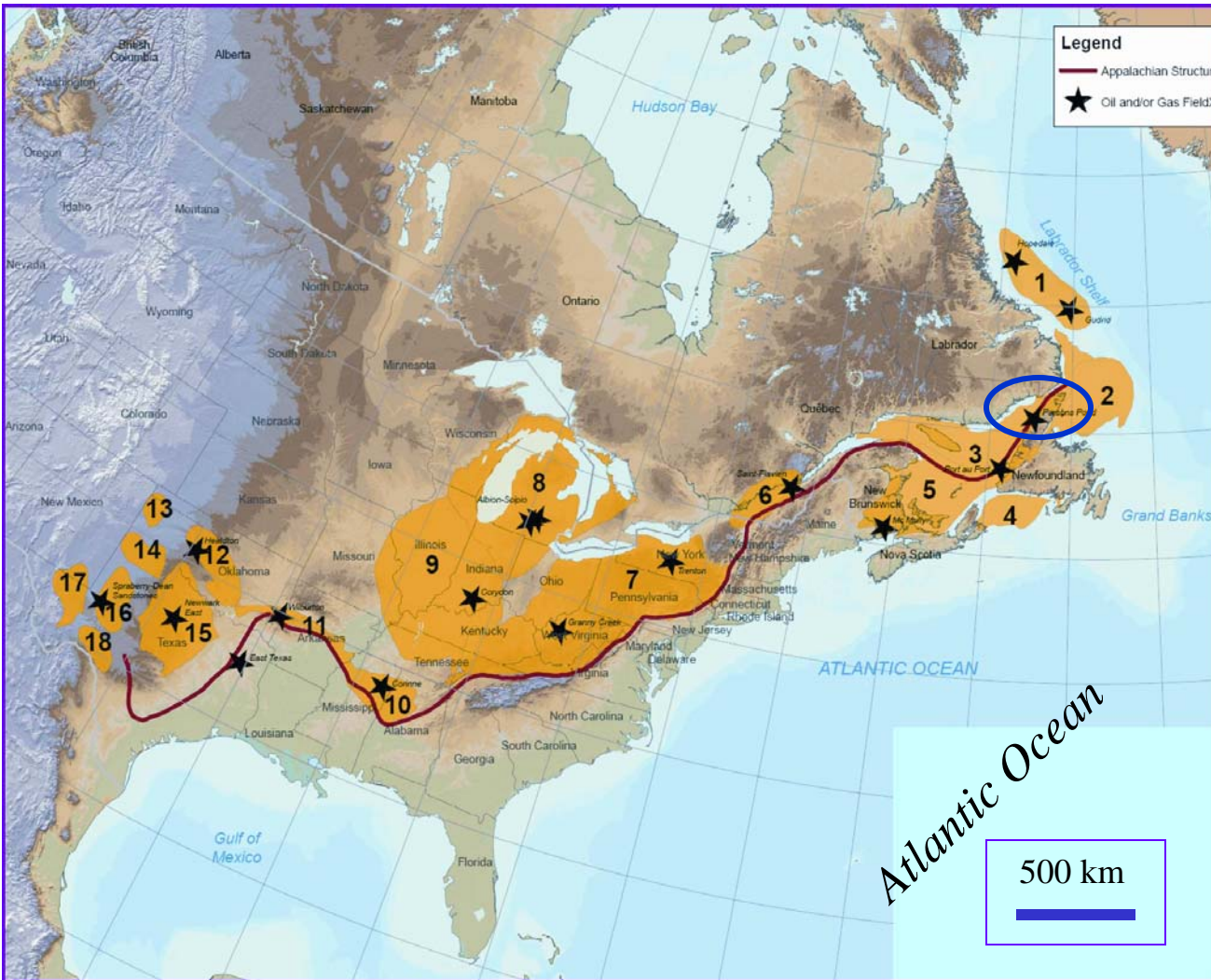


Reconstructed geological configuration of North Atlantic basins, seaways and continental fragments during Late Jurassic (after GeoArctic, 2011, provisional map)

Large Paleozoic Under-Explored Basins in Atlantic Canada

- Atlantic Provinces including Newfoundland and Labrador were affected by an older Wilson Cycle that was initiated during Early Paleozoic and culminated with the build up of the Appalachian Fold Belt and its corresponding foredeep
- This cycle ended with the Alleghenian Orogeny which was accompanied by formation of several Carboniferous successor basins - the largest being the Maritimes (Magdalen) Basin with two extensions in NL: Bay St. George and Deer Lake sub-basins
- Western NL is part of the continental wide Appalachian Structural Front. This front stretches from Texas through the eastern US seaboard, the New England states, through Quebec and the Atlantic provinces and into Western Newfoundland and contains more than 20 proven petroleum basins (see next slide)
- Some of the largest and most productive USA oil & gas fields are located along the ancient Paleozoic continental margin and the Appalachian Fold Belt (next slide)

North America Appalachian Basins



1. Hopedale (Labrador)
2. St. Anthony
3. **Anticosti**
4. Sydney
5. Magdalen
6. St. Lawrence Lowlands
7. Appalachian
8. Michigan
9. Illinois
10. Black Warrior
11. Arkoma
12. Anadarko
13. Dalhart
14. Palo Duro
15. Forth Worth
16. Midland
17. Delaware
18. Val Verde

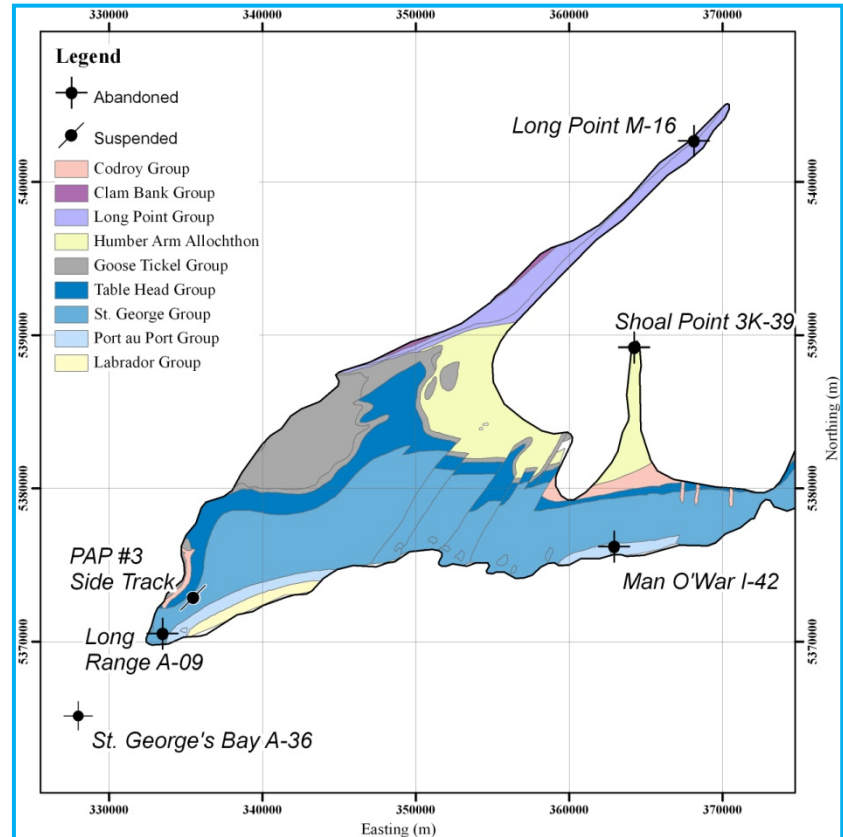
Large Paleozoic Under-Explored Basins in Atlantic Canada

- **The Anticosti Basin** of Ordovician to Silurian age (510-415 million years old), underlies the northern part of the Gulf of St. Lawrence
- **The Magdalen Basin** of Pennsylvanian of Late Carboniferous to Permian age (approximately 350-250 million years old), underlies the southern part of Gulf of St. Lawrence. **The Bay St. George Basin**, located south of Port au Port Peninsula, is an arm of the predominantly Carboniferous Magdalen Basin
- Only 9 offshore exploration wells were drilled for Paleozoic plays in Western Newfoundland, all located on or close to Port au Port Peninsula; only one – St. George's Bay A-36 - is a true offshore well; 5 wells are significant as they reached their targets, 3 are very shallow and 3 are sidetracks (see following table)
- A dozen wells have penetrated Paleozoic strata, including good quality reservoirs while drilling for Mesozoic synrift targets on the Grand Banks, Orphan and Labrador basins. Significant gas accumulations were found in Lower Paleozoic strata of Hopedale Basin (Enachescu, 2008)

West Newfoundland Offshore Wells

Well No	Well Name	TD (m)	Status
1	Long Point M-16	3810	D&A
2	Long Range A-09	3685	D&A
3	St. George's Bay A-36	3240	D&A
4	Man-O-War I-42	677	D&A
5	Shoal Point K-39	3035	D&A
6	Shoal Point 2K-39	2740	Sidetrack
7	Shoal Point 2K-39Z	36	Shallow
8	Glori E-67	10.6	Location
9	Shoal Point 3K-39	1735	Sidetrack

Yellow = Deep wells; Red = Shallow well;
Orange = Location only; Blue = Side track



Location of main offshore and onshore to offshore exploration wells

Large Paleozoic Under-Explored Basins

- Other less explored Paleozoic offshore basins are located in the Gulf of St. Lawrence, surrounding the island of Newfoundland (Sydney Basin to the S, St. Anthony Basin to the N and Bonavista Platform to the E)
- Paleozoic rocks were recovered from the upper part of the pre-rift basement of the Grand Banks and Labrador Sea Mesozoic basins
- Together, the Anticosti and Magdalen basins cover an area about the size of New Mexico or half of the Canadian Province of Alberta
- Significant volumes of clastic sediments were accumulated during the Paleozoic in these basins including excellent source and reservoir rocks
- Extensional, compressional and transtensional traps were formed
- Based on last 20 years of exploration and research, the basins have potential for both large conventional and unconventional resources

Paleozoic Hydrocarbons in Canada

- Over 20% of world oil reserves originate in Paleozoic strata
- Canada has a large amount of its light oil and gas production from Paleozoic sedimentary rocks in the Western Canadian Sedimentary Basin
(e.g., http://www.ags.gov.ab.ca/publications/wcsb_atlas/atlas.html)
- Large Paleozoic discoveries were made in the Arctic Islands, but remain as stranded resources
- Older (Norman Wells, Belle, Tedji Lake, Tweed Lake) and recent (Nogha, Lac Maunoir) oil and gas discoveries were found in Paleozoic reservoirs rocks in the Mackenzie Valley Corridor area
- Cambrian sandstone discoveries in the Colville Hills (NWT) are sourced from algal-rich intervals within Cambrian shales
- A great exploration and production effort is now ongoing for unconventional oil and gas resources in the Paleozoic Basins of Alberta, Saskatchewan, Northern BC, the Atlantic Provinces and Northwest Territory. The exploration activity is especially high for liquid-rich hydrocarbons in shales e.g. Horn River, Exshaw, Bakken, Montney, Duverney, Utica, etc.

Western NL Unconventional Resources

- When compared to the rest of Canada's and USA's Paleozoic basins, Western Newfoundland is in a very early stage of exploration for unconventional resources
- The Western NL drive for exploring unconventional resources was triggered by developments in well stimulation technology and remarkable exploration and production results in Western Canada's tight sandstone and shale reservoirs (e.g. Bakken, Horn River, Muskwa, Duverney, etc.)
- Close to NL, the gas production from New Brunswick tight sands (McCully's Hiram Brook sandstone) and testing of hydrocarbons from Frederick Brook shale (New Brunswick) and Utica shale (Quebec), have stimulated geochemical investigations of Western NL's shales in Anticosti and Deer Lake basins
- Shoal Point Energy (SPE) has investigated the petrophysical, geomechanic and reservoir properties of several Cambro-Ordovician aged Green Point Shale intervals and investigated their flow potential in two side-track wells on Port au Port Peninsula (Shoal Point 2K- 39 and 3K-39)
- Dear Lake Oil and Gas (DLOG) has tested with a shallow well (Werner Hatch#1) the reservoir potential of the Mississippian aged Rocky Brook Formation Shale in Deer Lake Basin

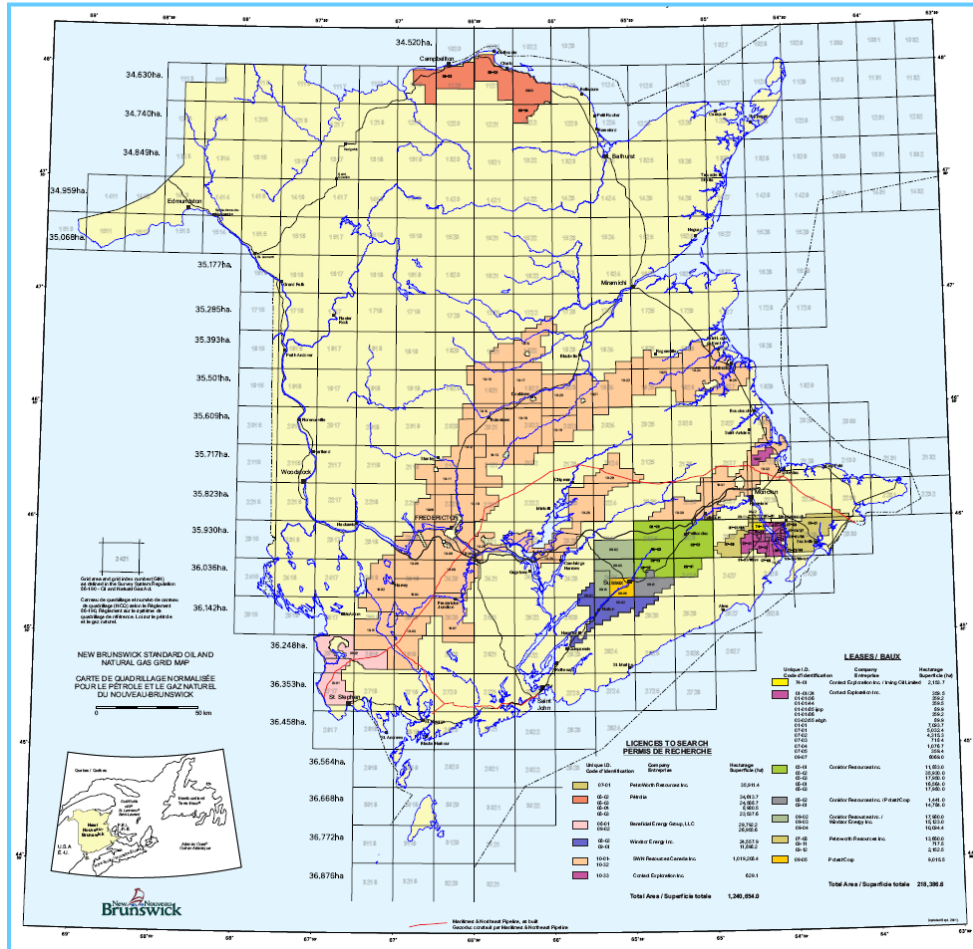
Recent E&P Activity in Atlantic Paleozoic Basins – Onshore New Brunswick

- The Province has seen a marked increase in petroleum exploration and development since the construction and placing into service of the Maritimes & Northeast Pipeline connecting the offshore Sable I. gas fields to the mainland
- Several companies have a licence to search for oil and gas in the Carboniferous basins: PetroWorth Resources, Petrolia, Beneficial Energy Group, Windsor Energy, SWN Resources Canada and Contact Exploration (1,240,654 ha). Contact, Contact/Irving Oil, Corridor, Corridor/Potash, Corridor/Windsor, PetroWorth and Potash own leases totaling 213,386,6 ha
- **Corridor** is the most active company in East Coast Paleozoic basins. Its McCully gas development produces about 16 MMcfd gross from a 400 ha (12,000 acre) fractured anticline, estimated by GLJ Petroleum Consultants (April 2011) to contain about 438 Bcf proven and probable gas resource in tight Carboniferous sandstone. Corridor also discovered 45° API oil at the South Branch G-36 well, 3 km SE of McCully gas field. Renamed Caledonia this oil field was covered by a small 3D seismic program. A 67 Tcf undeveloped gross discovered resource was estimated in the Frederick Brook (FB) shale. A vertical well to assess FB shale potential is planned for this year
- **Apache** (50%) and Corridor (50%) have had an agreement to explore southwestern NB (Elgin area) for shale gas resource development, but Apache terminated the agreement in spring of 2011 after drilling 2 wells that performed poorly after fracking. However Corridor announced that it will proceed with a phased development of the Frederick Brook shale gas field

Recent E&P Activity in Atlantic Paleozoic Basins – Onshore New Brunswick

- **Contact Exploration** has re-initiated production from the previously exhausted Stoney Creek Field (800,000 bbls and 30 Bcf produced between 1909 and 1991). The field that was shut-in for 15 years is estimated to contain 20 MMbbls; the field was produced in the past with less than a 5% recovery rate. According to Contact one vertical well drilled in 2008 and 2 horizontal wells drilled in 2010 were put into production (total production about 100 bopd) using fracking and multi-stage completion. An additional 3 to 5 wells are planned for 2011. The company suggests that there is also additional potential for gas in the Stoney Creek field as well as on the flanks of the structure
- **Contact** also has a large acreage position in the shale gas play of the Moncton and Cocagne sub-basins
- **Windsor Energy** has a 58,000 ha exploration licence to the south of McCully gas field. During 2010 it acquired 80 km of new 2D seismic data looking for tight gas in Carboniferous rocks
- **Corridor (operator) and Windsor Energy** each hold a 50% working interest in three exploration licences located to the west of the McCully Field, covering an area of 106,740 gross acres. No major exploration activities have been announced for these licences

Recent E&P Activity in Atlantic Paleozoic Basins – Onshore New Brunswick



- **Southwestern Energy (SWE)**, a US based independent, won a 3-year exploration rights for two large New Brunswick blocks totalling about 2.5 million acres for a \$47 Million exploration work commitment. In 2010 the company conducted a detail geochemical survey that indicated some combination of oil and gas source rocks. In 2011 additional geochemical sampling was carried out along with the acquisition of approximately 1000 km of 2-D data

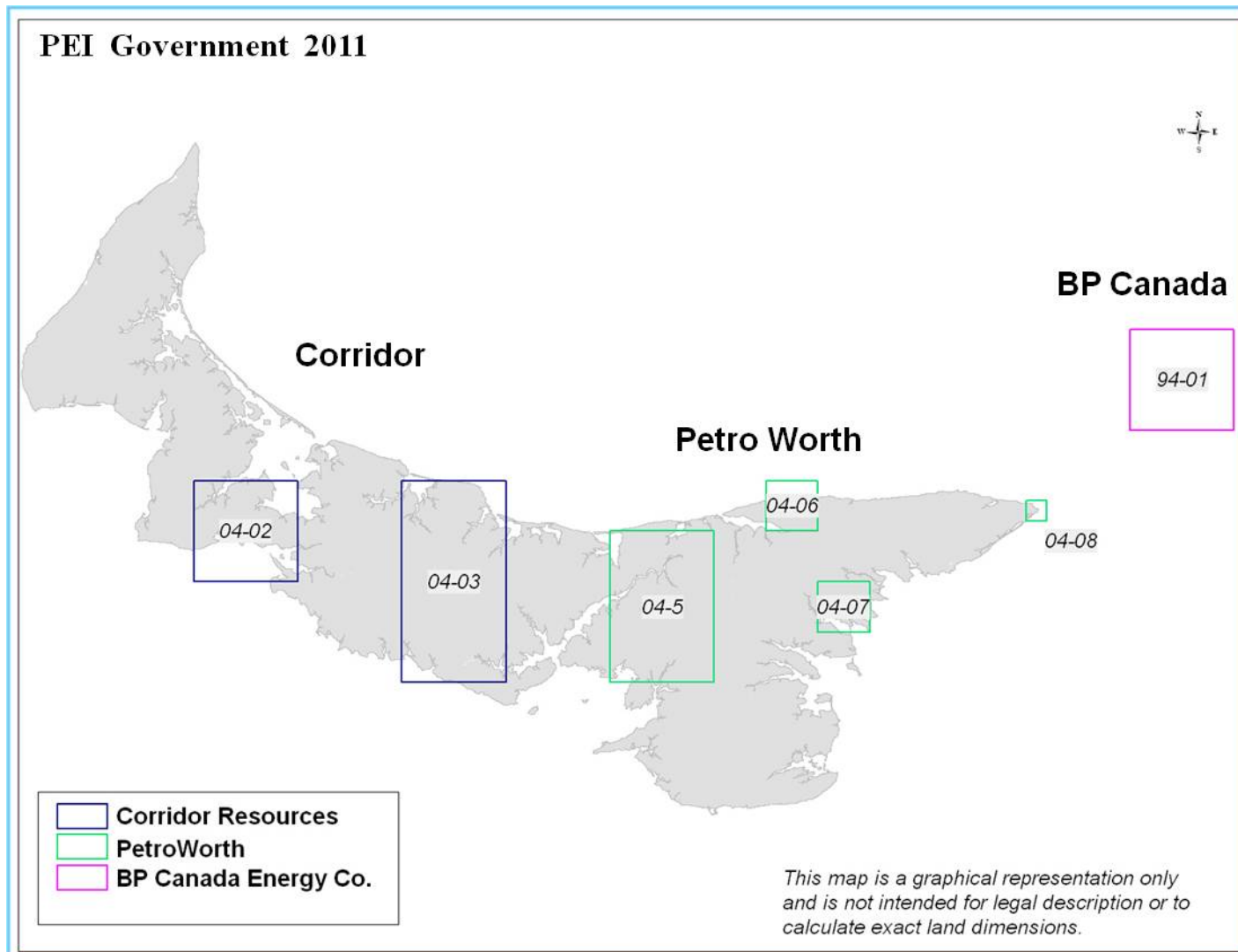


http://www.gnb.ca/0078/minerals/PDF/Oil_NG_Agreements-e.pdf

E&P Activity in Atlantic Paleozoic Basins – Onshore PEI

- Only twenty exploration wells and one re-entry well have been drilled on and around the province. PEI is underlain by rocks equivalent to Pictou Group of Nova Scotia and New Brunswick. The sandstones, shales and conglomerates are informally termed the “PEI Red Beds.” The island’s subsurface contains structural traps within this Pictou Group equivalent beds which resulted from folding, salt movements, faulting or a combination of these processes
- A significant gas discovery was made in 1974 offshore at East Point E-49; the well tested 5.5 MMcfd from a structure estimated to contain 77 Bcf in Late Carboniferous sandstones but for now this structure is considered sub-economic
- **Corridor Resources** has two exploration licences consisting of 260,000 net acres on the island. In 2007 **Corridor** drilled Green Gable #3 and found gas in the Bradelle sandstones but encountered problems during stimulation operations and the well is presently suspended. The well data and stimulation results are presently being reviewed
- Little conventional oil and gas exploration took place during 2010 and 2011
- **PetroWorth Resources** holds 4 exploration licences on PEI targeting both conventional and unconventional resources. PetroWorth has conducted several seismic programs on its present and expired PEI properties, including 318 km of 2D and 108 sq km of 3D. Beside a small 2D program in 2010 (14 km) no other activity is reported on the 4 ELs (see next slide)

E&P Activity in Atlantic Paleozoic

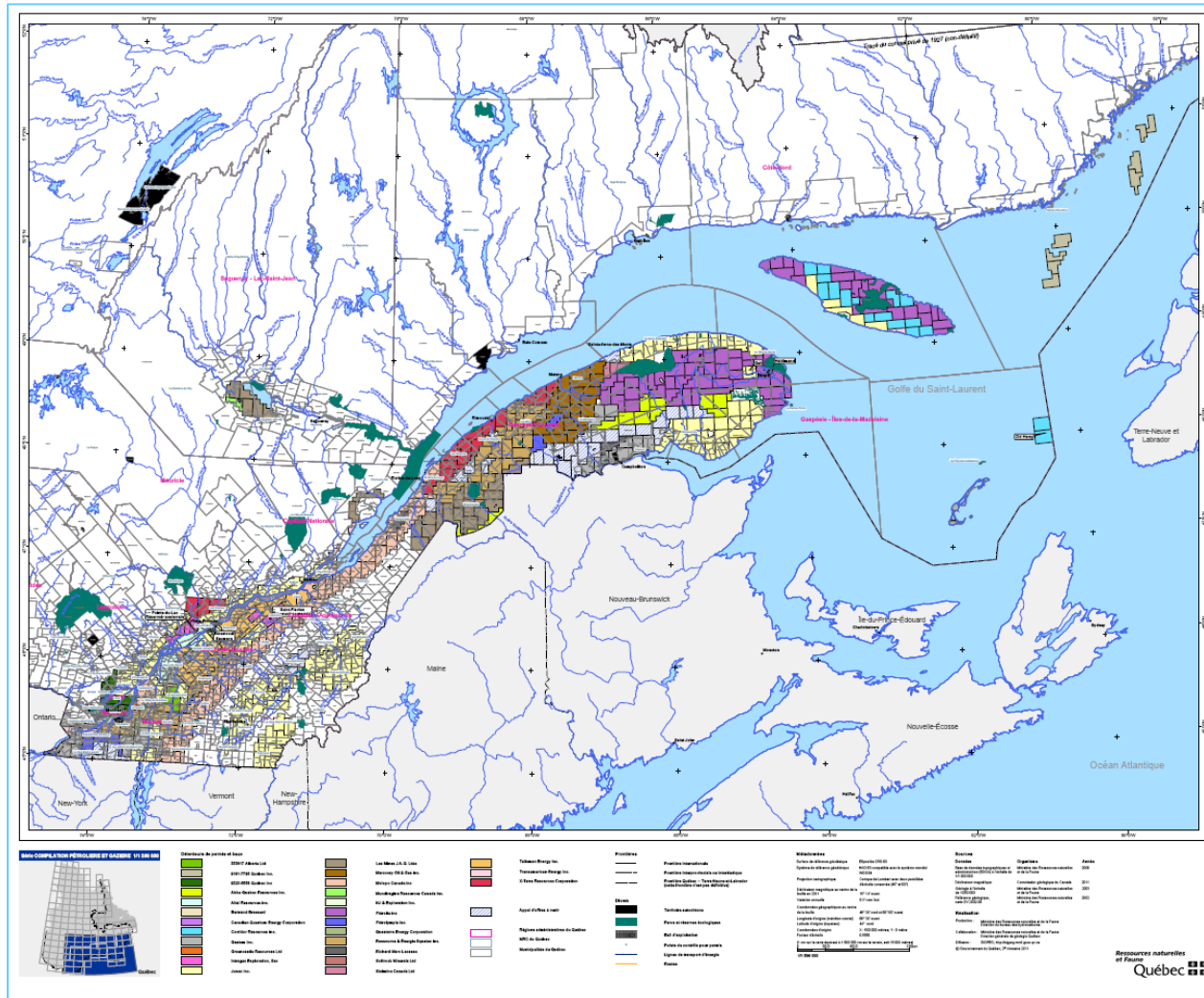


<http://www.gov.pe.ca/photos/original/11GasHldrMap.jpg>

E&P Activity in Atlantic Paleozoic Basins – Onshore Quebec

- Petroleum systems have been identified in the St. Lawrence Lowlands, Anticosti Island and Gaspé basins
- 3 gas accumulations were discovered within Paleozoic reservoirs. Two fields in the St. Lawrence Lowlands Basin are now depleted and used as gas storage reservoirs: Pointe-du-Lac (it produced 2.5 Bcf) and Saint-Flavien (it produced 5.7 Bcf)
- Exploration in St. Lawrence Basin has mainly focused on the Trenton Black-River sedimentary zone. Home-grown companies such as **Gastem Inc., Junex, Petrolia Inc, and Questerre Energy Corp.**, other Canadian companies and International players such as: **Talisman Energy, Corridor, SCDM Energy (Bouygues Group France), Pilatus Energy (Switzerland), Spratt Asset Management (Toronto) and Forest Oil (USA)**, are owners of exploration rights
- In the Gaspé Basin, **Junex** developed the Galt gas field discovered in the early eighties. Production is stimulated by fracturing and commercialized by trucking of CNG. The field is estimated to contain about 1 Bcf gas within an oil and gas bearing Devonian dolomite/carbonate formation (HDT) situated at about 2000 m subsurface
- East-southeast of Galt, the Haldimand field operated by **Pétrolia** tested 34 bopd of light crude (50° API) from Devonian sandstones at depths of approximate 1000 m. This “first Quebec” oil discovery is being delineated using 3D seismic, geochemical studies and further drilling to 1000 + m
- Since unconventional exploration began in 2008, close to 30 wells have been drilled making Quebec a hot spot for unconventional gas exploration. However, in the spring of 2011, the Provincial Government introduced a 30 month fracturing ban impacting the majority of onshore sedimentary areas under permit. As a result, currently there is very little exploration activity in the Province

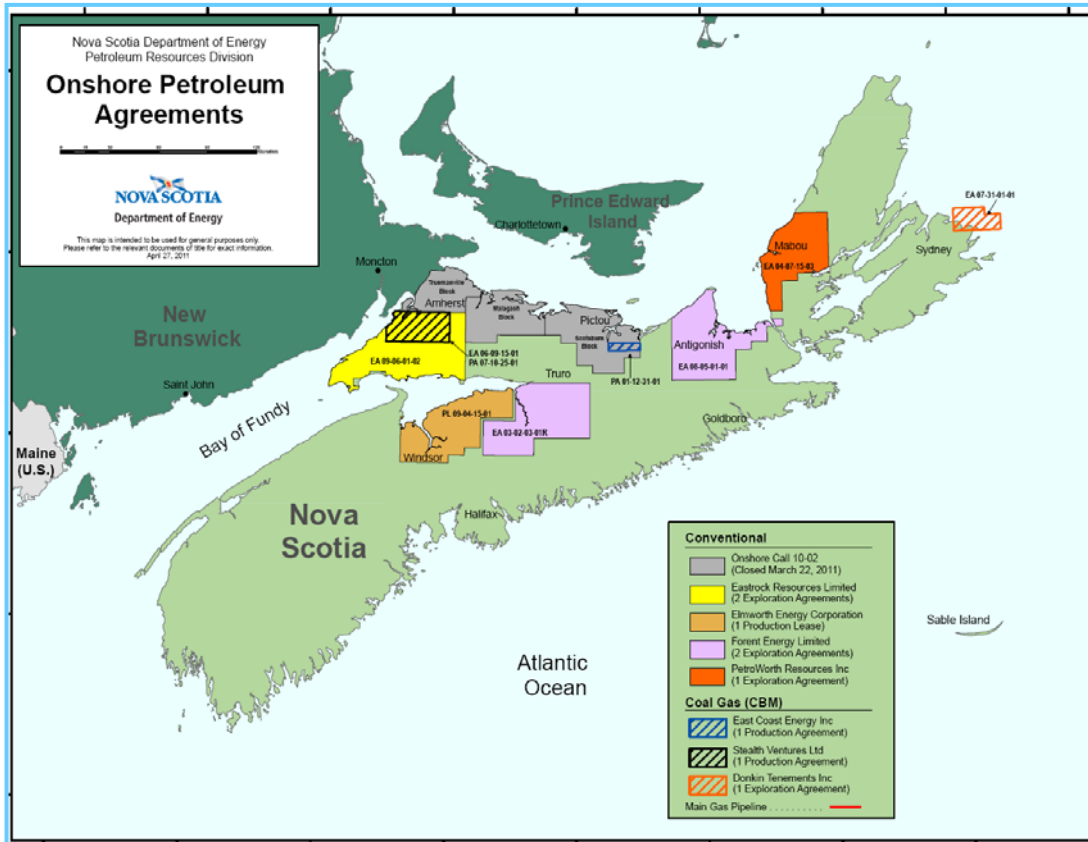
E&P Activity in Atlantic Paleozoic Basins – Onshore Quebec



E&P Activity in Atlantic Paleozoic Basins - Onshore Nova Scotia

- While all of Nova Scotia's large oil and gas discoveries and gas production are from offshore Late Jurassic-Cretaceous sandstones (e.g. Sable Island fields) or Late Jurassic carbonates (Deep Panuke), there is significant exploration activity in its onshore basins
- The onshore and offshore Paleozoic basins are part of the Appalachian Orogeny or the Carboniferous successor basin stage. Onshore, Paleozoic basins have seen only modest exploration for conventional hydrocarbons. Only about 30 wells were drilled deeper than 1000 m. No significant conventional discovery was made to date, but oil and gas shows and well tests have been recorded in the Sydney, Cape Breton, Antigonish, Cumberland and Minas basins
- Two coal bed methane Production Agreements and one Exploration Agreement are active (see next slide)
- **Triangle Petroleum** of Calgary had success exploring for shale gas at its site in the 474,625 acres Windsor Block, part of the Maritime Basin. Triangle and partners drilled 5 wells on the block for unconventional resources and completed one. In April 2009, the provincial government approved Triangle's 10-year production lease, which requires the company to drill seven wells in the block by 2014 for both conventional and nonconventional resources
- **PetroWorth** holds 383,000 acres in Cape Breton Island where it has carried out a 80 km 2-D seismic program. The company plans to drill a well on its acreage

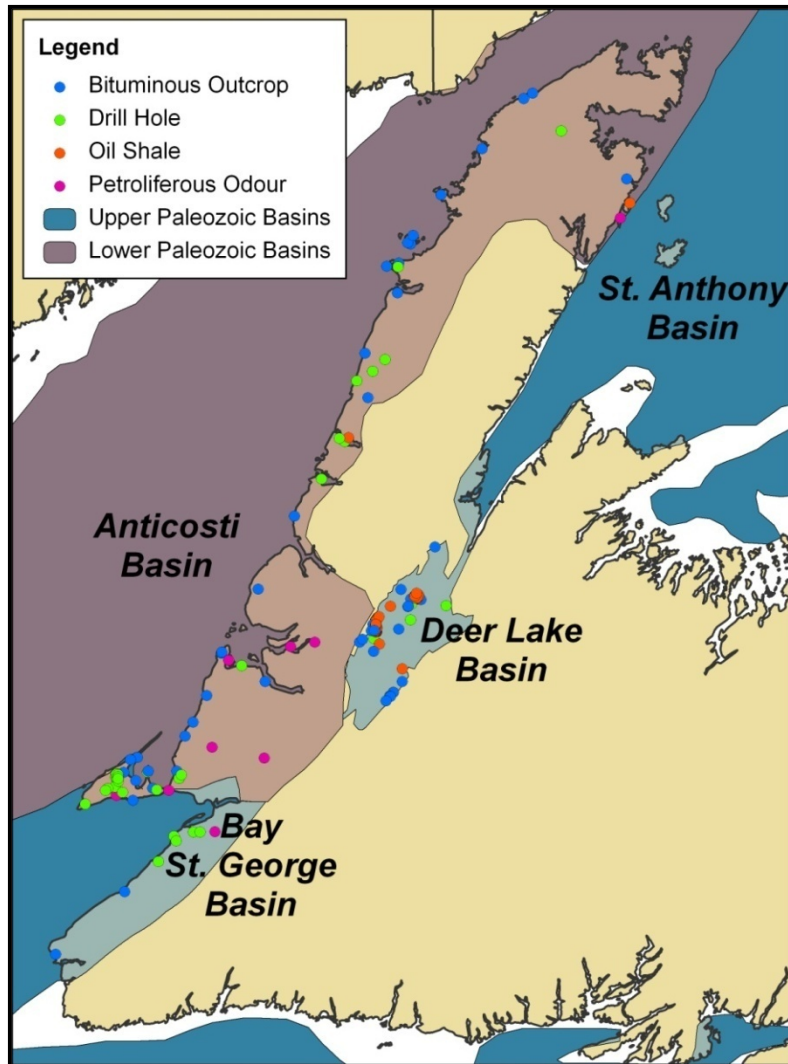
E&P Activity in Atlantic Paleozoic Basins - Onshore Nova Scotia



- **Forent Energy**, has conducted an airborne gravity gradiometry survey on its 208,000 ha Alton Block to identify Carboniferous Gays River reef build-ups. A 2D seismic acquisition program consisting of 65 km was completed early summer of 2011 and the company intends to drill three wells targeting conventional reservoirs. Forent is also pursuing the Horton shale gas play
- **Eastrock Resources** is active in the Nova Scotia onshore since 2006 where it holds 258,000 ha. It has acquired about 100 km of seismic reflection data in the Cumberland Block. The company has both conventional and unconventional prospects located in two large exploration blocks

<http://www.gov.ns.ca/energy/resources/RA/maps/onshore-petroleum-agreements.pdf>

Western Newfoundland Onshore Exploration History



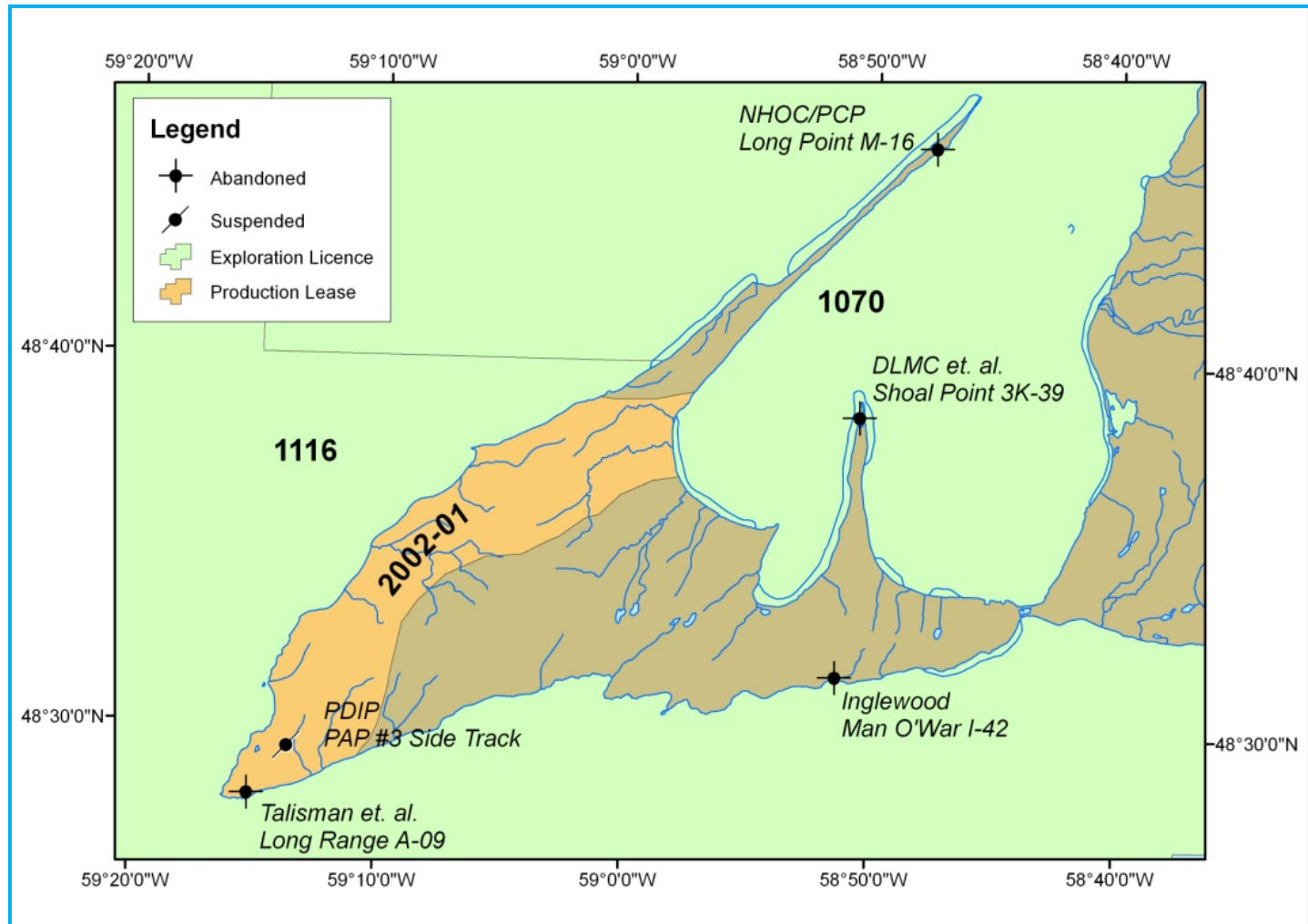
- Numerous hydrocarbon seeps, oil shows in historical wells and some early light oil production are reported in the Paleozoic rocks of Western Newfoundland
- Sporadic episodes of petroleum exploration in the Appalachian fold belt and foreland has been ongoing since 1867
- These efforts have been rewarded only by excellent hydrocarbon shows or hard to evaluate finds, and only minor commercial production during the early part of the twentieth century
- Recently (1995 to present) production tests and tracking of oil was done from the Port au Port #1 well and its sidetracks
- A small gas flow was obtained from Western Adventure #1 well in Deer Lake Basin
- Other oil and gas shows were recorded in wells drilled in the past 3 years by Vulcan in Bay St. George Basin
- The Seamus and Finnegan wells drilled by Nalcor and partners in 2010/2011 reportedly had good gas shows

Significant Onshore Discovery Well

Exploration well	Year	Operator	Partners	KB m	TD m	TD in	Core	DST	Obs.
Port au Port #1	1995	Hunt	Pan Canadian	221	4699	Hawke Bay	None	Two	Discovery well

- Port au Port #1 (PAP #1) discovery marked a new chapter in oil and gas exploration in the onshore and offshore Paleozoic basins of Western Newfoundland
- Tests flowed 1,528 bopd of 51° API oil from an Aguathuna interval between 3471.7-3476.2 m and 1742 bopd from an interval between 3459.2-3462.2 m
- The discovery well in Aguathuna Formation (dolomitized limestone) formed the core of the Production Licence (PL) 2002-01 awarded initially to Canadian Imperial Venture Corporation (CIVC). The PAP discovery was renamed Garden Hill South oil field and covers an area of approximately 11 km²
- The PL 2002-01 is now licensed to Enegi Oil Plc through PDI Production Inc., the group's principal operating subsidiary. No economic production has been recorded yet, but there are more plans for well re-entry and workovers

Exploration and Delineation Drilling on Port au Port Peninsula



Onshore Western Newfoundland

- **Production**

- PDIP

- Garden Hill South Field

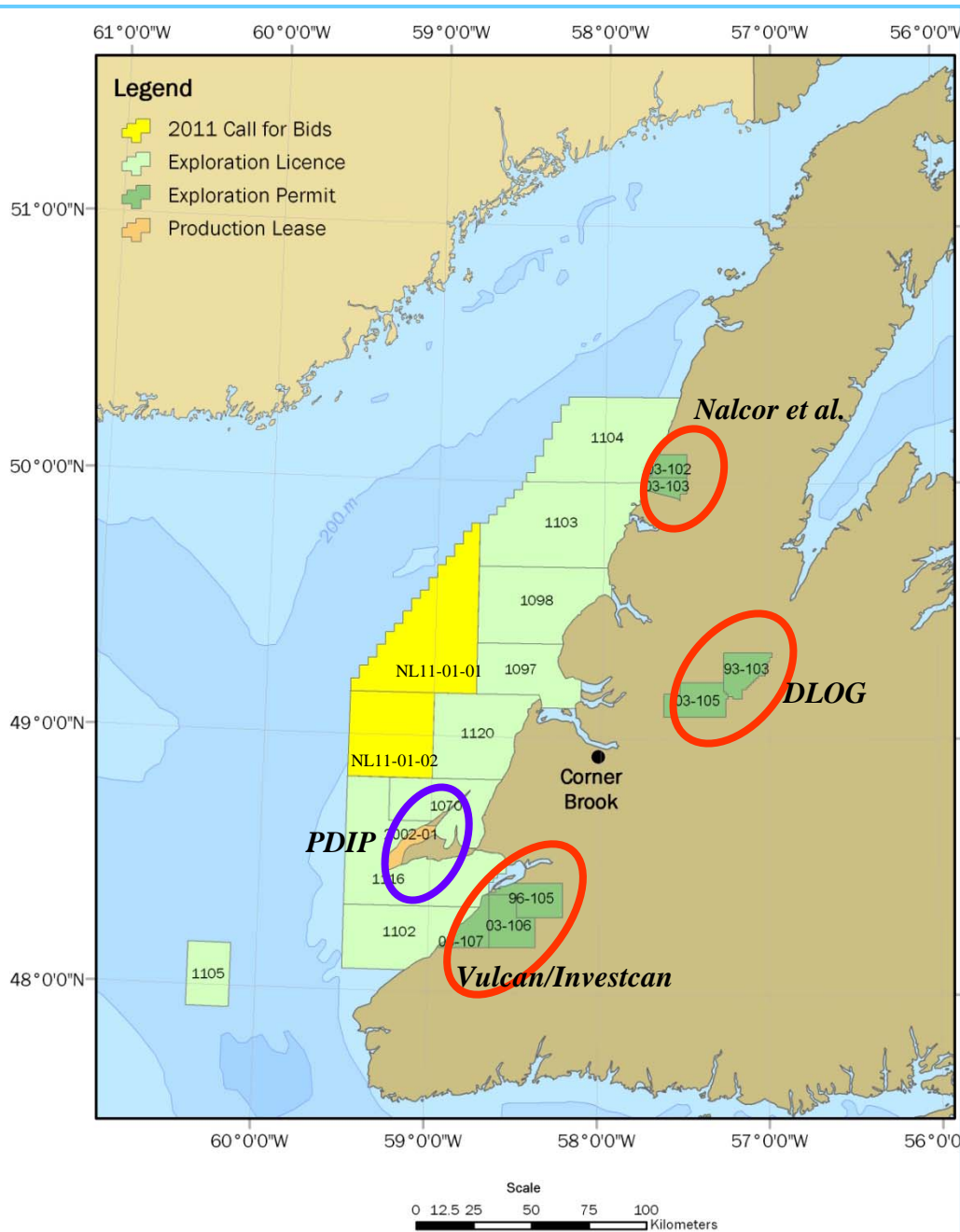
- **Exploration**

- Vulcan/Investcan

- Deer Lake O&G (DLOG)

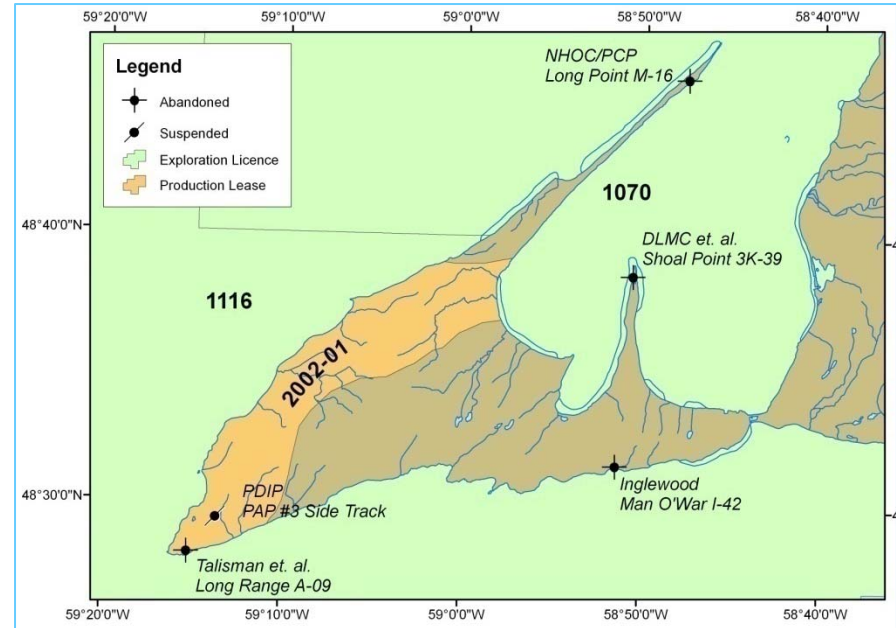
- Nalcor Energy et al.

Note: NL onshore exploration is administered and regulated by the Government of Newfoundland and Labrador Department of Natural Resources, Energy Branch



Garden Hill Field

- In Port au Port #1, two platformal Aguathuna Fm. Zones, believed to be in communication, tested at rates of about 1500 bopd of light oil, with gas rates of about 2.5 MMcfd
- Analysis of results of extended pressure testing was complicated by wellbore plugging but appeared to show pressure depletion.
- Subsequent sidetrack drilling by farm-in operators (first CIVC, then PDIP/Enegi) indicates a complex reservoir near the wellbore

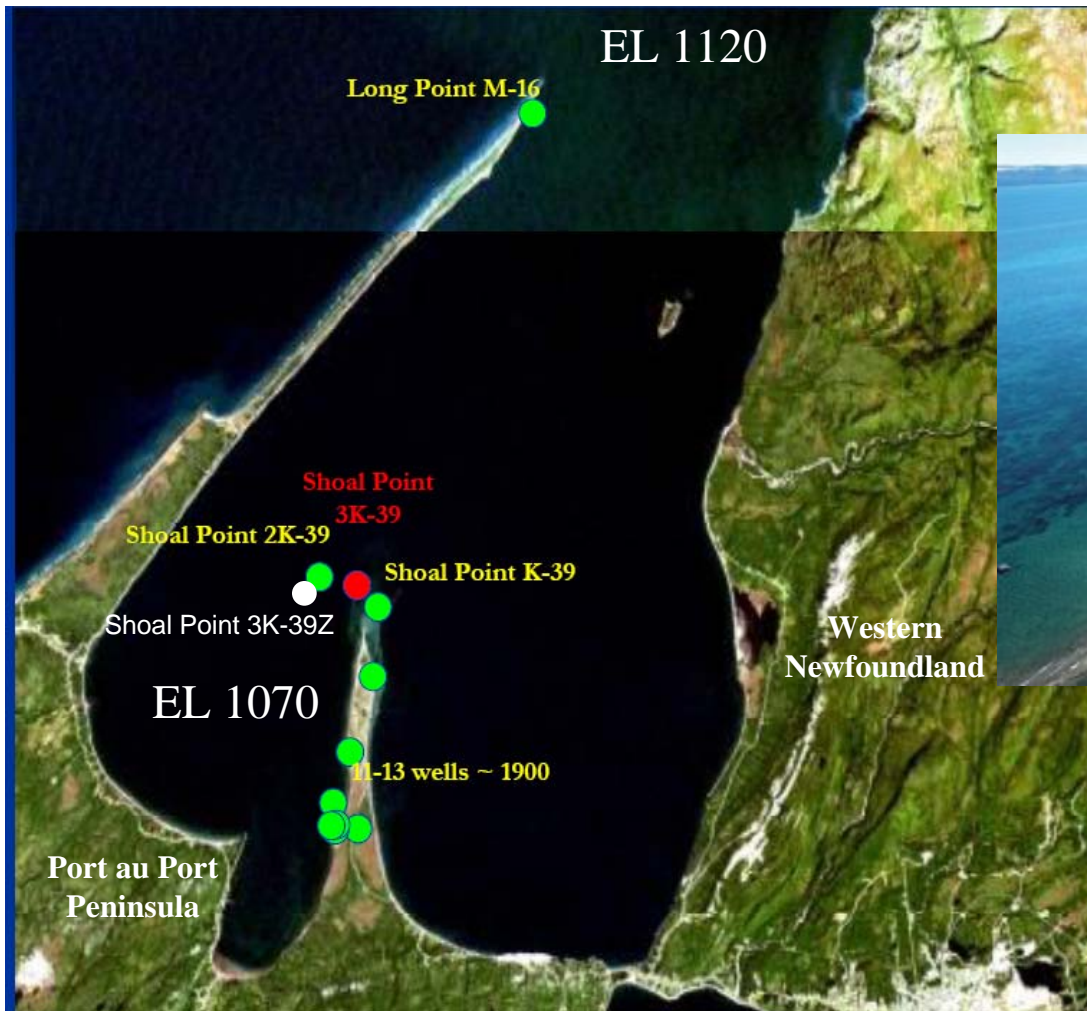


- PDIP acquired 100% interest in the Lease in 2005, drilled 3 sidetracks, produced oil and continue to fulfill the conditions of the PL 2002-01 extension agreement
- No doubt there is oil contained in the Garden Hill structure but questions remain as to the size of the accumulation, connectivity between karsted zones and how to commercially produce the oil contained in hydrothermal dolomite (HTD)
- Up to now all flows from this accumulation during production tests were sub-economic or could not be sustained

NL Unconventional Play Results

- Potential for tight sand and shale gas was encountered in several wells from the Bay St. George Basin, Parson Pond Basin and Deer Lake Basin
- In the Bay St. George Basin, Vulcan Minerals has assembled a large well and seismic database, including new seismic lines recorded in 2010 over the shallow Flat Bay oil accumulation. A shallow core program planned around the Flat Bay #1, will test the producibility of the sandstone and conglomerate reservoir (Fishell's Brook Formation) and aid in the selection of a location for a 1000 m well
- Positive results on the hydrocarbons content, reservoir and geomechanical properties of the Green Point Shale were provided by Nu Tech for the Green Point 3K-39 well. While all parameters were indicative of producibility and pervasive fracturing of the shale was identified, no sustained flow was obtained from this well. Further tests are planned by Shoal Point Energy (SPE) to further investigate the petroleum potential of Green Point shale of the Port au Port Peninsula
- No fracking or flow test were performed on the tight gas intervals encountered by Nalcor and al. in the Seamus and Finnegan wells, but the new, valuable data will be integrated for onshore regional studies and correlation into offshore blocks
- No flow test were was performed on Werner Hatch #1. Deer Lake Oil and Gas will integrate the results into their future plans

Green Point Shale Play



Courtesy of Shoal Point Energy

217,285 acres of Green Point Shale potential in EL 1070 for SPE and partners

Offshore Western Newfoundland Exploration History

- Eight offshore wells have been drilled in the Western Newfoundland jurisdiction, of which seven were directionally drilled from land and one had to be abandoned due to operational problems
- Most of the wells were drilled in the late 1990s and were located in the vicinity of the Hunt PanCanadian Port au Port #1 discovery
- Several tests of the carbonate reservoirs: Long Point M-16 (drilled in 1995-6, TD at 3810 m in Port au Port Group), Long Range A-09 (drilled in 1996, TD at 3685 m in Watts Bight Formation), Shoal Point K-39 (drilled in 1999, TD at 3035 m in Hawke Bay Formation), encountered only shows. Man O' War I-42 (drilled in 1998, TD at 667 m in Forteau Formation) was terminated due to mechanical problems
- The offshore St. George's Bay A-36 well (drilled in 1996, TD at 3240 m in Forteau Formation) located in shallow water, 6 km south-west of the PAP Peninsula, contained several zones of good to excellent vuggy and cavernous porosity as well as bitumen and minor live oil shows
- Three Shoal Point side tracks (2K-39, 2K-39Z and 3K-39) targeted at the Green Point interval had mixed results while one hole had only a surface location drilled

West Newfoundland Offshore Wells

Exploration Well	Year	Operator	Partners	WD (m)	TD (m)	TD in Form/Gr	Core	DST	Observation
Long Point M-16	1996	Hunt	PanCanadian	0	3810	Berry Head	yes		D&A onshore to offshore well
Long Range A-09	1996	Talisman	CanOxi, Oilexco, Vinland	0	3685	Watts Bight			D&A onshore to offshore well
St. George's Bay A-36	1996	Hunt		83.8	3240	Forteau	yes		D&A, true offshore well
Man-O'War I-42	1998	Inglewood		0	677	Forteau			Shallow well cored
Shoal Point K-39	1999	PanCanadian		0	3035	Hawke Bay		yes	D&A onshore to offshore well
Shoal Point 2K-39	2008	Shoal Point	PDI,CIVC	0	2740	Table Head			Abandoned, onshore to offshore
Shoal Point 2K-39Z	2008	Shoal Point	PDI, Shoal Point Energy	0	36	N/A			Shallow Abandoned
Glori E-67	2008	Tekoil	Ptarmigan	0	10.6	N/A			Location only
Shoal Point 3K-39	2010	Shoal Point	CIVC	0	1735	Not public yet			Not public yet

Yellow = deep wells; Red =Shallow well; Orange = Location only; Blue = Side track; N/A = Not applicable

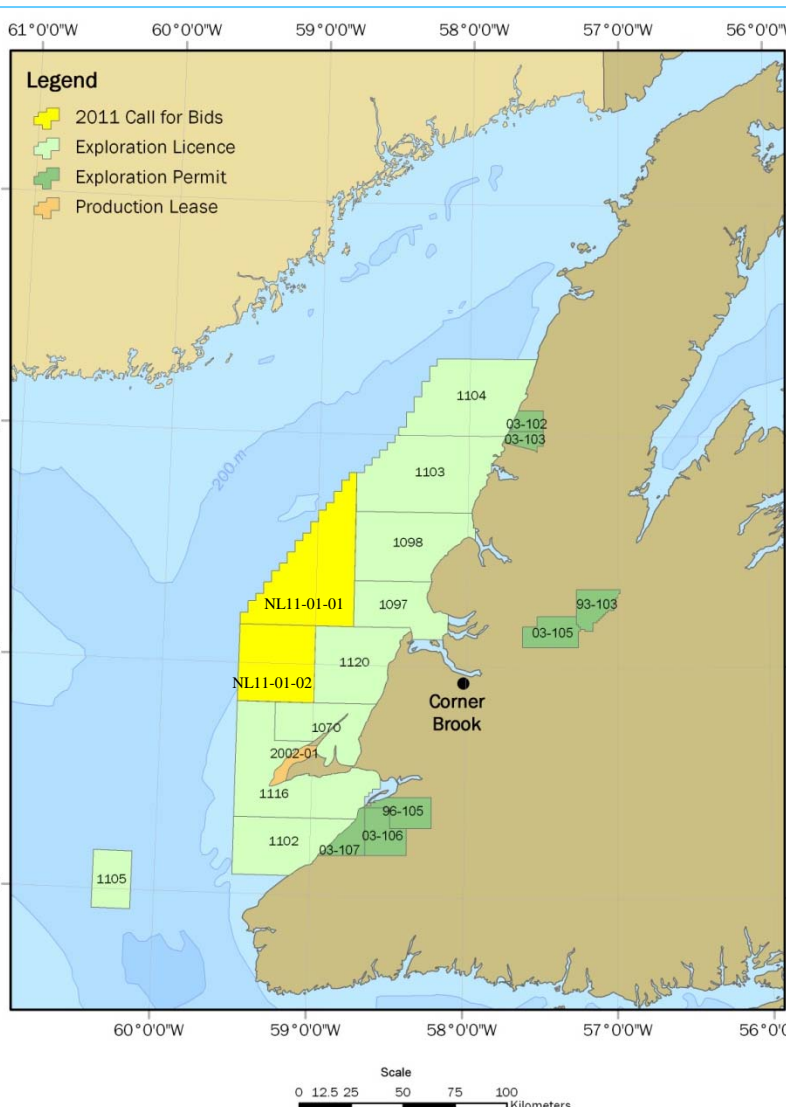
West Coast Newfoundland Offshore Exploration History

- In an earlier 1990s exploration phase, majors such as Mobil, BHP, Hunt, PanCanadian were active collecting 2D reflection data and drilling several wells, including the Port au Port #1 discovery well
- In the past decade, exploration activity was carried out by homegrown junior oil and gas companies that focused on acquiring ELs, reprocessing older data, remapping and finding prospects and leads in both Ordovician and Carboniferous formations
- Interest in a hydrothermal dolomite play has recently been given a boost by success in similar rocks in New York State and exploration of the trend elsewhere in Atlantic Canada (e.g. Gaspé Peninsula)
- Up to 2008, only 2D data has been recorded in Western Newfoundland; the 1990s marine seismic data is good to fair quality; more than 12,000 km acquired provides good imaging of the subsurface
- A dense 2D survey (or E 3D - densely spaced coverage using one-streamer) was recorded in 2008 by GSI for NWest covering 598 km² of its contiguous blocks

Offshore Western Newfoundland

- Nine large ELs issued by C-NLOPB are active and exploration is ongoing
- The larger of the ELs are over 200,00 ha (or about 80-84 GOM tracts)
- Two ELs have obtained a one year extension after the interest owners placed a drilling deposit fee with C-NLOPB
- During the 1990s five wells were drilled and a 12,203 line km seismic grid was collected
- Recently 3 sidetracks were drilled from onshore into offshore and a small one streamer-E3D program was collected
- There should be more seismic programs and new shallow water (30 to 100 m) drilling in the next few years

Offshore NL exploration areas are licensed by the C-NLOPB to the party submitting the highest bid in the form of work commitments



E&P Activity in Atlantic Paleozoic Basins - Offshore

- In an early exploration phase the East Point E-49 well drilled in 1970 flow tested at 5 MMcfd. This well is estimated to contain in-place gas reserves of 77 Bcf in Carboniferous sandstone (Lavoie, 2007)
- The most active phase of exploration in Gulf of St. Lawrence waters on the Newfoundland side took place in the early-mid nineties when several large Exploration Licences were operated by large companies such as Hunt, PanCanadian, Talisman, BHP and Mobil
- At that time 5 wells were drilled including the PAP #1 oil discovery
- A number of large leads and prospects have been defined in the Gulf of St. Lawrence, but remain undrilled. One of these prospects is the Old Harry prospect mapped by Corridor and partially contained in EL 1105
- Several ELs were awarded in the Anticosti and Maritime basins in Quebec's jurisdictional waters. Exploration plans were cancelled after the government agencies raised environmental concerns. Offshore exploration is now under a moratorium
- To date in 2011, there has been no seismic acquisition or drilling from offshore installations in any of the Atlantic Provinces including Western NL

Offshore West Newfoundland ELs

EL No.	Basin	Size (ha)	Date Issued	Bid Amount \$	Representative	Other Partners
1097	Anticosti	96,100	2006	260,000	NWEST Oil and Gas Inc.	Vulcan (19%)
1098	Anticosti	159,872	2006	512,012	NWEST Oil and Gas Inc.	Vulcan (19%)
1103	Anticosti	216,164	2007	275,004	NWEST Oil and Gas Inc.	Vulcan (19%)
1104	Anticosti	187,744	2007	275,004	NWEST Oil and Gas Inc.	Vulcan (19%)
1070	Anticosti	103,040	2002	278,621	CIVC	Shoal Point Energy, Gestion
1116	Bay St. George Anticosti	211,987	2009	600,000	PDI Production Inc.	
1102	Bay St. George	124,320	2007	406,000	B.G. Oil & Gas Ltd.	DLOG (25%)
1105	Magdalen	51,780	2008	1,521,000	Corridor Resources Inc.	
1120	Anticosti	140,210	2010	1,200,000	Ptarmigan Resources	Shoal Point Energy farmed in for shallow rights in 27, 230 ha

Offshore Western Newfoundland Active Exploration Licences, Historic Bid Amounts and Parcels' Particulars.

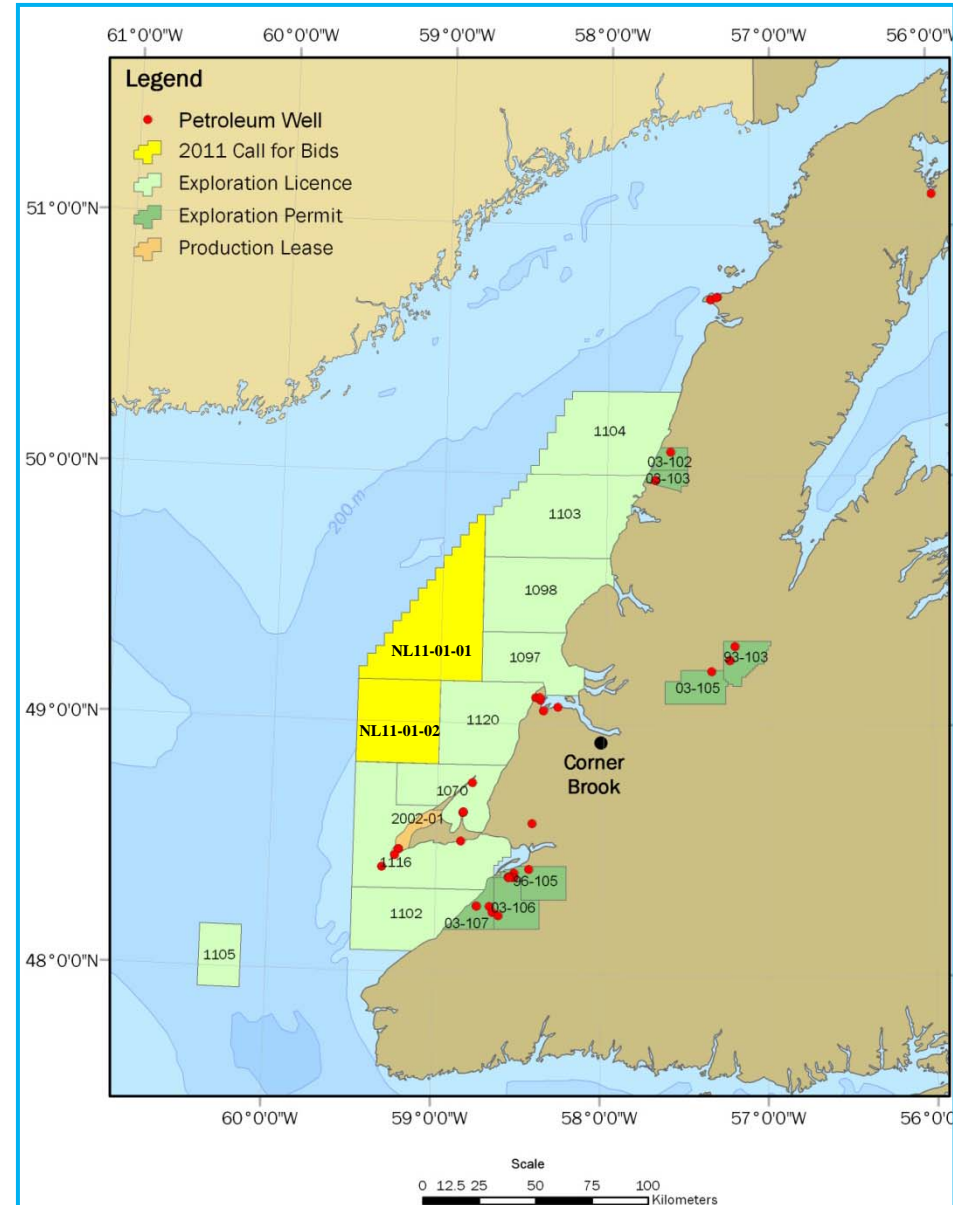
Offshore Western Newfoundland

Current Exploration Licences:

- NWest: 1097, 1098, 1103, 1034
- Ptarmigan: 1120
- CIVC: 1070
- PDIP: 1116
- BG O&G: 1102
- Corridor: 1105

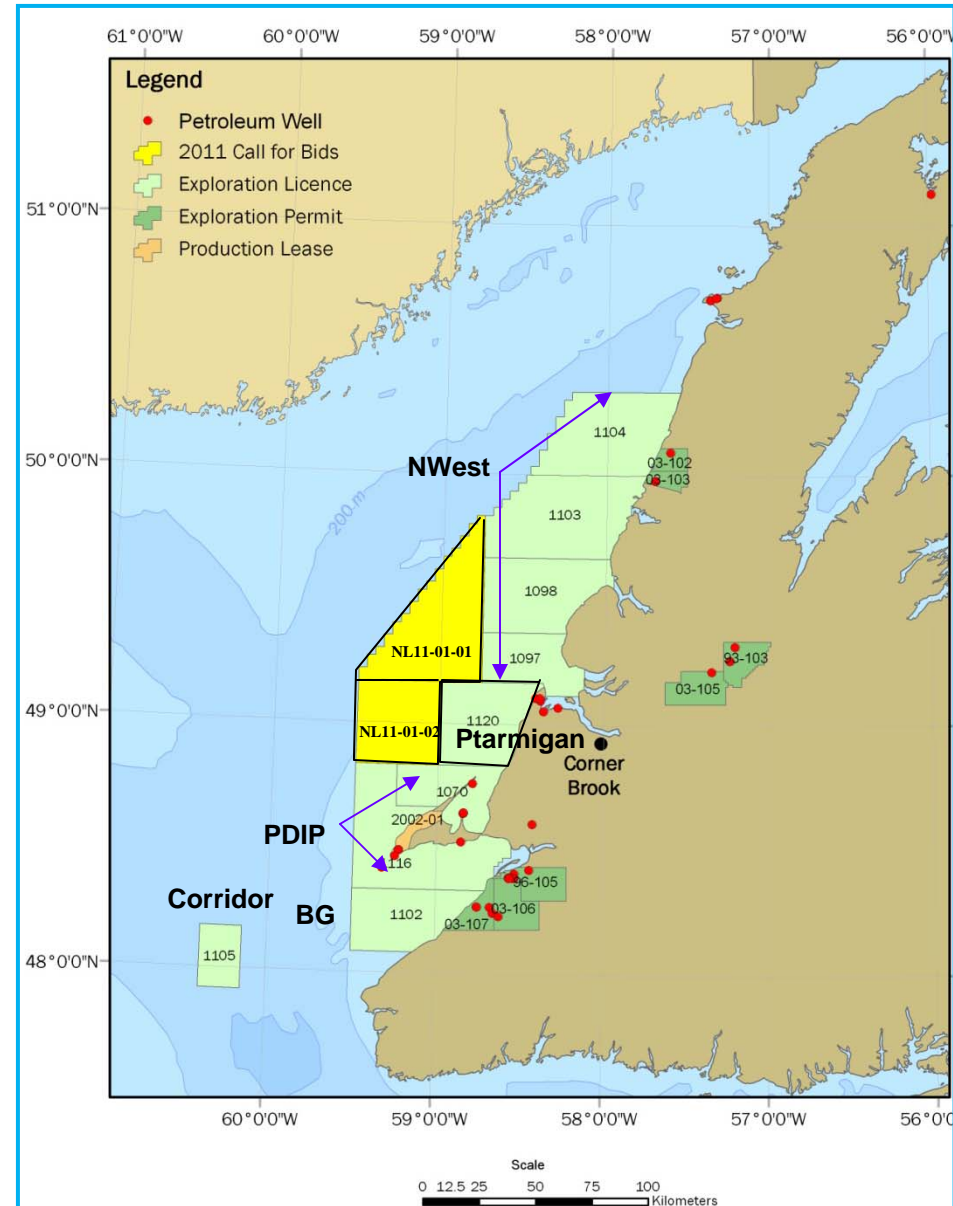
CFB NL11-01 Parcels:

- NL11-01-01
- NL11-01-02



Offshore Western Newfoundland

- Recent Drilling
 - **Dragon Lance Management** on behalf of Shoal Point Energy:
Shoal Point 3K-39 in EL 1070
- Recent Exploration
 - **NWEST**
Dense 2D data (Exploration 3D) over ELs 1096 & 1097 interpreted; looking for partners
 - **B.G. O&G/DLOG**
Defined a salt induced closure
 - **Corridor**
Old Harry structure ready to drill in NL waters

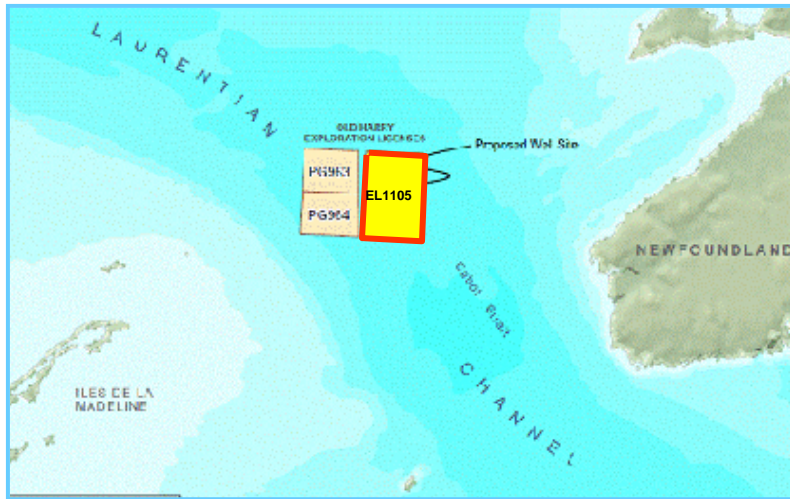


Recent Offshore Western NL

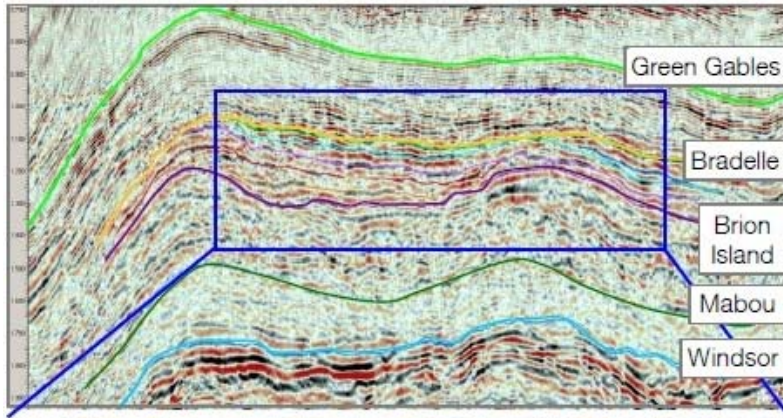
Call for Bids and Exploration Results

- Except for the older, validated and extended EL 1070, all the active ELs were issued in the past 5 years: 2 in 2006 (Anticosti Basin), 3 in 2007 (2 in Anticosti Basin and one in Bay St. George Basin), 1 in 2008 (Magdalen Basin), 1 in 2009 (spreading in both Anticosti and Bay St. George basins) and 1 in 2010 (Anticosti Basin)
- The nine licences cover a total of 1,291,217 ha (see previous Table). A new round of offshore drilling is anticipated in the near future in order to evaluate these licences
- NWest Energy Inc. holds about 659,880 ha (1.6 million acres) of prospective property over four blocks off Newfoundland's west coast: ELs 1097, 1098, 1103 and 1104. The "T" shallow water prospect covered by a GSI exploration 3D is ready to drill and the company is looking for partners. The ELs 1097 and 1098 have received a one-year extension after posting a \$250,000 drilling deposit with C-NLOPB
- In EL 1102, B.G. Oil and Gas and DLOG, using older 2D seismic data, have reconfirmed the presence of a salt induced anticline that forms a large closure for potential Carboniferous sandstone reservoirs. This structure nicknamed "Young Harry", has the drilling target at approximately 2000 m and lies in the shallow waters of the Bay St. George Basin. The EL owners are also looking for partners
- Ptarmigan has delineated several prospects and leads using a reprocessed 2D grid and is preparing a 3D acquisition program for the portion of EL1120 covering the Appalachian platform and foredeep

Recent Offshore Western NL Call for Bids and Exploration Results



- Corridor was awarded its EL 1105 in 2008. The EL partially covers a large Carboniferous salt induced structure
- In February 2011, Corridor filed a Project Description with the C-NLOPB for the drilling of an exploration well on the Old Harry structure, located in Laurentian Channel. If regulatory approval is obtained, the proposed well would be drilled between mid-2012 and early 2014
- Corridor is currently completing a rigorous Environmental Assessment (EA) in EL 1105 and environs
- While Corridor has Quebec exploration licenses for the Old Harry feature since 1996, the issuance of exploration permits for the Quebec side of the prospect is still pending



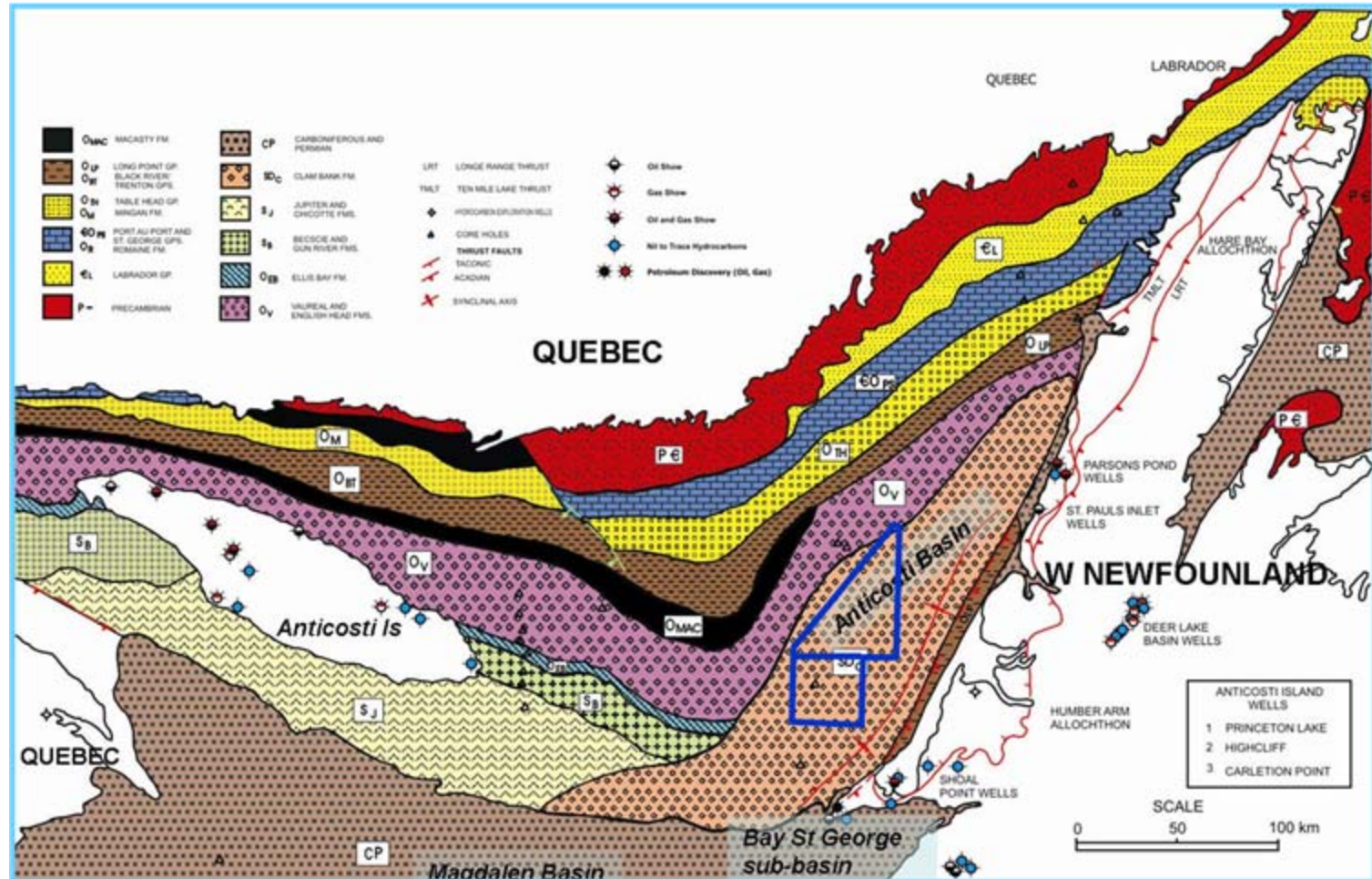
3. Regional Geology



3. Regional Geology of the Western Newfoundland Basins

- Western Newfoundland and Hopedale Basin in Labrador forms the north-eastern N. American end of an extensive, once continuous Texas to Northern Europe, Paleozoic aged mountain chain developed during the Appalachian Orogen
- The Appalachian Orogen evolved through a Wilson cycle, starting 600 million years ago and closing with continental collision and the formation of Pangea approximately 300 Ma ago. The geologic subdivisions of Newfoundland record the development of the:
 - Lower Paleozoic continental margins,
 - Intra-continental rifts,
 - Iapetus oceanic basement,
 - Terrains resulting from the docking of several island chains, and
 - Final continent-continent collision (Laurentia and Gondwana)

Bedrock Geology of Anticosti Basin



Sea bottom outcrop of Silurian Clam Bank Fm and Ordovician Long Point CFB NL11-01 area (modified after Sinclair, 1990). Blue triangle shows location of CFB NL11-01 parcel and blue rectangle shows location of CFB NL11-01-02 parcel.

Basin Evolution

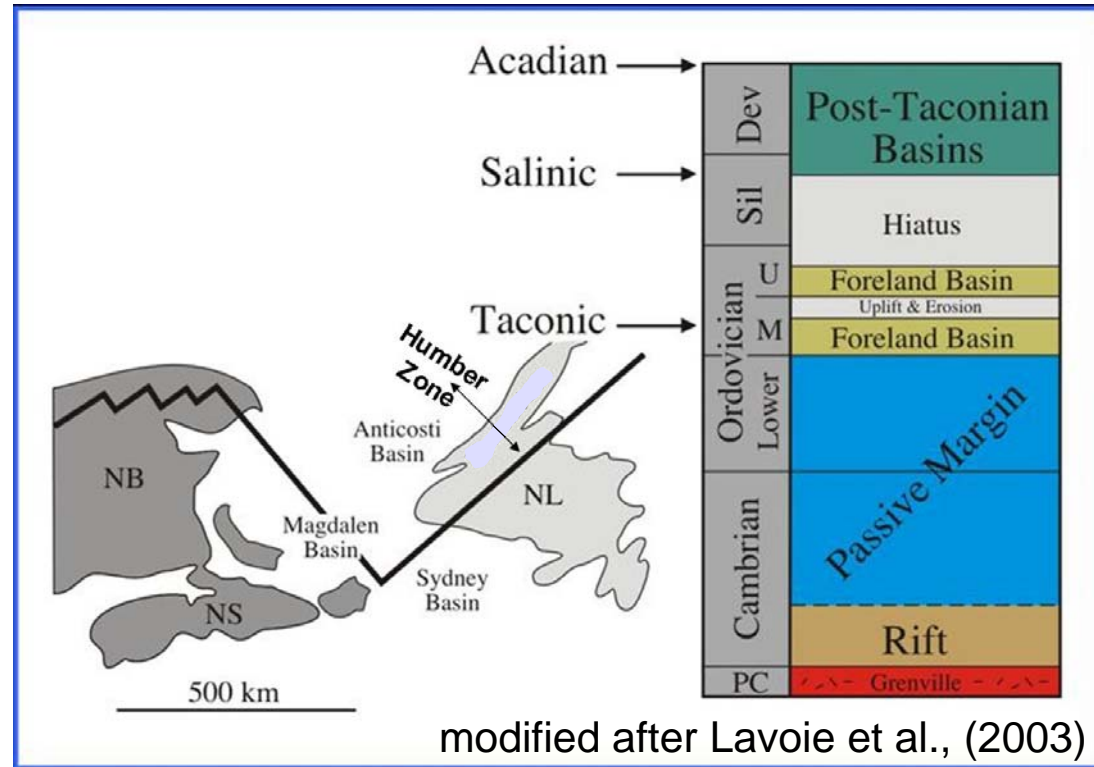
Using information from various sources, Cooper et al. (2001) has divided the Paleozoic strata of the Humber zone into 6 tectono-stratigraphic megasequences:

1. *Siliciclastic synrift sediments* (Late Proterozoic-Early Cambrian) deposited as the Iapetus Ocean opened up
2. *Passive margin strata* (latest Early Cambrian-Early Ordovician) that consists of shallow water carbonates passing eastward into basinal shales
3. *Flexural forebulge sediments* of the Taconic foreland basin that migrated westward through the region (latest Early Ordovician to earliest Mid-Ordovician). A Mid-Ordovician sequence of sub-tidal carbonates and shales was deposited
4. *Culmination of Taconic orogeny sequence*. This episode resulted in the westward overthrusting of basinal sediments (Humber Arm allochthon) and ophiolites. During this period, siliciclastic shallow marine sediments were deposited in the quiescent Taconic foreland basin (Late Ordovician to Salinic)
5. *Emplacement of Taconic allochthon sequence*. Silurian Salinic orogeny caused more displacement of the orogenic belt toward the west and exposure and erosion of the metamorphosed hinterland. Sedimentation in the Salinic foreland basin and deformation of the Cambro-Ordovician carbonate platform took place
6. *Successor basin fill*. Transtensional dextral reactivation of preexisting major basement faults followed the compressional deformation of the Late Devonian Acadian orogeny, creating successor basins with thick Carboniferous clastic fill

Schematic Paleozoic Evolution of Western Newfoundland

After the Early Paleozoic North American continental margin rifted in early Middle Ordovician, the Western Newfoundland area was formed during three orogenic phases:

- 1.) **Taconic** (late Middle Ordovician)
- 2.) **Salinic** (Late Silurian)
- 3.) **Acadian** (Devonian)

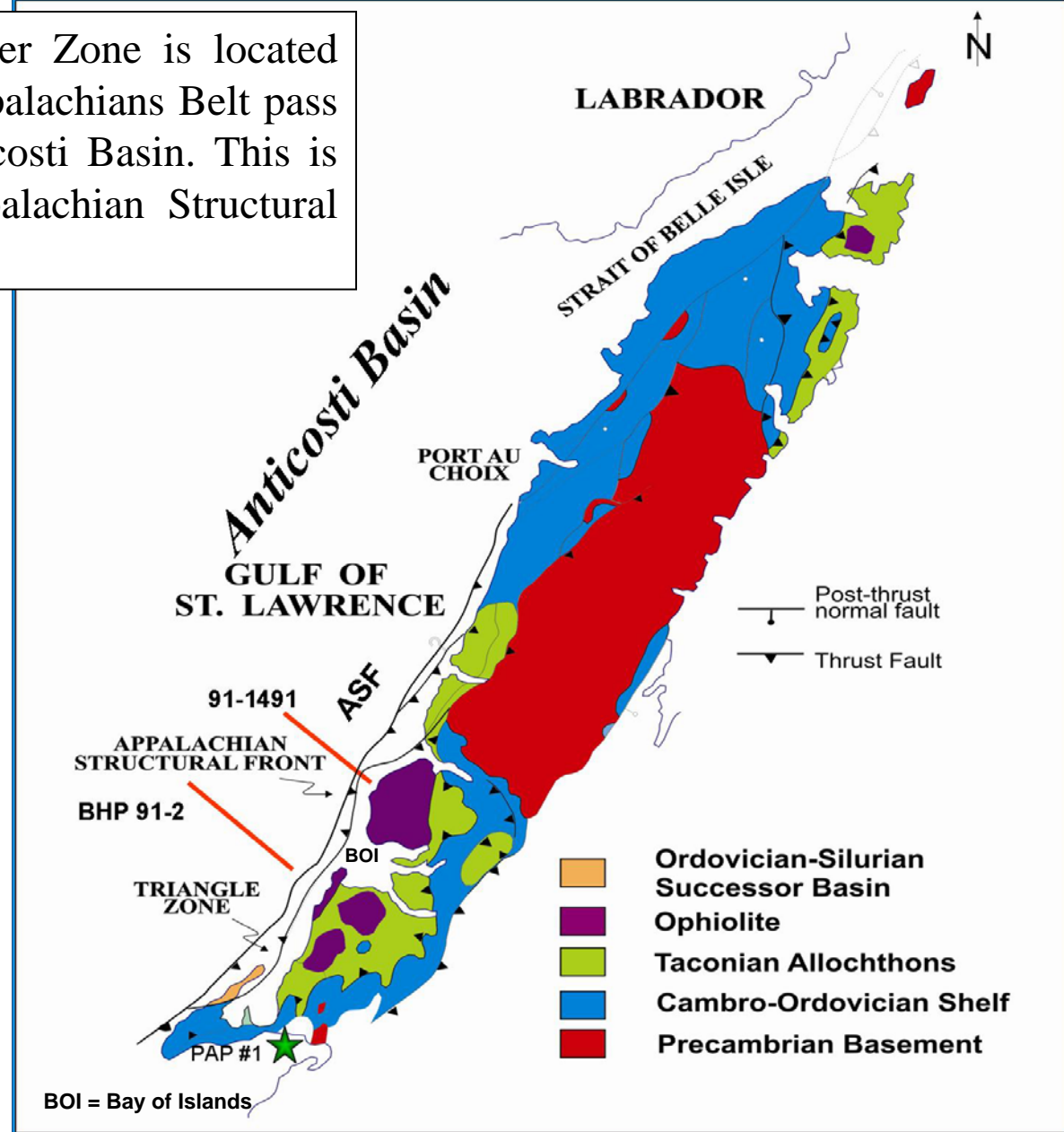


***Note:** Comprehensive accounts of NL Paleozoic regional geology, petroleum potential and seismic examples are given by Atkinson and Fagan, 2000; Fagan and Hicks, 2005; Enachescu (2006a, b and 2008) and are available at: <http://www.nr.gov.nl.ca/mines&en/oil/>

The western limit of the Humber Zone is located where deformed rocks of the Appalachians Belt pass into flat-lying rocks of the Anticosti Basin. This is called Logans Line or the Appalachian Structural Front (ASF)

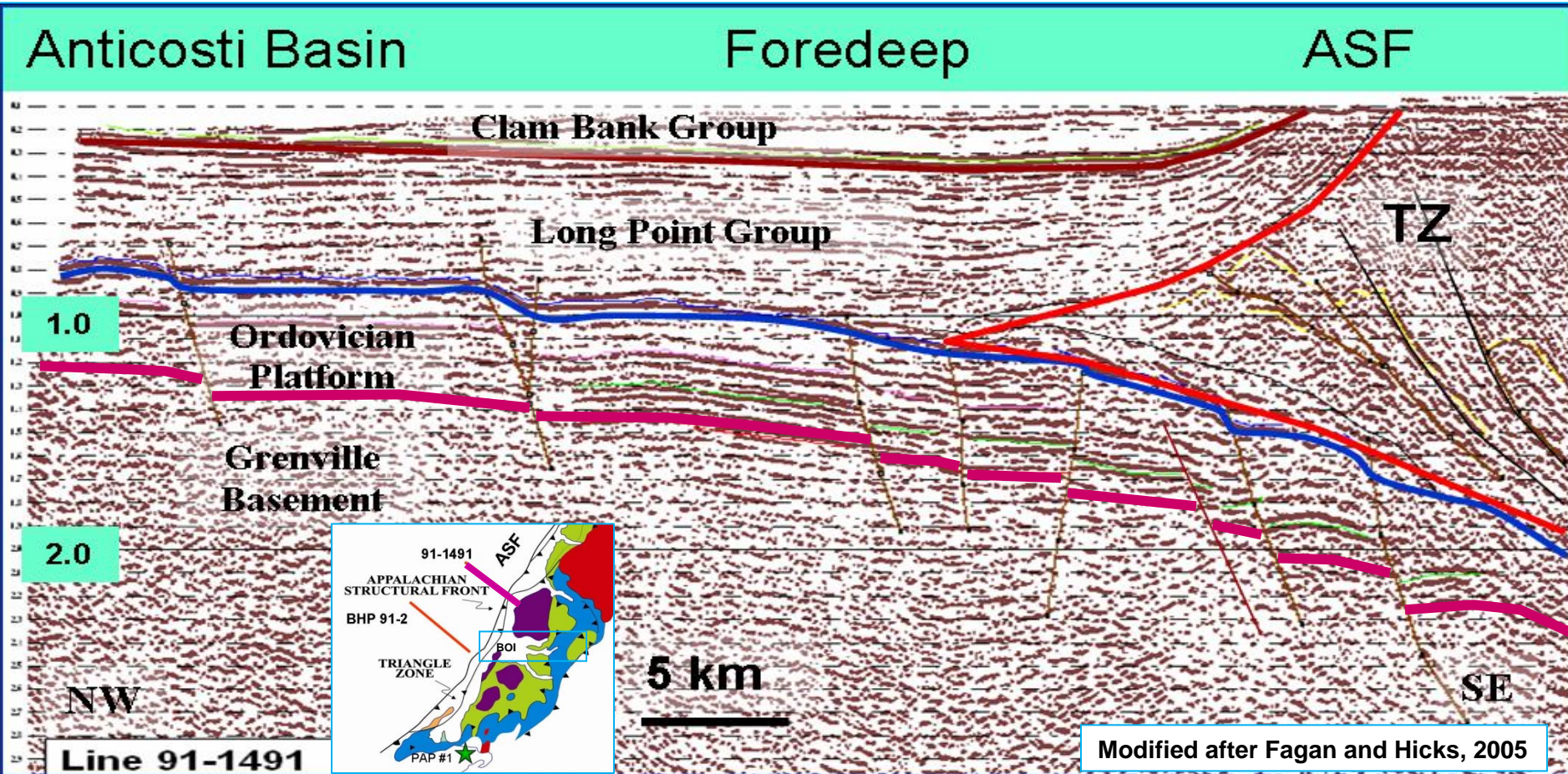
Geologic successions found on land continue offshore all the way to the **Appalachian Structural Front (ASF)**:

- A Carbonate Platform with a veneer of Carboniferous rocks forms the **Appalachian Foreland**
- The **Carbonate Platform** is affected by normal faults which in places have undergone inversion
- Also shown are locations of the seismic lines 91-1491 and BHP 91-2 illustrating regional structural setting (next slides)



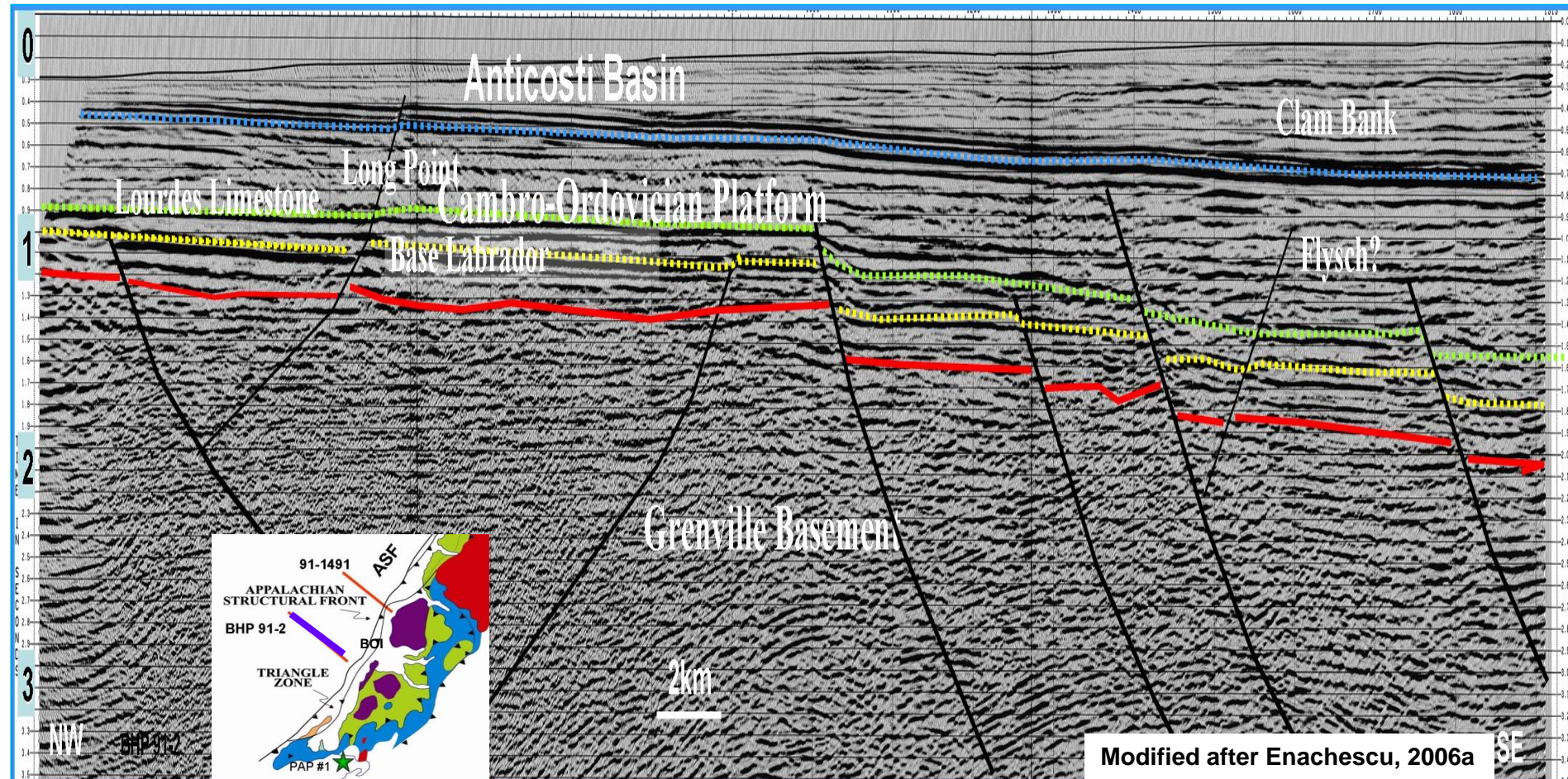
Geology map of the onshore Anticosti Basin (Humber Zone)
(after Cooper et al., 2001)

Seismic Dip Line 91-1491



Representative marine seismic line from offshore Western Newfoundland, showing the axial part of the Anticosti Basin, the faulted Cambro-Ordovician Carbonate Platform, the Siluro-Devonian fractured and east-dipping layers, the Foredeep, the Appalachian Structural Front (ASF) and the Triangle Zone (TZ) including several thrust sheets.

Seismic Dip Line BHB 91-2



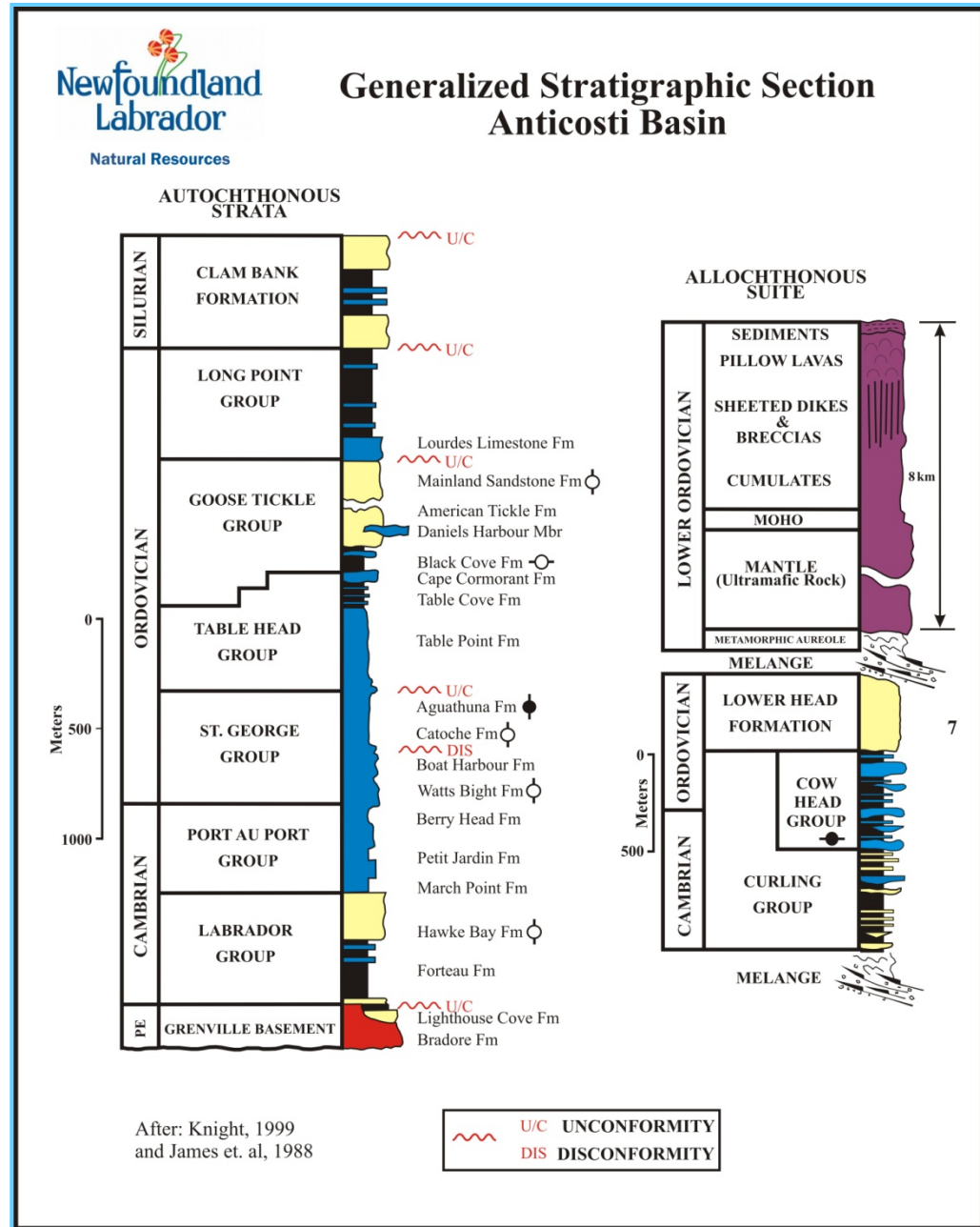
Marine seismic line from offshore Anticosti Basin located south of Bay of Islands (BOI). Line illustrates the faulted Cambro-Ordovician Carbonate Platform dipping southeastward. Several rotated blocks and a horst are potential hydrocarbon traps. Late Ordovician and Silurian groups (Long Point and Clam Bank) overlay the Carbonate Platform.

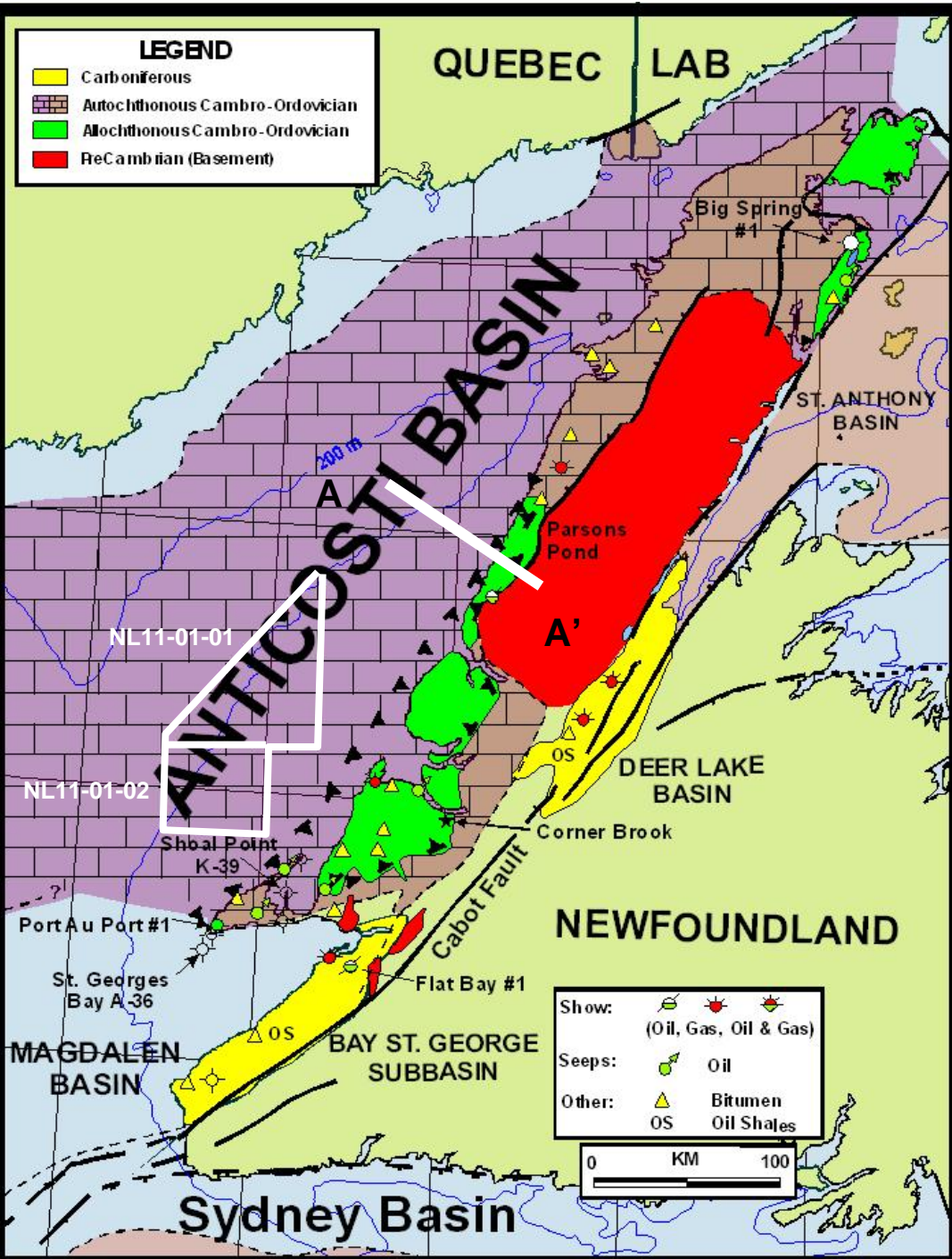
Anticosti Basin Overview

- The Early Paleozoic Anticosti Basin is one of several basins that preserve Cambrian to Ordovician shelf and foreland basin rocks along the Appalachian trend of eastern North America
- Except for wells drilled from Anticosti Island, Port au Port Peninsula and shallow wells drilled on land in the Parsons Pond area, no other wells have been drilled in this basin
- Cambrian and Ordovician rocks of the Anticosti Basin include sandstones and carbonates that were deposited along the continental shelf and slope that bordered the ancient continent of Laurentia
- The Appalachian Structural Front (ASF) is a major thrust zone separating moderate to intensely deformed, transported rock (on the south-eastern side of the fault in the Anticosti Basin) from their non-deformed to weakly deformed, non-transported equivalents (to the north-western side of the fault)



Generalized stratigraphy of the autochthonous and allochthonous sequences forming the Lower Paleozoic Anticosti Basin extending offshore and onshore Western Newfoundland (after GNL DNR). Unconformities, and source and reservoir rocks are highlighted





Anticosti Basin

Today the Early Paleozoic shelf is preserved in Western Newfoundland as a lightly deformed and faulted, mainly carbonate, autochthonous platform sequence that is locally overlain (onshore and nearshore western Newfoundland) by transported slope to basin sediments and ophiolites that were thrust westward during continental collision

Geological map of the offshore Lower Paleozoic Anticosti and Magdalen basins and the onshore Appalachian belt including sedimentary sub-basins and oil and gas shows and seeps (modified after Cooper et al., 2001). Locations of CFB NL11-01 parcels and the cross section AA' indicated by the white line are shown in the next slide.

4. Petroleum Geology of the Anticosti Basin

Source Rocks

Reservoir Rocks

Seals

Hydrocarbon Traps

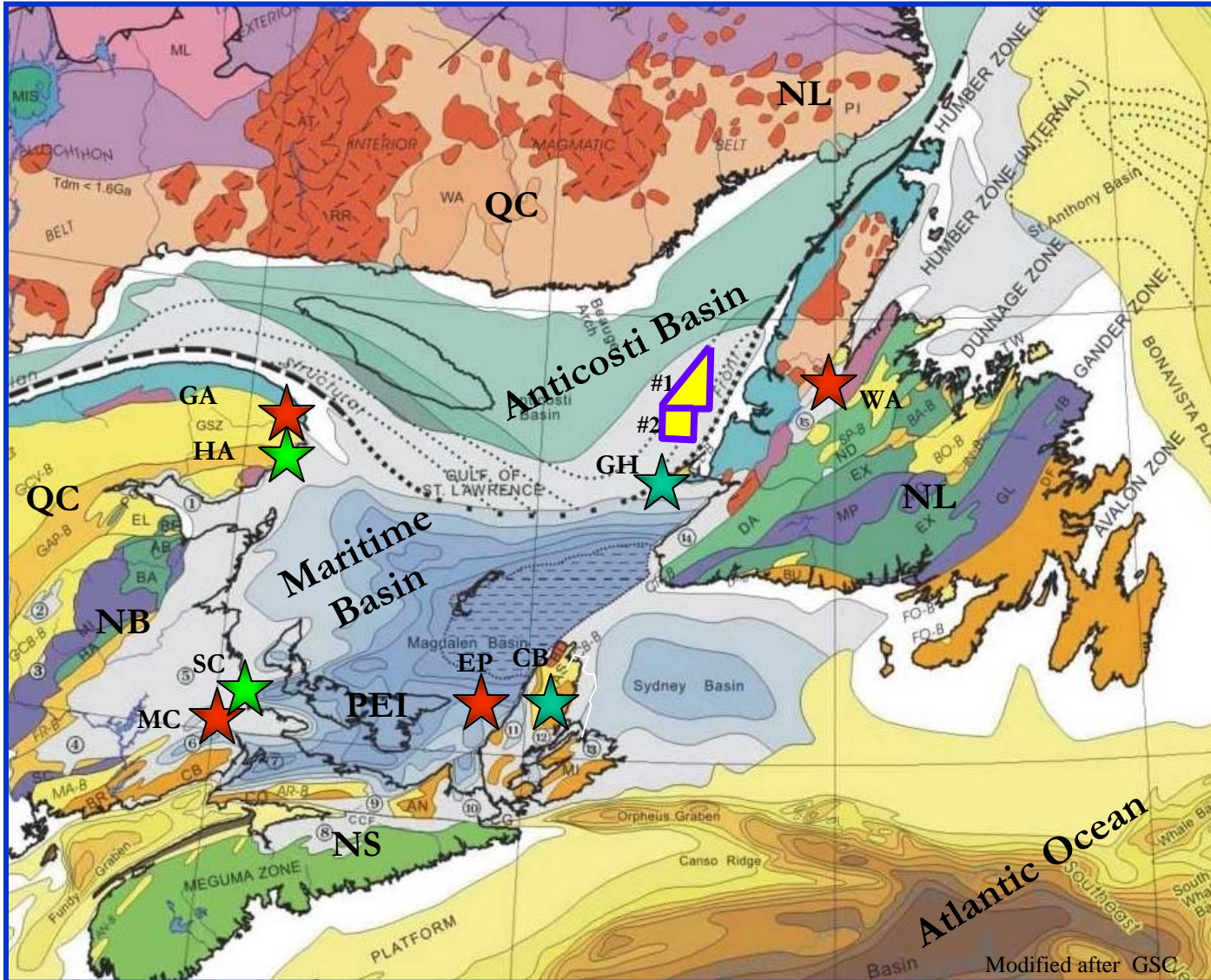
Maturation and Migration

Trenton-Black River Exploration Model

Petroleum Prospect Risks



Regional Geology and Petroleum Discoveries



 = Location of Call for Bids NL 11-01 Parcels 1 and 2

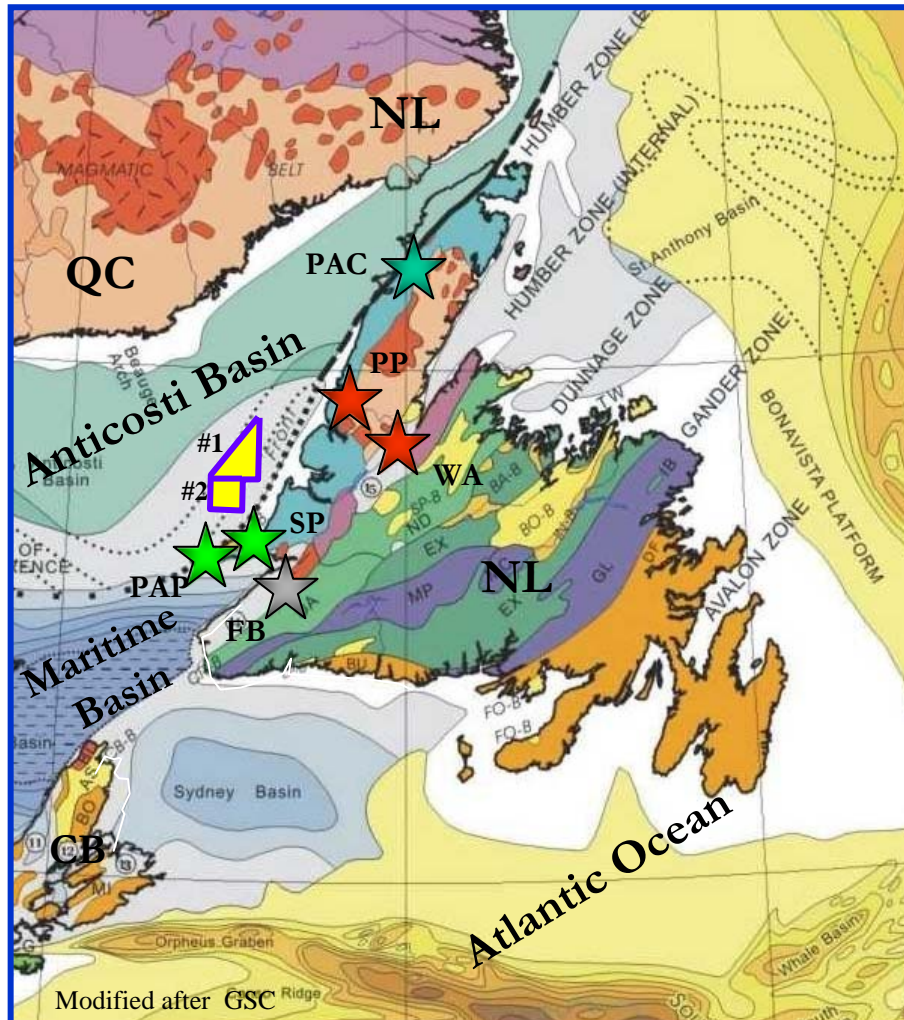
Hydrocarbon fields

MC = McCully
 SC = Stoney Creek
 GA = Galt
 GH = Garden Hill

Discoveries

EP = East Point
 HA = Haldimand
 CB = Cape Breton
 seeps and shows
 WA = West Adventure gas flow

Newfoundland Geology Map and Significant Petroleum Shows



PAP = Port au Port #1 Oil Discovery

SP = Shoal Point oil in Green Point shales

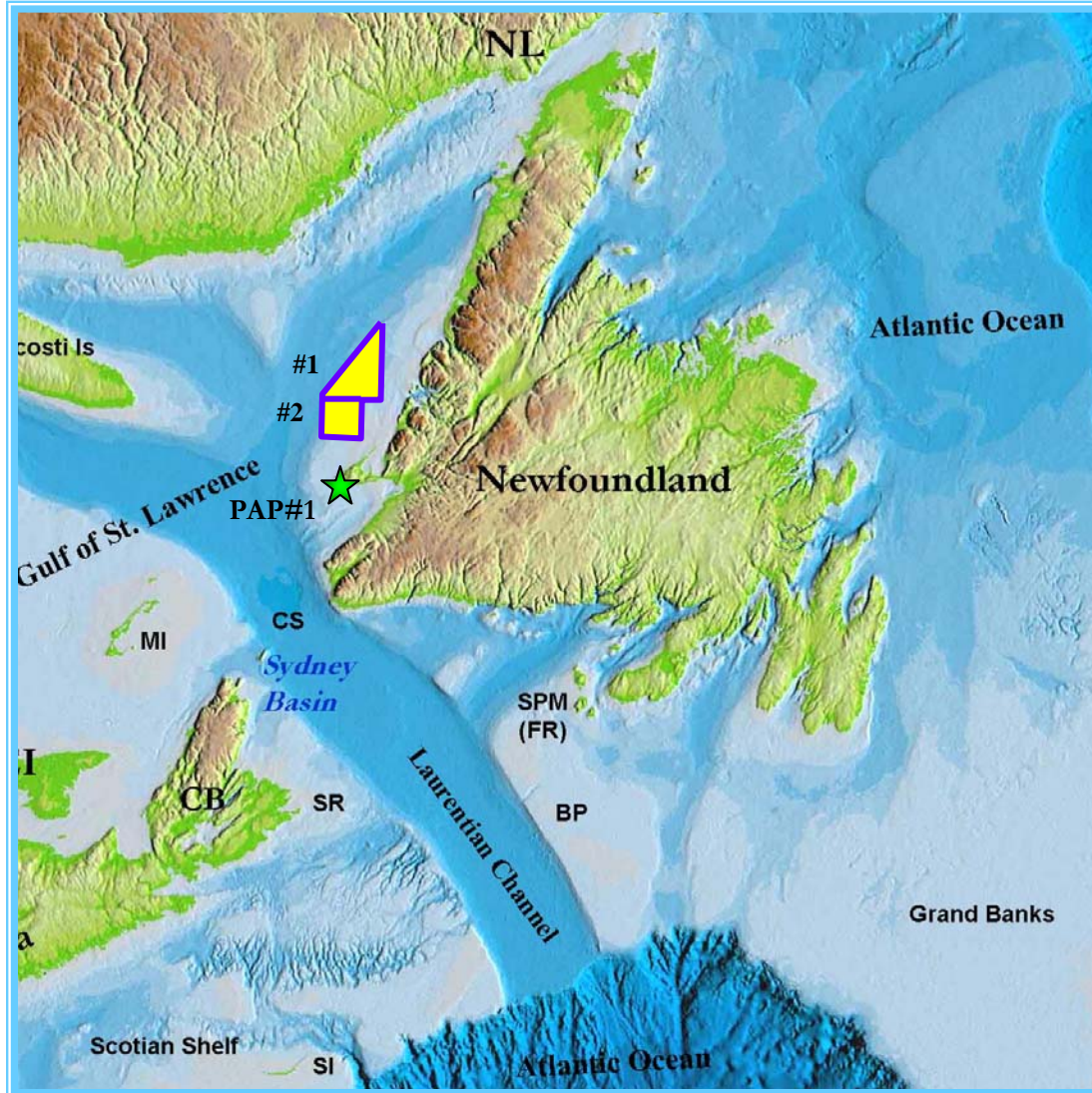
FB = Flat Bay wells that intersected tight oil zone

WA = West Adventure #1 gas flow

PAC = Port au Choix exhumed oil field

PP = Nalcor's Parsons Pond wells with gas shows

Petroleum Geology



- Systematic geochemical investigations, regional geological studies performed in the Anticosti Basin and information obtained from the sparse drilling that has occurred, have shown that **all the prerequisites for viable hydrocarbon systems are clearly satisfied**
- With the exception of the PAP #1 discovery area, this basin and particularly its north-eastern side situated in shallow water, is mostly unexplored and contains “high risk - high reward” frontier type plays

Petroleum Geology

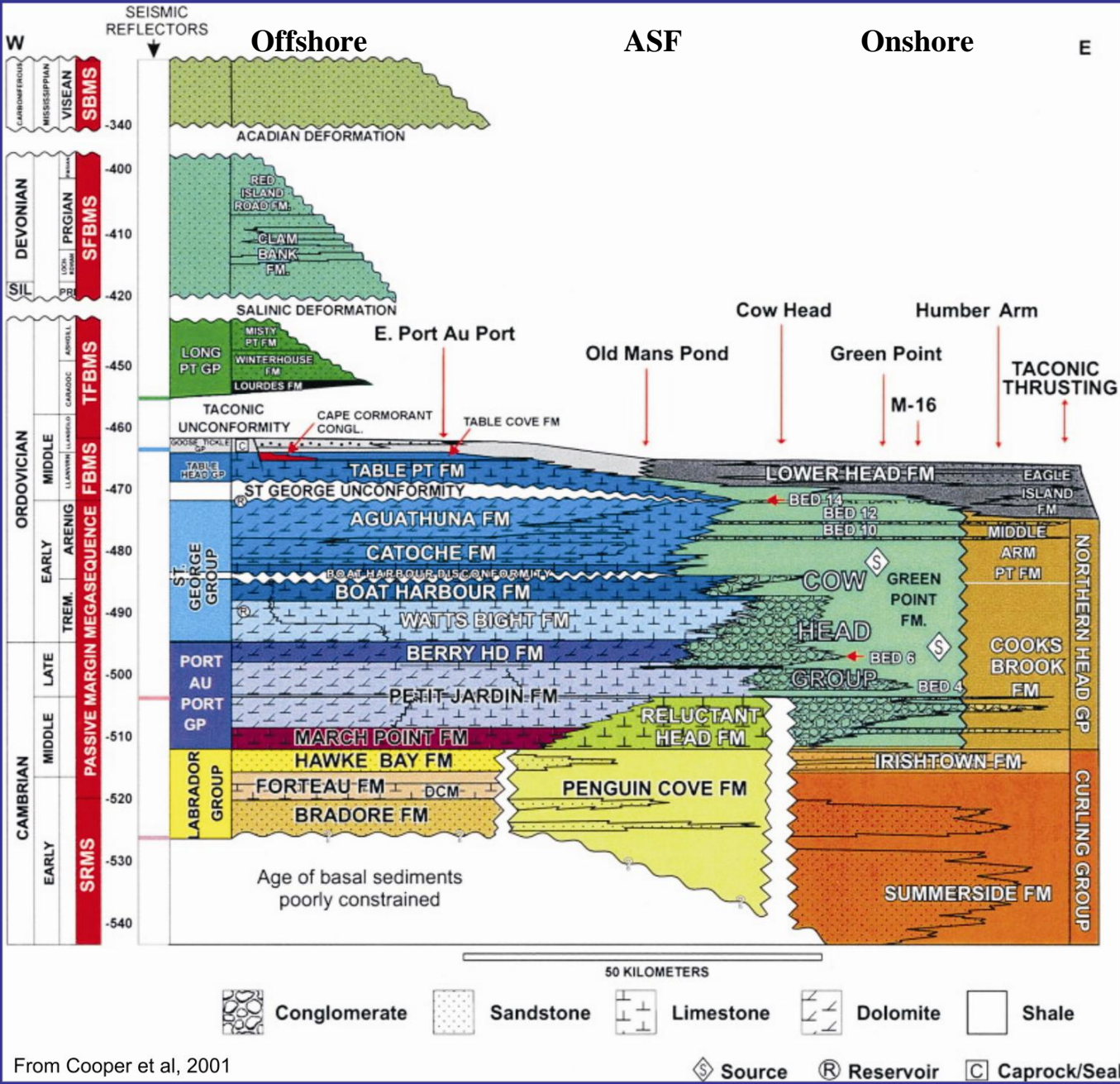
- The Anticosti Basin is the largest of the Western Newfoundland Paleozoic basins, covering vast areas both offshore and onshore
- The basin contains rock sequences ranging in age from Lower Cambrian to Devonian, with a sliver of overlying Carboniferous clastics. The Cambrian-Ordovician shallow marine platform and coeval deep water facies occupies the Gulf of St. Lawrence
- The Appalachian Triangle Zone (TZ) is located near the shoreline while its larger overthrust belt is located nearshore and on land in the relatively low lying coastal area. The TZ is also constituted from Cambro-Ordovician beds (see seismic section in slide 60 and geological cross-section AA' on slide 64)

Hydrocarbon Plays

Six conventional plays are recognized in Gulf of St. Lawrence Cambro-Ordovician strata that are valid offshore Western Newfoundland (GSC, Lavoie et al., 2009):

- 1) Cambrian rift sandstones
- 2) Lower Ordovician hydrothermal dolomite (HTD)
- 3) Carbonate thrust slices at the Appalachian structural front
- 4) Middle-Upper Ordovician HTD
- 5) Passive margin slope clastics, and
- 6) Foreland sandstones and carbonates

Generalized lithostratigraphy of the autochthonous and allochthonous sequences forming the Lower Paleozoic Anticosti Basin of Western Newfoundland (after Cooper et al., 2001)

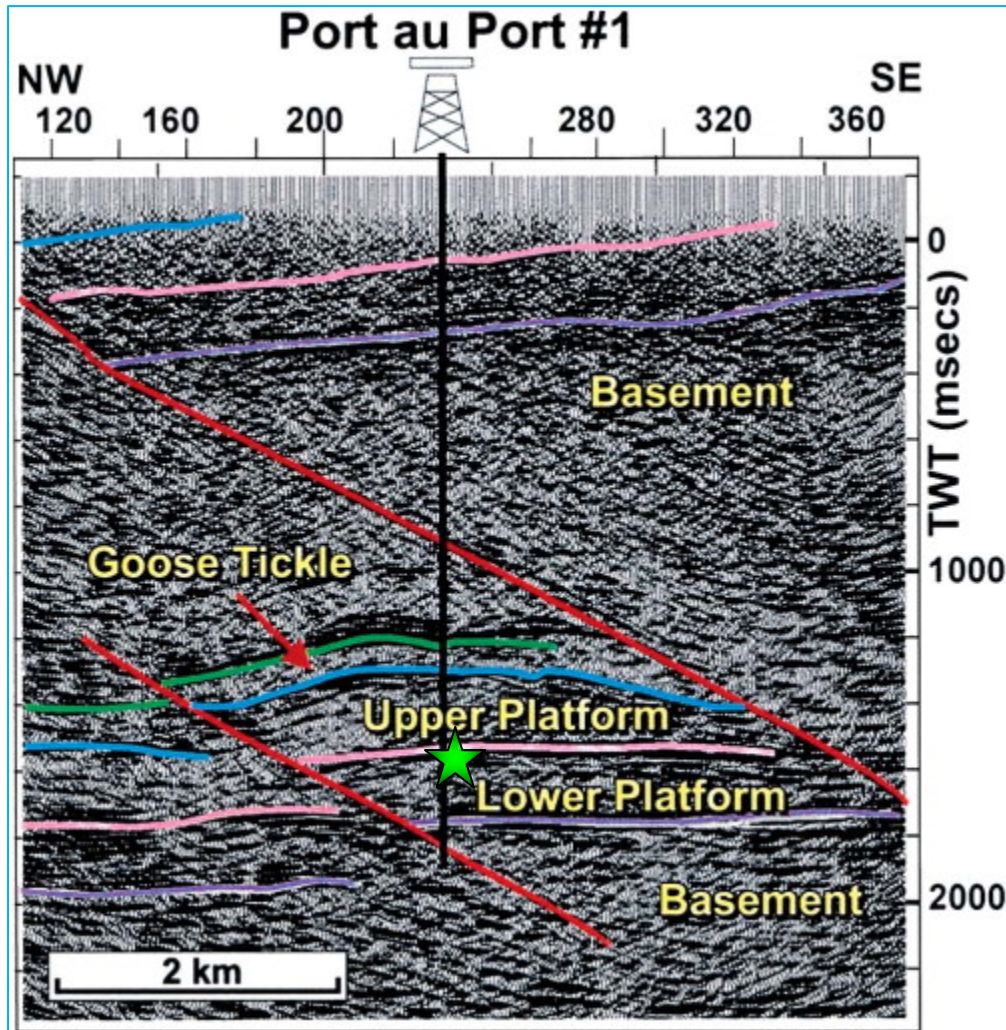


From Cooper et al, 2001

Hydrocarbon Plays

- In Western Newfoundland:
 - 1) the Lower Ordovician and Mid-Upper Ordovician HTD,
 - 2) the Carbonate thrust slice, and
 - 3) the Lower Devonian sandstonehave either oil and gas production, significant shows or exploration data indicating possible hydrocarbon accumulations
- The Silurian-Devonian successor basin beds are usually shallow and relatively flat-lying. While good sandstone reservoirs are present in the Siluro-Devonian aged Clam Bank Formation these are not considered viable targets
- The 1995 PAP discovery in Lower Ordovician HDT has brought greater attention to the petroleum potential of the Anticosti Basin where CFB NL0911-01 parcels are located

Hydrocarbon Plays



The Port au Port #1 discovery proved a working petroleum system represented by:

Late Cambrian to Mid-Ordovician Green Point source rock and the Lower Ordovician Aguathuna HDT reservoir

★ = Aguathuna pay zone

Source Rock

Several Paleozoic intervals with medium to rich source rocks have been recognized from drilling and outcrop sampling:

1. Green Point shale (Late Cambrian). The proven source rock for the Anticosti Basin onshore Western Newfoundland is present in the Humber Arm allochthonous sedimentary suite. Green Point samples yielded a **TOC of 1.74% to 3.04%** (C-NLOPB), but values up to **10%** were also reported by Fowler et al. (1995) and Cooper et al. (2001). **HI of 367-451** and **OI of 4-26** were reported (Sinclair, 1990). Fowler et al., (1995) indicate that Green Point strata are significant **Type I/II oil prone** source rocks

Geochemical fingerprinting has identified the Green Point shale as the source rock for the oil shows at Parsons Pond and for the PAP #1 discovery. Average thickness for the Green Point shale is 50 m, however thicker intervals were logged in the Shoal Point and Garden Hill sidetracks. The source rock is marginally mature to mature when sampled in outcrop

Source Rock (Cont.)

2. McCasty shale (Late Ordovician). This shale is the recognized source rock on Anticosti Island. The McCasty shale has not been encountered in Western Newfoundland but may be present in the undrilled offshore foreland basin. Seismic data indicates that the NL11-01 parcels would contain the foreland basin sequences including the McCasty source rock

3. Black Cove-Cape Cormorant shale (Mid-Ordovician). Part of the autochthonous suite from this formation, has been sampled from outcrop and should be present in the offshore foreland basin. Outcrop samples yielded an average **TOC of 1.2%** by (C-NLOPB); values up to **8%** were reported (Atkinson and Wright, 2006). This shale has a **HI of 246** and an **OI of 18** (Sinclair, 1990)

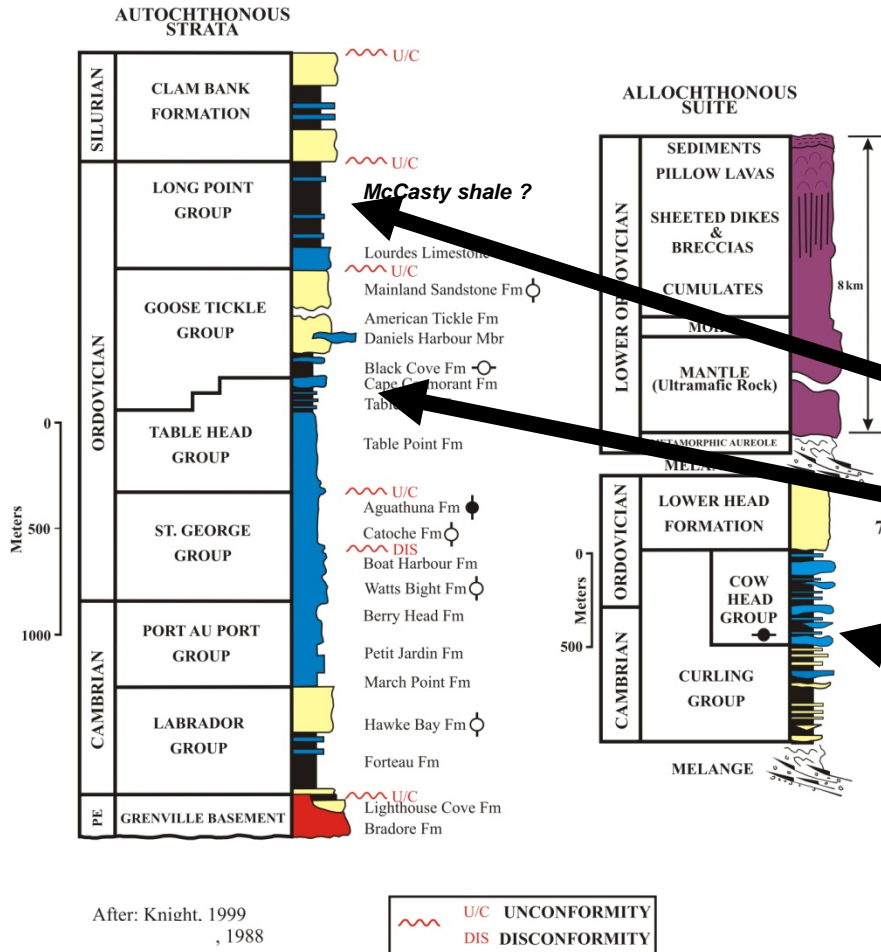
An important distinction between the Green Point shales and the Black Cove/Cape Cormorant and McCasty sequences is that the latter are present in the autochthonous foreland basin, and should therefore be widespread throughout the Gulf of St. Lawrence (Sinclair, 1990)

Source Rock (Cont.)

Lower Paleozoic intervals with medium to rich source rocks have been recognized from drilling and outcrop sampling

- *McCasty shale*
- *Black Cove-Cape Cormorant shale*
- *Green Point shale*

Generalized Stratigraphic Section Anticosti Basin



Source Rock (Cont.)

Reservoirs rocks in the Anticosti Basin are predominantly dolomitized carbonate rocks and sandstone. Both primary and secondary porosity have been encountered in wells and outcrop

1. St. George Group (Early Ordovician) and Port au Port Group (Mid- to Late Cambrian) carbonates. Well and outcrop information indicates that all of the Ordovician carbonate reservoirs are within dolostones of the Early Ordovician St. George Group and Middle to Late Cambrian Port au Port Group. Factors controlling porosity within the Aguathuna Formation (the productive zone at Port au Port #1) are not well understood and the porosity appears to be highly variable

Deeper reservoirs such as the Watts Bight and Catoche formations may provide more regional and predictable dolostone targets. The Catoche Formation has been mapped in outcrop by Knight (2008) who indicates broad-based occurrence of Catoche porosity in Western Newfoundland. All these carbonates are included in the early Ordovician St. George Group



Lower Ordovician Carbonate Reservoir Rocks In Western Newfoundland

Reservoir Rock

- Approximately 350 km north of the Port au Port Peninsula, in the Port au Choix area, the Ordovician Carbonates (including the Catoche, Aguathuana and Spring Inlet dolomites) are inundated with bitumen and Cooper et al. (2001) concluded that the Port au Choix Peninsula contains a large exhumed oil field
- Dolomite porosity is microcrystalline, inter-crystalline and vuggy
- Secondary porosity creation in Ordovician carbonates depends on exposure and karstification of the platform carbonates during extension and rotation in Middle Ordovician as well as fracturing, solution injection and preferential dolomitization of previously karsted and high energy grainstones zones during the Devonian (Cooper et al., 2001)

Reservoir Rock (Cont)

2. *Lower Paleozoic sandstones.* The Hawke Bay Sandstone (Cambrian aged Labrador Group) was porous in the hanging wall at PAP #1 but was tight in the repeated section in the footwall. Cambrian sandstone form the main reservoir for the Northwest Territory's oil and gas discoveries in a similar Paleozoic structural setting. Additional reservoir potential is recognized within the autochthonous Late Ordovician Goose Tickle Formation that contains Mainland and American Tickle sandstones

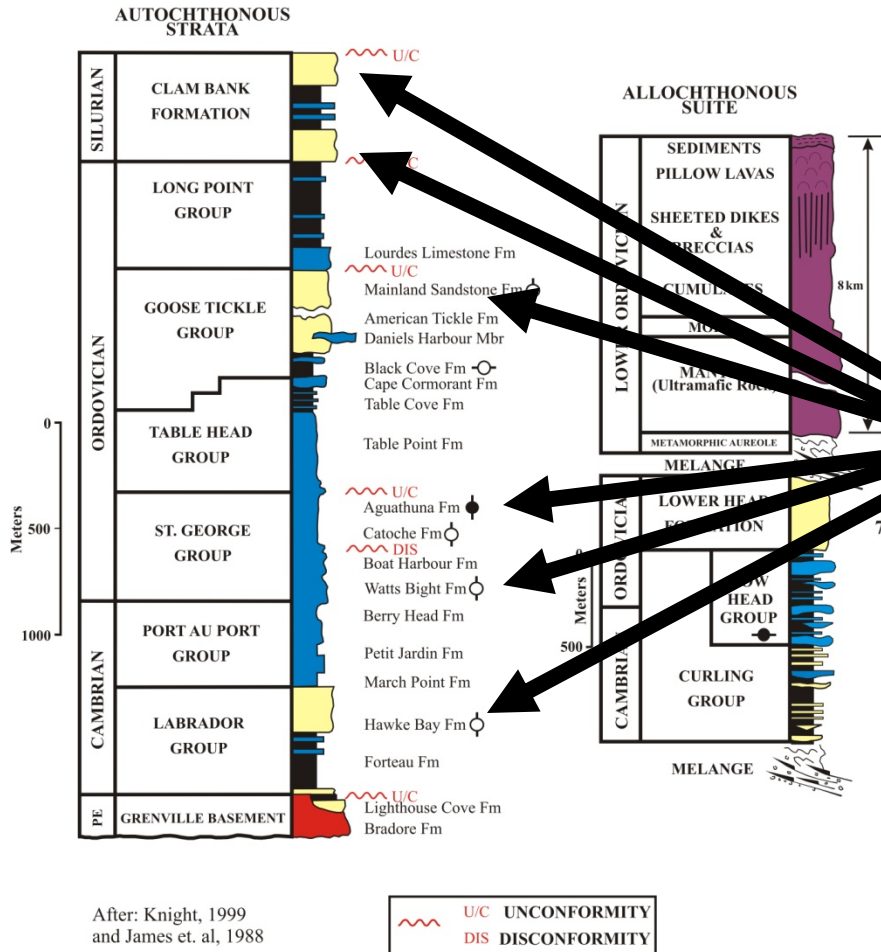
3. *Other reservoirs.* Also contained in the Goose Tickle Group are dolomitized carbonate conglomerates of the Daniels Harbour Member and calcarenites carried in hanging wall thrusts (Knight – pers. comm.). Other reservoir intervals were encountered in the Watts Bight Formation. The Late Ordovician Long Point Group and Silurian-Devonian Clam Bank groups are not widely outcropped in Western Newfoundland but may be drilled offshore. More likely the Long Point Group will be dominated by shales with minor limestones. The Clam Bank sequence offshore may also present unexplored porous clastic and carbonate zones. Other mentioned clastic reservoirs are Eagle Island Sandstone, Blow-Me-Down Brook Sandstone and the Misty Point Fm in the Long Point Group (16% porosity in outcrop reported by Quinn et al., 1999)

Reservoir Rock (Cont.)

- Porosity is most extensive in the upper Catoche Formation, spottier in the peritidal Aguathuna and Spring Inlet members, and extends as high as the lower Table Point Formation
- The possibility of directly mapping hydrothermal dolomite porosity on high quality 3D seismic data and mapping of seismic attributes related to fluid indicators in this area remains to be explored
- Both source and reservoir rocks may be present in places within the synrift sequences present under the Carbonate Platform. These rocks have never been penetrated in the Anticosti Basin but similar Early Paleozoic synrift sequences are productive in other Paleozoic basins. An example is the Cambrian of the Mackenzie Corridor in NWT that provides both quality reservoirs and source rocks

Reservoir Rock (Cont.)

Generalized Stratigraphic Section Anticosti Basin



After: Knight, 1999
and James et. al, 1988

Reservoirs predominantly dolomitized carbonate rocks and sandstone with both primary and secondary porosity

- *Ordovician carbonates*
- *Lower Paleozoic sandstones*
- *Other reservoirs: Daniels Harbour Mbr, Watts Bight Fm, Long Point Gr, Clam Bank Gr, Eagle Island Sandstone, Blow-Me-Down Brook Sandstone, Misty Point Fm of the Long Point Gr, Catoche Fm, Aguathuna and Spring Inlet mbrs, lower Table Point Fm*



**Lower Ordovician carbonate reservoir in
Western Newfoundland**

Seals

Finding good seals should not be a problem in the Anticosti Basin as the Lower Paleozoic succession contains a number of tight shales and carbonates

- Tight intervals are present in both allochthonous and autochthonous successions represented by shales, carbonates and various evaporite intervals
- The Middle Ordovician *Black Cove Shale* is a regional top seal for the foreland Carbonate Platform

Hydrocarbon Traps

Structural traps in the Anticosti Basin are associated with deformation of the platform in front of and along the Appalachian Structural Front

- North of Port au Port area the deformation front is a classic Triangle Zone with trapping possibilities in the overlying thrust sheets and underlying faulted and tightly folded autochthonous platform
- Traps in the autochthonous or foreland Carbonate Platform are rotated fault blocks or inverted fault blocks including footwall shortcuts of the thick skinned thrusts. This deformation zone is present in the eastern, shallower water part of the Anticosti Basin
- Cambro-Ordovician Platform and its cover deepens eastward through numerous steps, creating horsts and rotated blocks bounded by basement penetrating faults. While these faults are predominantly normal faults, minor inversion is observed in places. This kind of deformation should be present in the CFB NL11-01 parcels

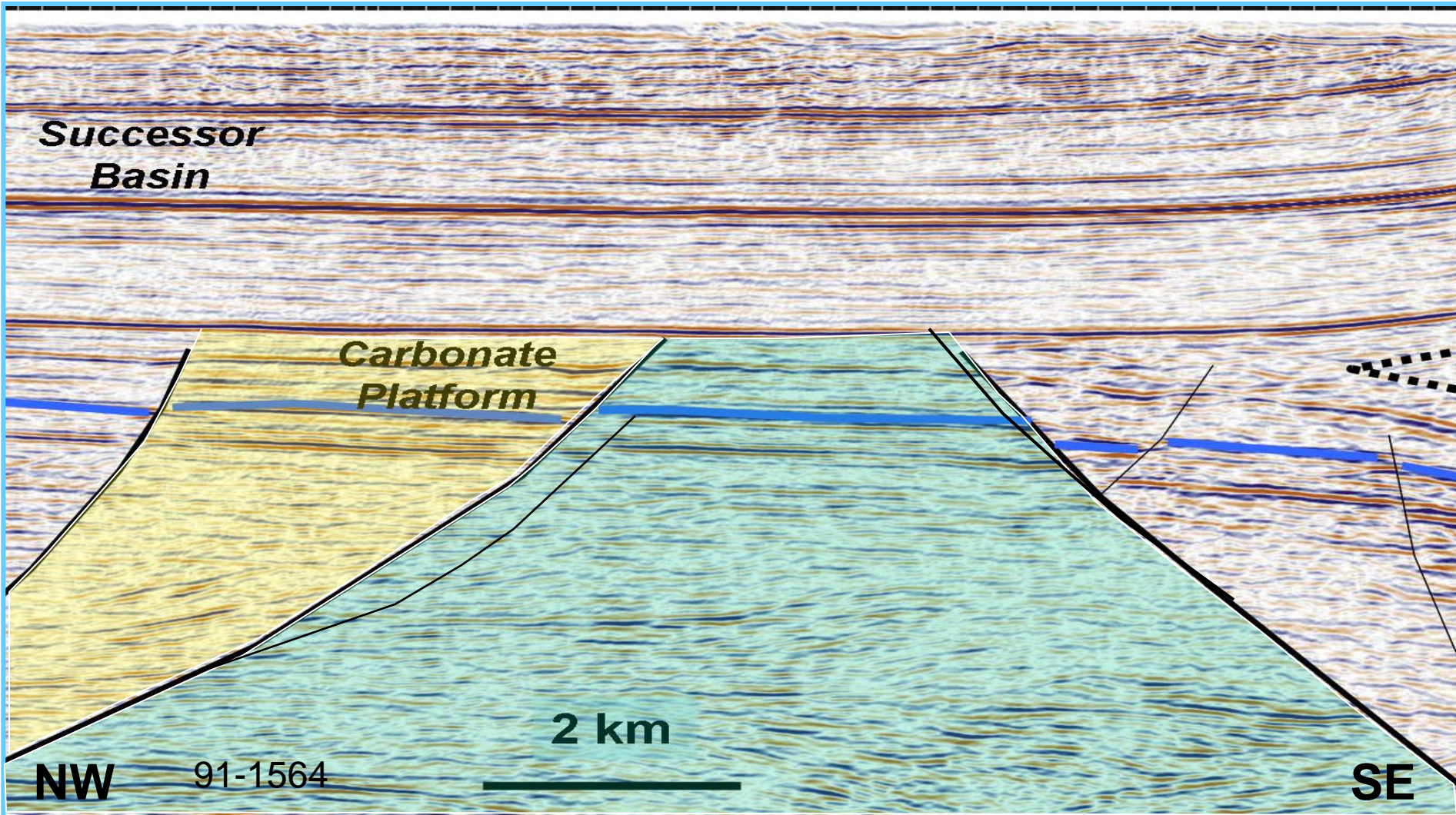
Hydrocarbon Traps (Cont.)

Both thin and thick skinned structures are present in the Humber Arm Allochthon

Cooper et al., (2001) and Atkinson (2005a and b) summarized all possibilities of

- a) Structural traps: horst blocks, tilted fault blocks, thrust sheet slices
 - b) Stratigraphic traps: sand lenses, pinchouts, fans, erosional edges, karstified and leached carbonates, dolomitized carbonates
- Enachescu (2006a, 2008 and 2009) has shown possibilities of two- , three- and four - way fault bounded closures in numerous interpreted seismic sections crossing the Anticosti Basins north of Port au Port Peninsula

Structural Traps: Horst and Tilted Block



Source C-NLOPB

Enachescu, 2011

Maturation and Migration

The Paleozoic source rocks should be all in the mature to overmature range

- After trap formation there were direct migration routes through porous beds or/and faults from the Green Point shale into allochthonous reservoirs
- Port au Port #1 oil and gas tests and the presence of oil in seeps and drilled wells demonstrate that source rocks are mature and that oil and gas were generated and migrated into traps
- Migration from other possible autochthonous source rocks is less understood

Trenton-Black River Exploration Model

Trenton-Black River reservoir is a successful hydrocarbon exploration trend in the Appalachian Basin

Exploration model including four prerequisites for porosity development in carbonate rocks (Smith, 2004):

1. Appropriate tectonic settings such as basement-rooted intra-platform wrench faults and fault intersections, fault-controlled margins, and the first carbonates deposited on newly-rifted/heavily-faulted continental shelf
2. Fault movement soon after deposition; much of the alteration takes place in the first kilometre of burial, so faults with minor vertical offset at the time of alteration may be in the best locations
3. Indication for breccification; breccias may be either karst or hydraulic, so look for saddle dolomite-cemented breccias
4. Petrographic evidence of hydrothermal alteration in cores and cuttings

Trenton-Black River Exploration Model (Cont.)

All prerequisites for the formation of HTD have been identified and confirmed in the carbonates and dolomites encountered in drilling and in the outcrops within the Anticosti Basin providing strong arguments that a similar play is present offshore Western Newfoundland!



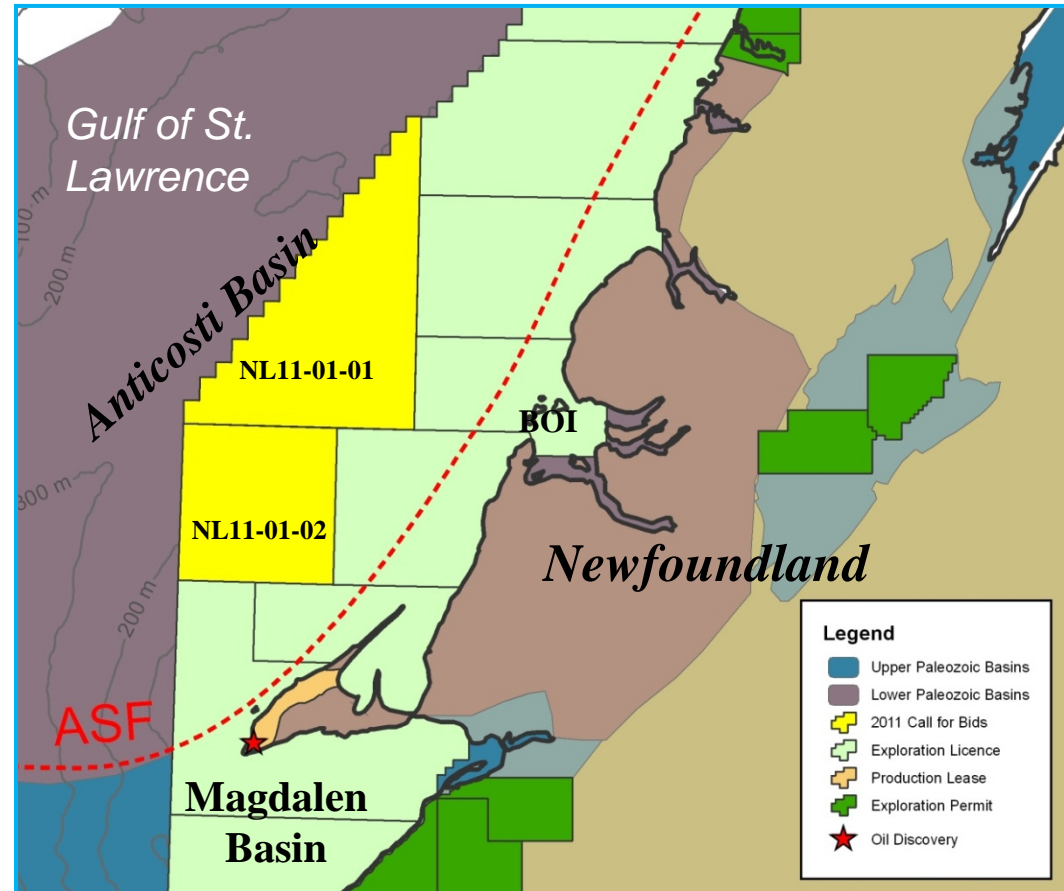
Petroleum Prospect Risks

Port au Port #1 oil and gas tests, presence of oil in seeps and drilled wells demonstrate that source rocks are mature and that oil and gas were generated and migrated into traps

- After trap formation there were direct migration routes through porous beds or/and faults from the Green Point shale into allochthonous reservoirs
- With source rocks in the oil window or dry gas window, trap preservation and presence of adequate reservoir remains the main risk factors in the Anticosti Basin. One example of field destruction is the Port au Choix exhumed oilfield located on the shore line, north of offered parcels
- Offshore, where prospective section is expected to be buried under thick Middle Ordovician beds, the risk of trap preservation should be lower
- There is also risk of tight reservoir or lack of connectivity in the case of karstified limestones

5. Petroleum Potential of Call for Bids NL11-01 Parcels

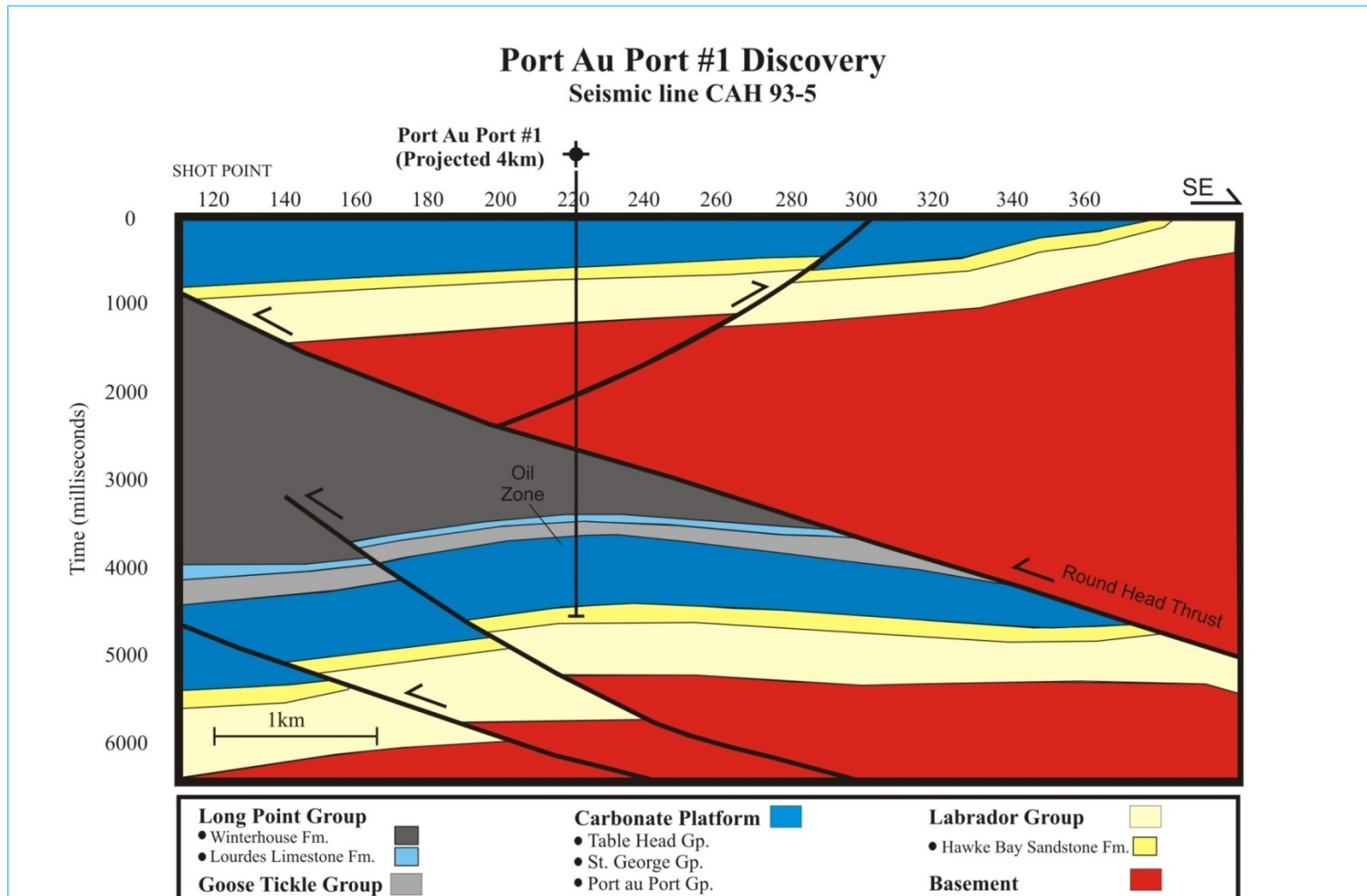
- Call for Bids NL11-01 includes two large parcels located north of Port au Port Peninsula and east of existing near shore ELs
- These blocks are relatively shallow water parcels (30-240 m WD), located in vicinity of proven hydrocarbon occurrences on the Port au Port Peninsula, Parsons Pond, Deer Lake and Port of Choix areas
- Parcels are located on the foreland and foredeep of the Appalachian Fold Belt



Significant Wells for CFB NL11-01

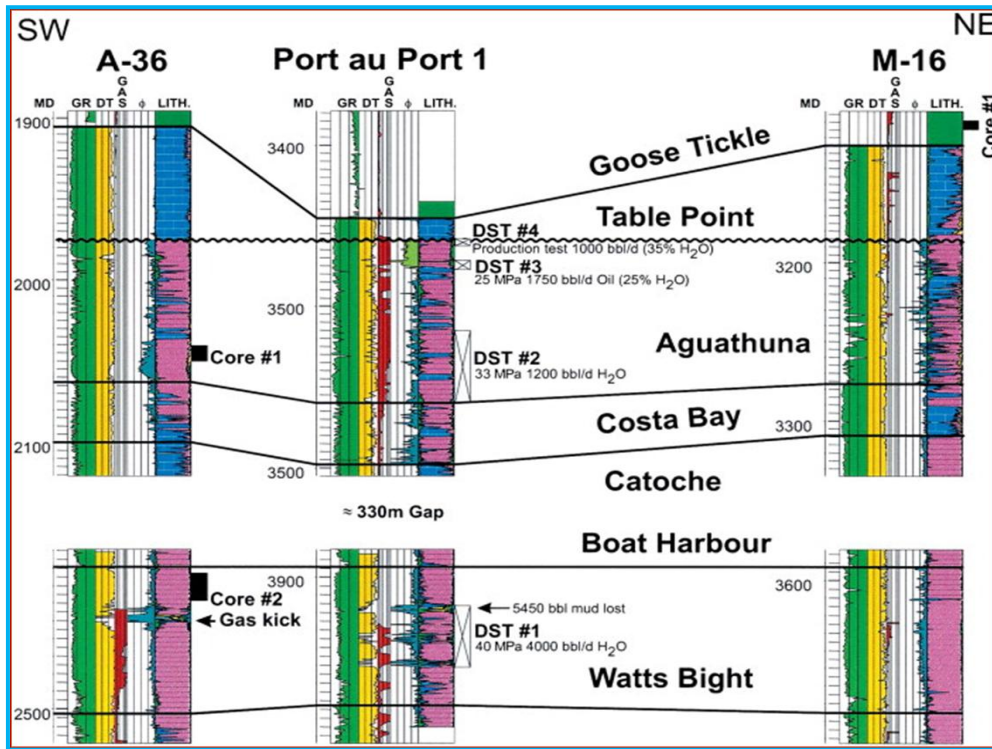
- The most significant well for the area, Port au Port #1, was drilled in 1995 approximately 100 km south of Parcel 1 and 50 km south of Parcel 2. Four intervals were tested two of which flowed oil. One test yielded 1,528 bopd and the other yielded 1,742 bopd of 51° API. The well was suspended as a potential oil well
- The PAP #1 well penetrated a higher imbricate block set by a footwall thrust, situated under the main Round Head Thrust. This thrust sets a large basement block above the platform carbonates. The intervals that flowed oil were in the Upper Aguathuna Formation. The reservoir consists of a low permeability matrix component and a high permeability cavernous/paleokarst component
- During a 6 day extended test, both pressure and GOR declined. No cores were taken
- During the early 2000s, CIVC who initially farmed into the project and obtained PL 2002-01, renamed the discovery the Garden Hill South field. CIVC has produced sub-economic flows from PAP#1 well, and drilled a sidetrack ST#1 that did not encounter the oil accumulation
- Subsequently PDIP/Enegi, the present operator of the PL 2002-01 drilled sidetrack ST#2 which was shut in for mechanical reasons. A third sidetrack ST#3 and more production tests are planned for 2011

Port au Port Structural Section

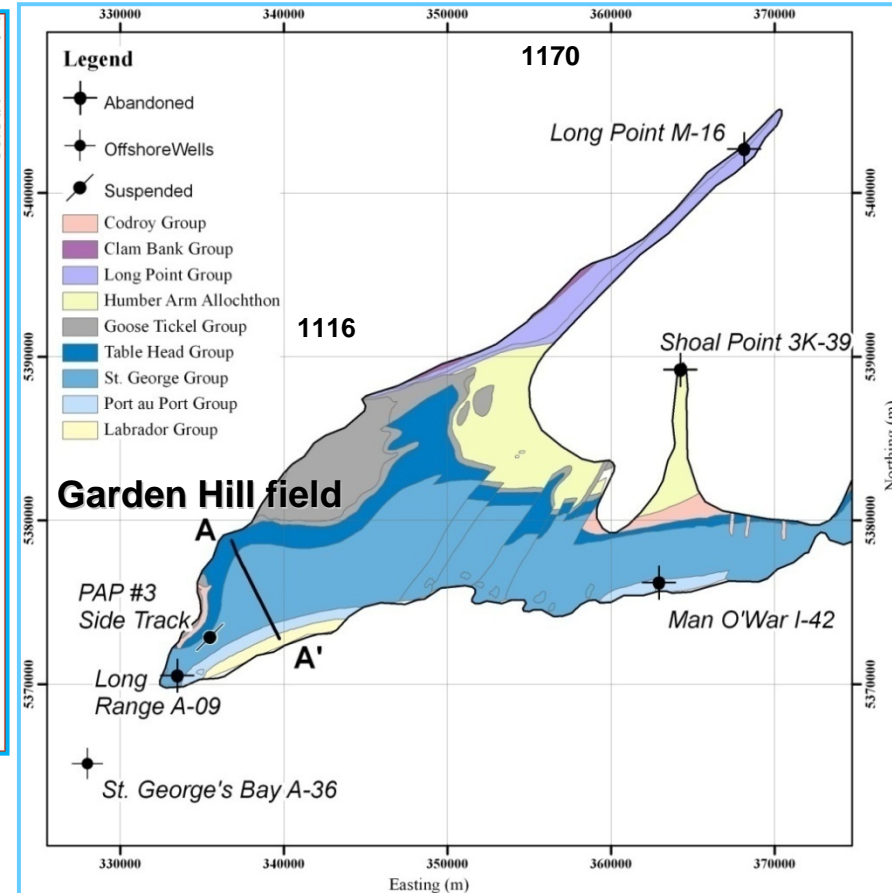


Geological cross-section after seismic section interpretation (location is contained in the next slide).

Garden Hill Field Trap



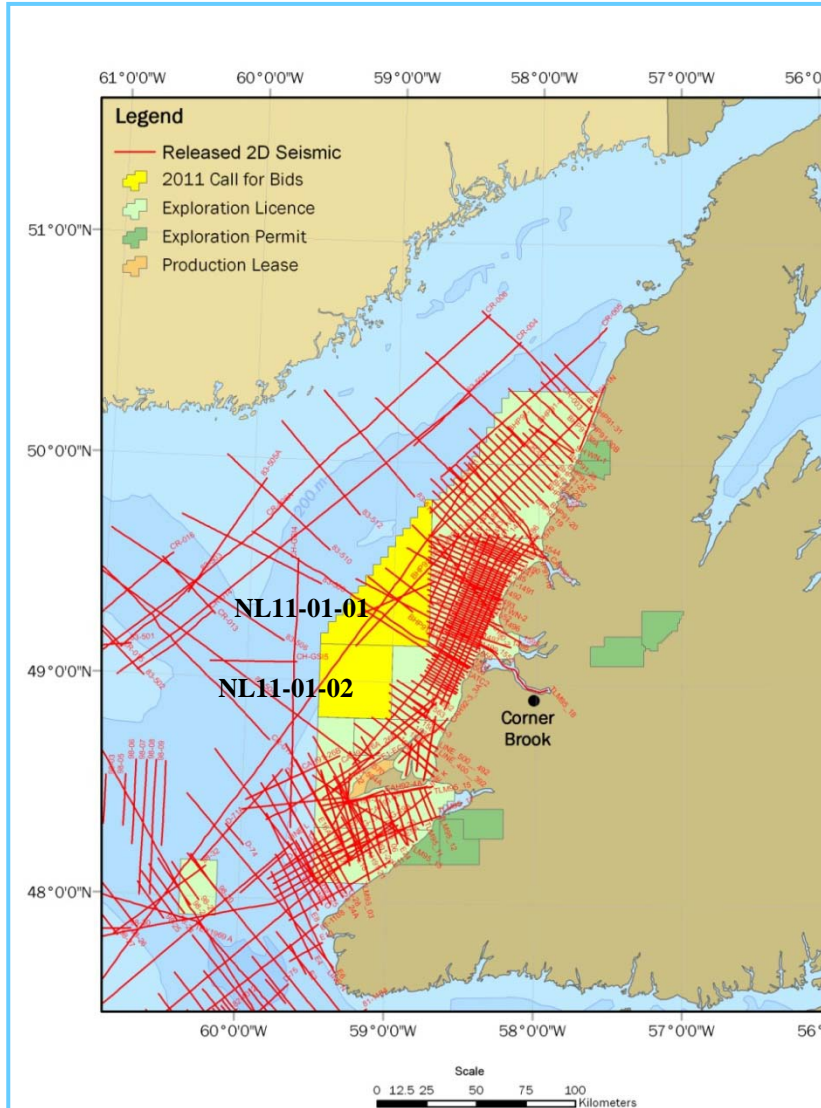
Log correlation of stratigraphic formations between the St. George's Bay A-36, **Port au Port #1** and Long Point M-16 wells (after Cooper et al., 2001).



AA' geological cross-section (contained in the previous slide)

Garden Hill field is a stratigraphic-diagenetic trap in which regional and local faults have major control on porosity and permeability. An unfolded, but faulted platformal Aguathuna Formation is expected in the area of the CFB NL11-01 parcels

Seismic Coverage



- The Call for Bids NL11-01 Parcels 1 and 2 are unevenly covered by a scarce 2D seismic grid
- Parcel NL11-01-01 has 2.5-3.5 km spacing in the dip direction and only several lines in strike direction
- Parcel NL11-01-02 has little modern data in the C-NLOPB database
- Approximately 500 km of modern 2D data is available for petroleum evaluation of the two CFB parcels (released data); more older vintage lines may be available but are not contained in the adjacent map

Seismic Coverage

- Digital data is owned mainly by BHP, ExxonMobil and Hunt who collected the data covering the parcels and environs during the early to mid 1990s
- BHP grid represents the majority of the seismic lines in the CFB NL11-01 parcels and was collected during a large regional seismic survey completed in 1991
- A HGS (GSI) vessel was used, equipped with a sleeve gun array source with a 3616 cu in volume. A fibre optic, 3000 m long, 240 channels digital cable was towed. A 25 m shot point interval and 12.5 m group interval was used
- Seismic data processing was done by HGS and has true amplitude recovery, designature applied in shot domain, F-K demultiple and gapped deconvolution. Most BHP lines are 60 fold, processed to finite difference migration and show fair to excellent quality in the foredeep area

Seismic Interpretation

- Regional seismic data shown in this presentation was tied with synthetic seismograms to several exploration wells in the Port au Port area and jump tied to the seismic markers present in the CFB NL11-01 area
- Full Cambrian to Devonian sedimentary sequence described from outcrops and cores and encountered in the Port au Port Peninsula wells are present in the parcels. On the illustrative seismic sections only a few markers and formations are displayed together with major faults
- Seismic lines in the parcels show the basin as a monocline, dipping and thickening toward the southeast, interrupted by thick-skinned normal faults affecting the Platform and the Grenville Basement
- Deformation of the overlying Silurian and Carboniferous layers is minimal; however several major faults penetrate these sequences
- Small strike-slip or reverse displacement is observed on some faults, but the main hydrocarbon play in the basin is set by rotation of blocks due to movement on deep penetrating normal faults

Litho-Stratigraphic Chart

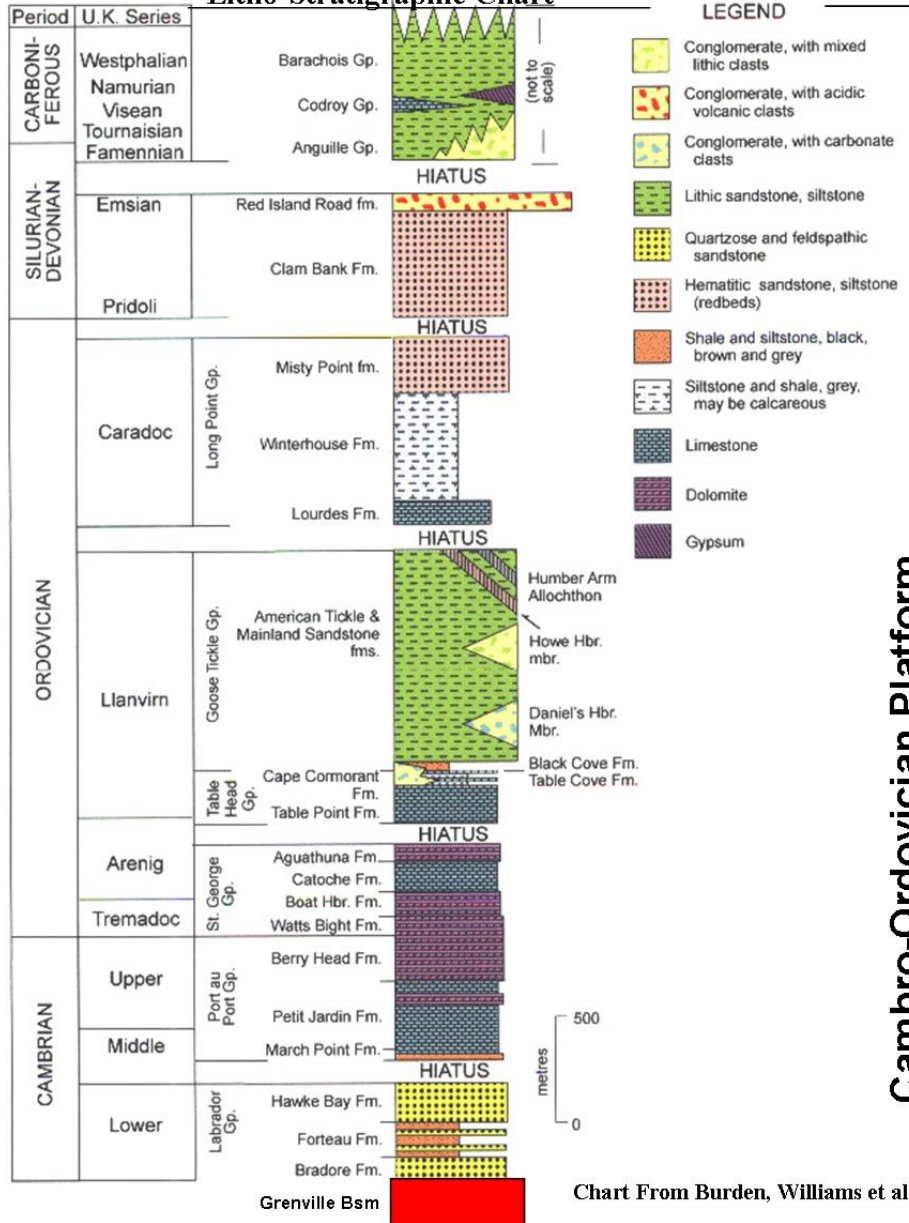
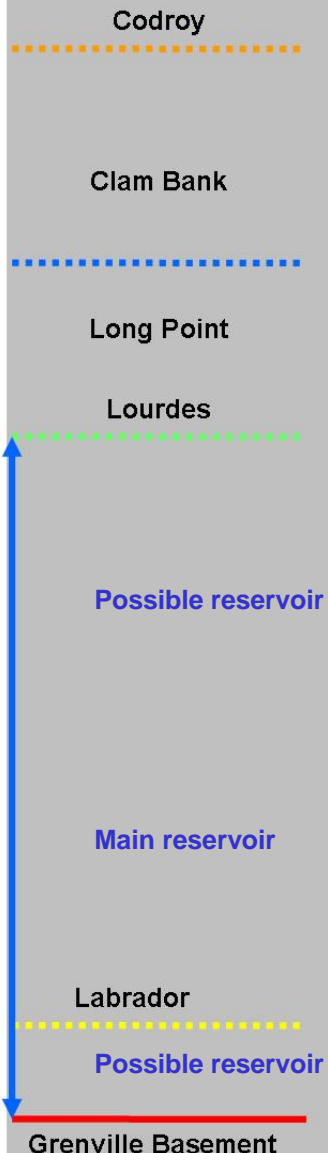


Chart From Burden, Williams et al.

Seismic Markers



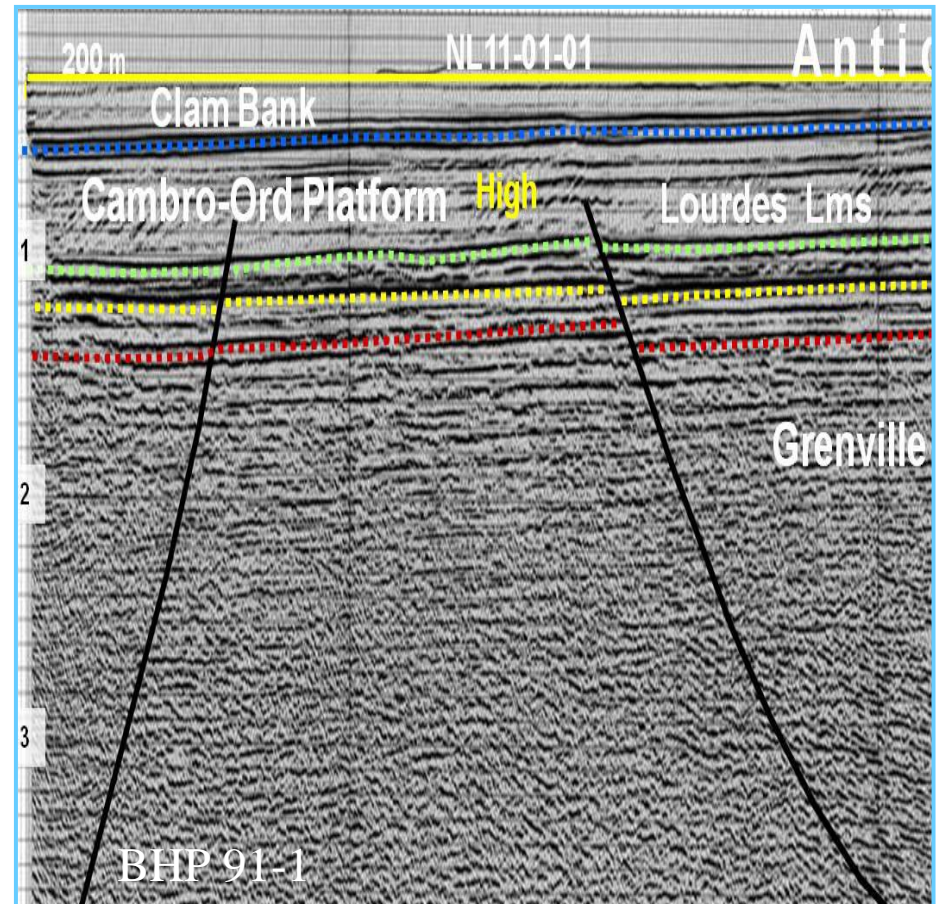
Anticosti Basin Lithostrat Chart & Seismic Markers used in this presentation

Seismic Interpretation

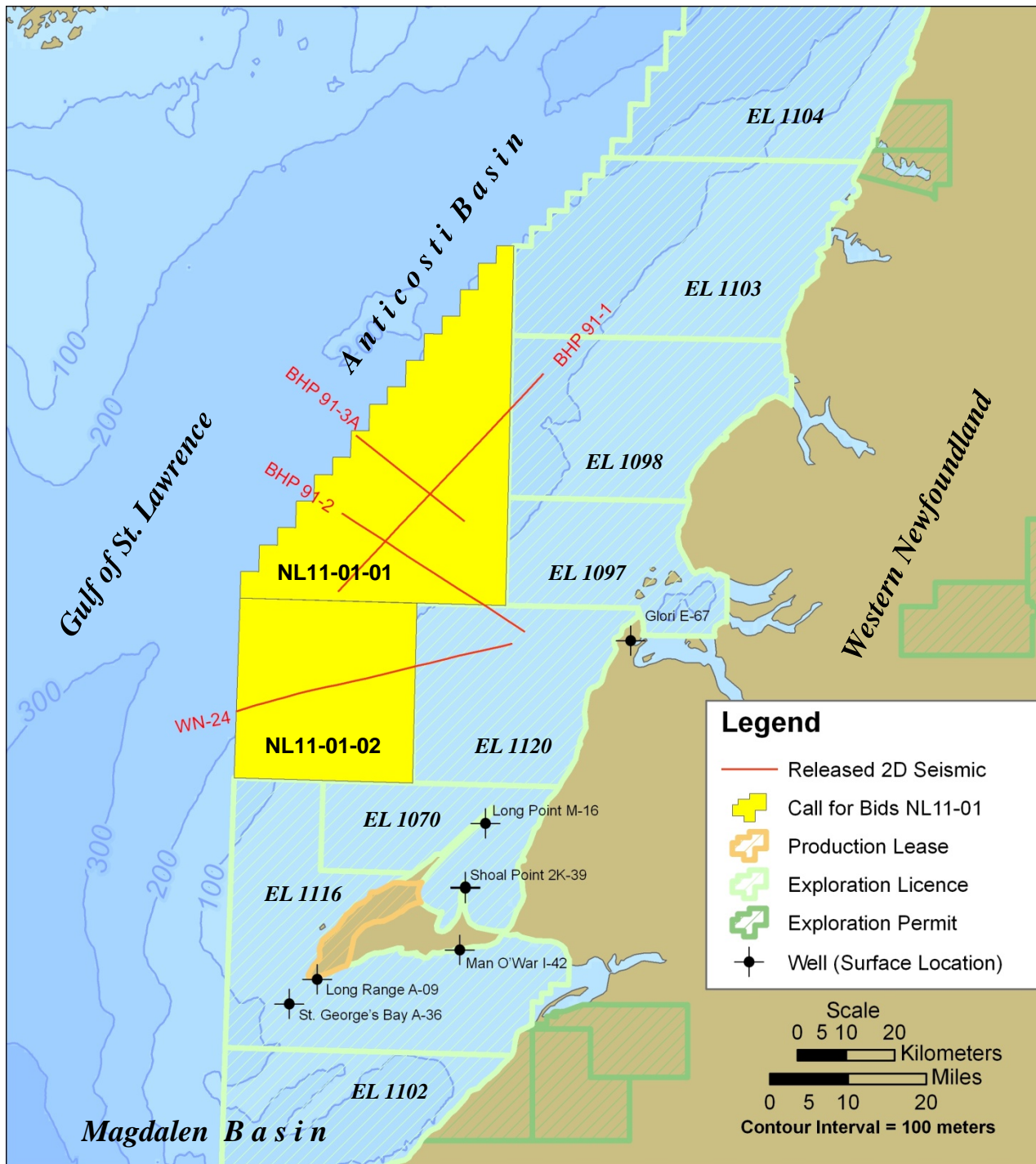
Using the available seismic grid, one major play fairway can be interpreted within the Cambro-Ordovician of CFB NL11-01 Parcels 1 and 2:

The Horst/Rotated Block Play,
present in the two parcels

In both parcels there are locations, where with 2.5-3.5 Km deep wells both the Carbonate Platform and the Cambrian synrift sandstone plays can be tested



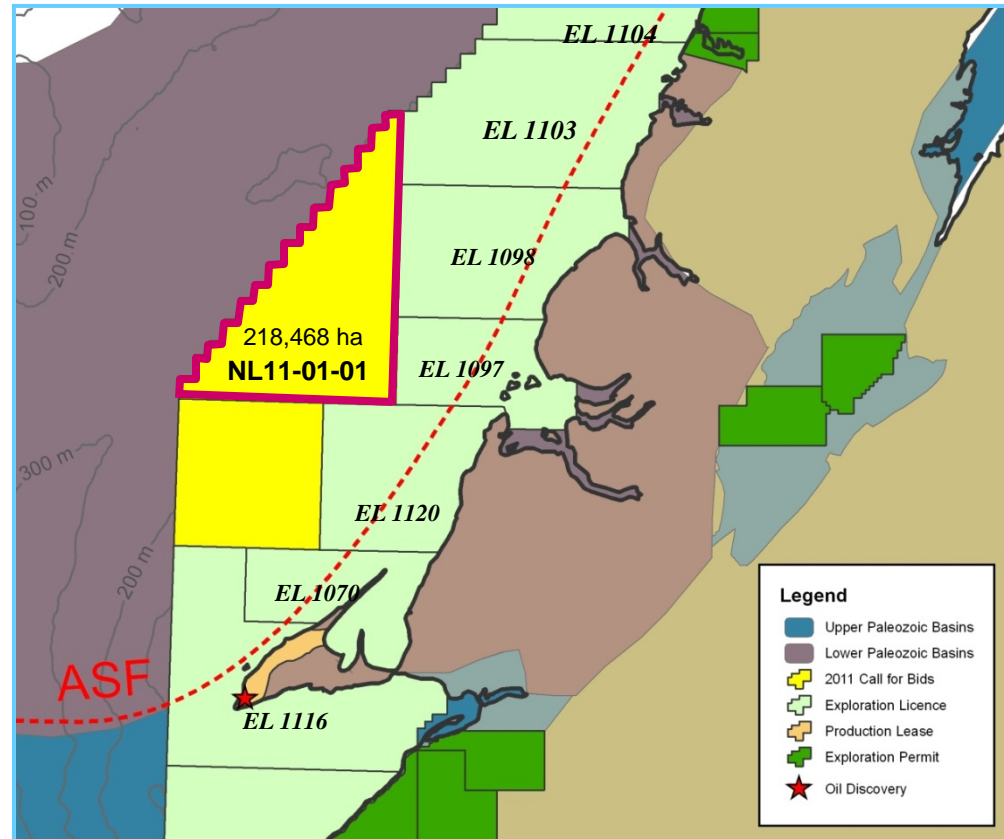
Source: C-NLOPB



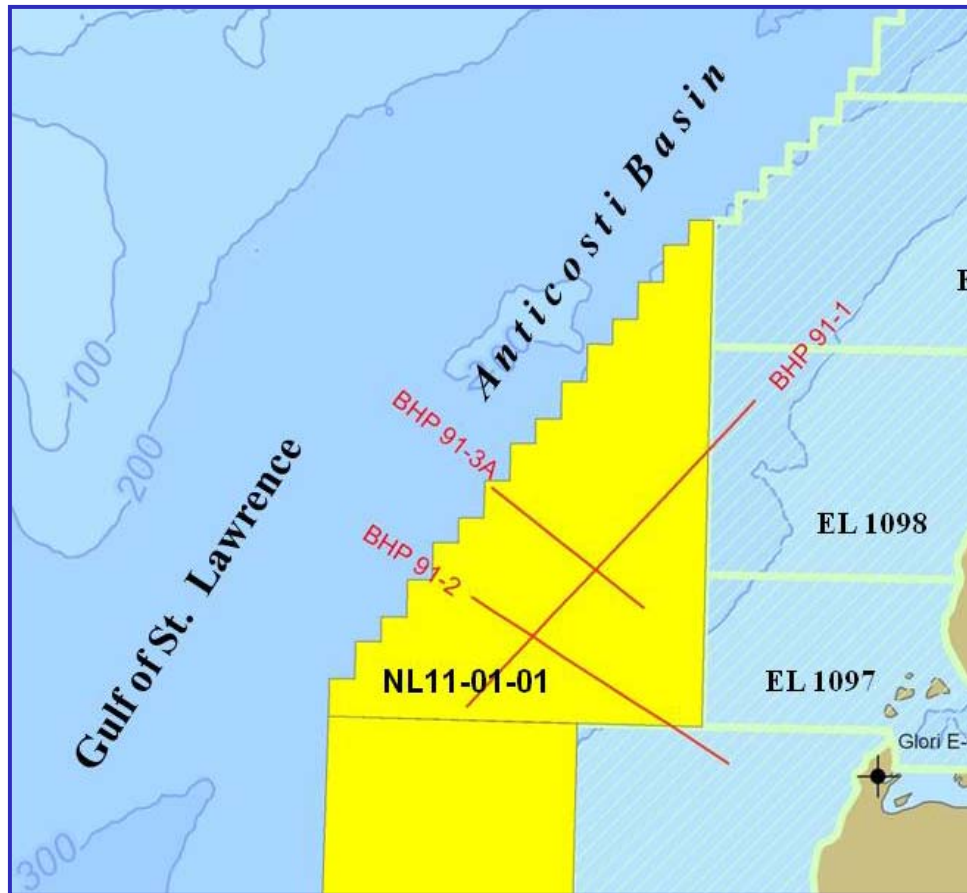
To illustrate this play
 three lines are
 interpreted in
 Parcel
 NL11-01-01
 and one line in
 Parcel
 NL11-01-02

Petroleum Potential of Call for Bids NL11-01 Parcel 1

- Parcel covers 218,468 ha (539,844 acres) in the western part of the Anticosti Basin seaward from ELs 1103, 1098 and 1097
- Largest parcel compared to the present ELs in Western NL
- This shallow water parcel (80-240 m WD) is located close to proven hydrocarbon occurrences on the Port au Port Peninsula, Bay St. George, Parsons Pond and Port au Choix
- Parcel is located on the foreland and foredeep of the Appalachian Fold Belt and comes close to the Appalachian Structural Front

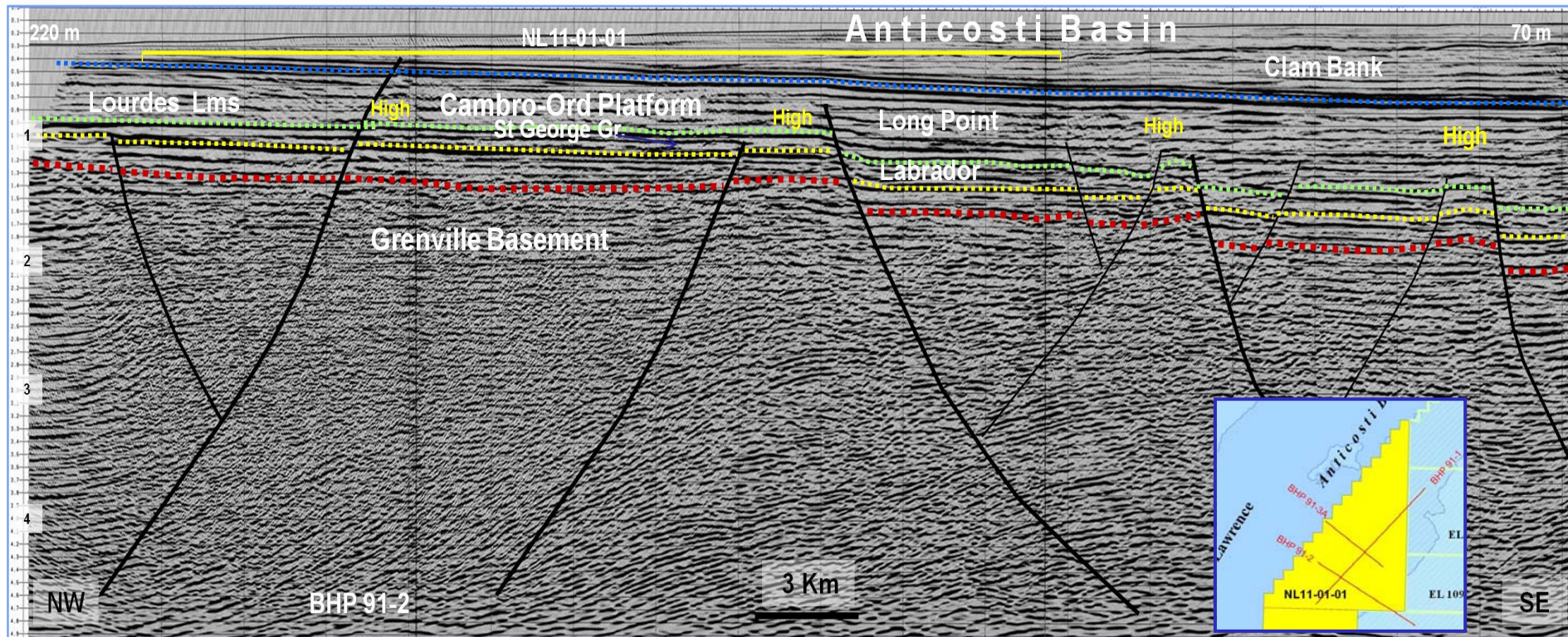


Parcel NL11-01-01



- Parcel NL 11-01-01 seismic coverage can be purchased as digital data from BHP, Exxon, Hunt or data brokers in Calgary and as hard copies for inspection, for the nominal cost of reproduction from the C-NLOPB in St. John's, NL
- Data grids older than 1980s are available from C-NLOPB only as individual seismic line hard copy or in microfiche

Line BHP 91-2

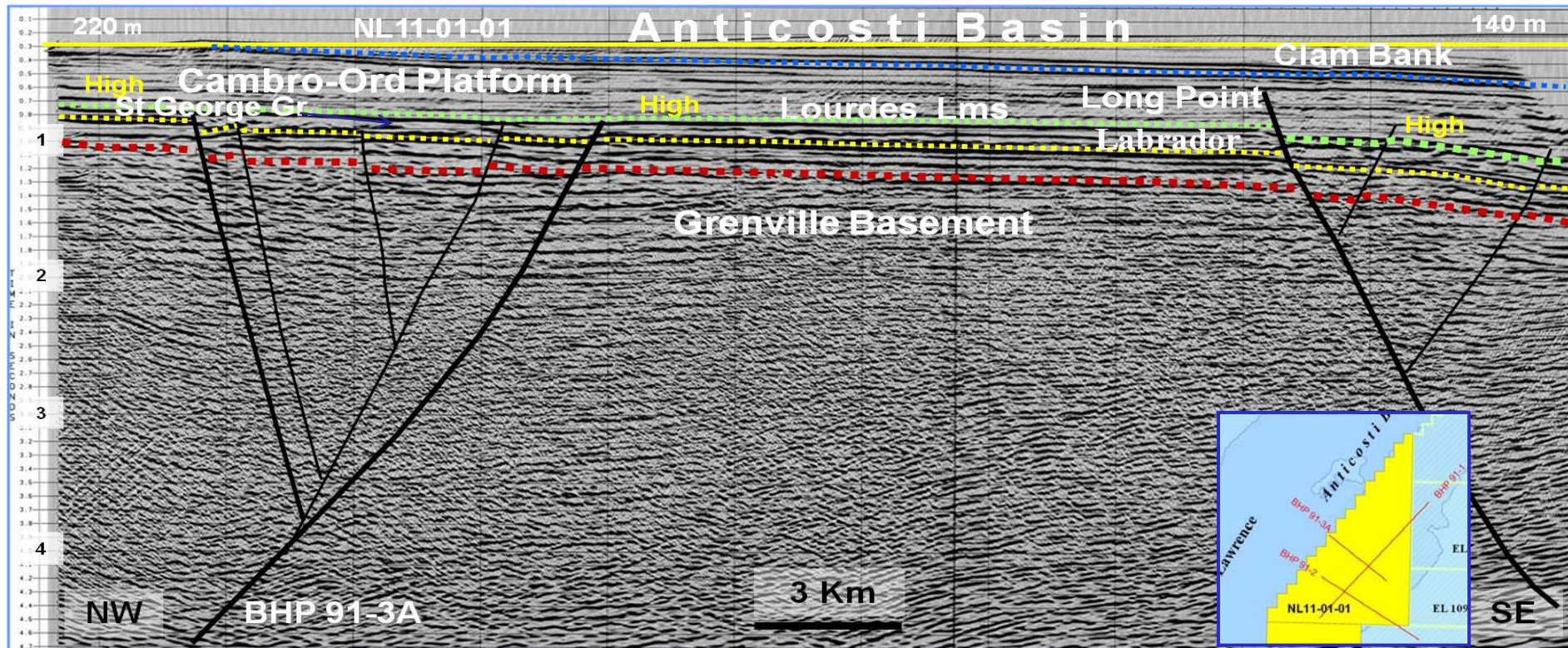


Interpreted dip seismic section BHP 91-2 within parcel NL11-01-01. The Carbonate Platform deepens toward south-east segmented in places by normal faults. One large horst and three rotated blocks are interpreted. The faults segment the synrift sequence (Labrador Fm), the Cambro-Ordovician Carbonate Platform and the Successor Basin sequences (seismic line source: C-NLOPB).

Seismic Line BHP 91-2

- This dip line (NW-SE) is located in the southern part of parcel NL11-01-01, crossing into EL 1170 at its southeastern extremity
- The line is positioned over the Anticosti Basin represented by the foredeep of the Appalachian Fold Belt
- The prerift basement and the Carbonate Platform deepens southeastward and is segmented by deep-penetrating normal faults; two faults also affect the successor basin formations (Long Point and even Clam Bank fms) probably due to late reactivation
- Two major faults with throws larger than 50 m and opposite dips delineate a **large horst at the Basement and Carbonate Platform levels**. This horst is 13 km wide in this section and contains a smaller, higher horst 3 km wide in the southeastern portion of the parcel. This horst may constitute a large structural trap, if closure can be proven by intersecting strike lines
- Potential reservoirs in Cambro-Ordovician including the proven St. George's Group carbonates and sandstones of the Labrador Group, can be tested with a 2500 to 3200 m deep well
- Other Carbonate Platform targets on this line are the possible closed grabens (trap door structures) visible both north and south of the major horst
- Other trapping possibilities are within The Long Point sequence that shows faulting, sedimentary structures and significant amplitude variation

Line BHP 91-3A

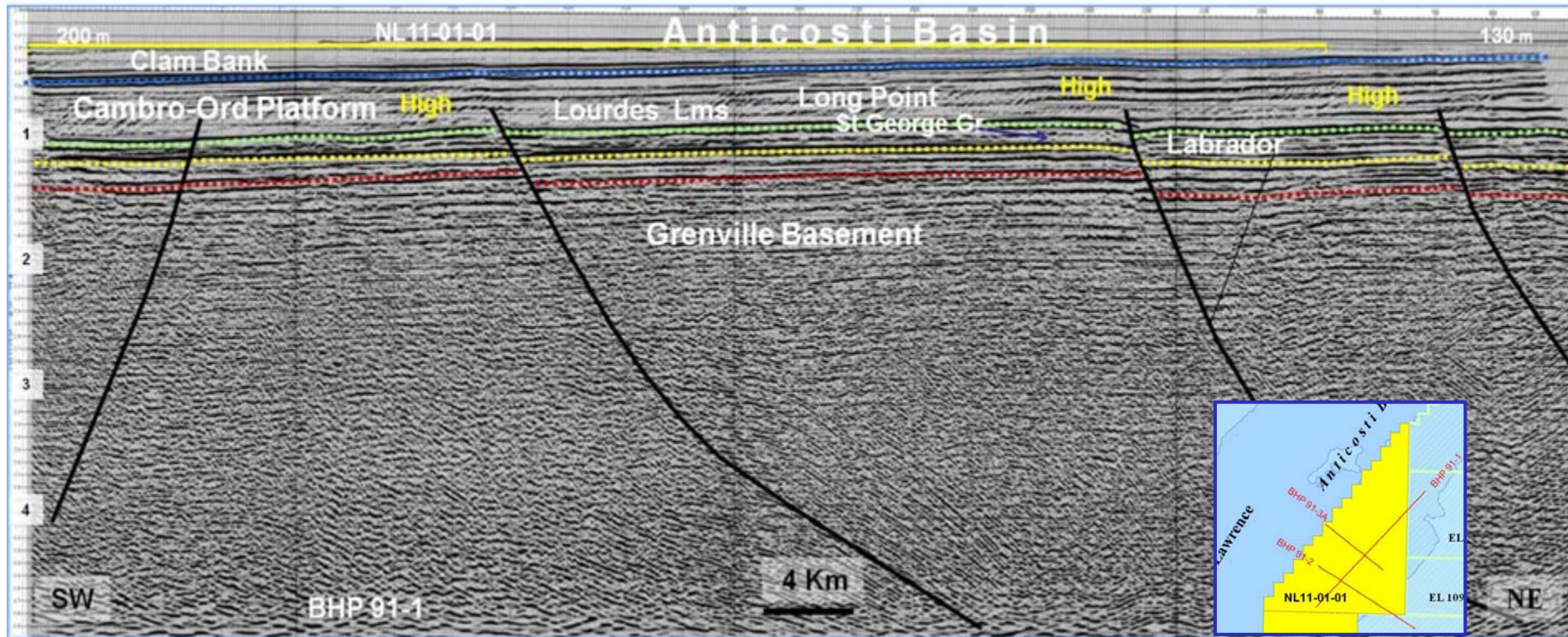


Interpreted dip seismic section BHP 91-3A within Parcel NL11-01-01. The Carbonate Platform deepens toward south-east segmented by normal faults. A very large horst, several rotated blocks and two roll-overs are interpreted. The faults segment the synrift sequence (Labrador Fm), the Carbonate Platform and in places the Successor Basin sequences (seismic line source: C-NLOPB).

Seismic Line BHP 91-3A

- This dip line (NW-SE) is entirely located in the central part of parcel NL11-01-01
- The line crosses the Anticosti Basin represented by the foredeep of the Appalachian Fold Belt
- The prerift basement and the Carbonate Platform deepens southeastward and is segmented by deep-penetrating normal faults; one major fault also affects the successor basin formations (Long Point Fm) probably due to late reactivation
- Two major faults with throws larger than 50 m and opposite dips delineate a **large horst at the Basement and Carbonate Platform levels**. This horst is 15 km wide in this section. If closure can be proven by intersecting strike lines, this horst may constitute a large structural trap
- Potential reservoirs in Cambro-Ordovician including the proven St. George's Group carbonates and sandstone of the Labrador Group, can be tested with a 2500 to 3200 m deep well
- Other Carbonate Platform targets on this line are two possible closed grabens, affected by fan faulting that may form "trap door" structures, both north and south of the major horst. An encouraging characteristic is that these features show rollover into major faults that may map as independent closures
- Another promising structural high extends northerly, out of the seismic section
- Other trapping possibilities are within The Long Point sequence that shows faulting, sedimentary structures and significant amplitude variation

Line BHP 91-1



Interpreted strike seismic section BHP 91-1 within parcel NL11-01-01 (line location in insert). The Carbonate Platform deepens towards the south-west segmented in places by normal faults. One large horst and two rotated blocks are interpreted. The faults segment the synrift sequence (Labrador Fm), the Cambro-Ordovician Carbonate Platform and on places, the Successor Basin sequences (seismic line source: C-NLOPB).

Seismic Line BHP 91-1

- This strike line (NE-SW) is located in the central part of parcel NL11-01-01, and has a small extension towards the north in EL 1098
- The line crosses the Anticosti Basin represented by the foredeep of the Appalachian Fold Belt
- The prerift basement and the Carbonate Platform gently deepens northwestward and is segmented by deep-penetrating normal faults; one major fault also affects the successor basin formations (Long Point Fm) probably due to late reactivation
- Two major faults with throws larger than 50 m and opposite dips delineate a **large horst at the Basement and Carbonate Platform levels**. This horst is 16 km wide in this section. If closure can be proven by intersecting strike lines, this horst may constitute a large structural trap
- Two individual, fault bounded highs are shown in this seismic section
- Potential reservoirs in Cambro-Ordovician including the proven St. George's Group carbonates and sandstones of the Labrador Group, can be tested with a 2500 to 3200 m deep well
- Other Carbonate Platform targets on this line are two possible closed grabens, located north and south of the major horst
- Other trapping possibilities are within The Long Point sequence that shows faulting, sedimentary structures and significant amplitude variation

Parcel NL11-01-01

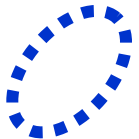
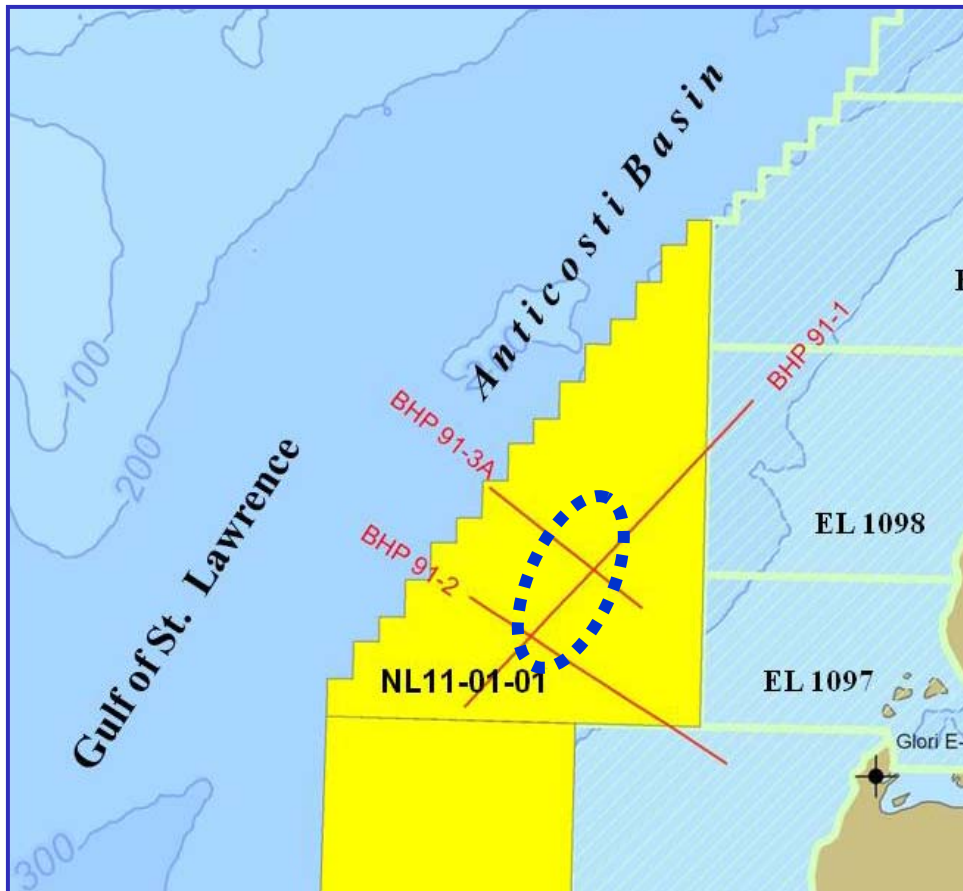
Summary

Structural leads:

- Large horst in south central portion of the parcel
- Seven local highs interpreted on three lines
- Possible trap door play with partial roll-overs visible on line BHP 91-3A

Stratigraphic leads:

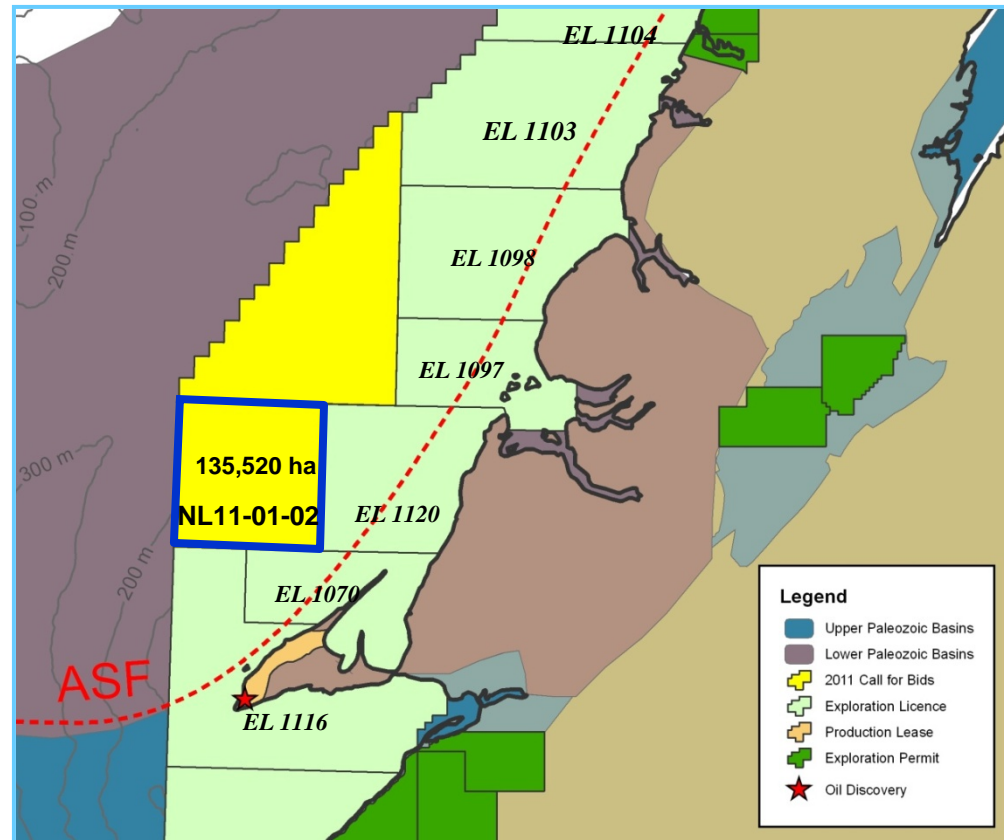
- Karst porosity developed in Aguathuna Formation
- “Granite wash” type play in Labrador Fm sandstone
- Porosity development in Successor Basin beds



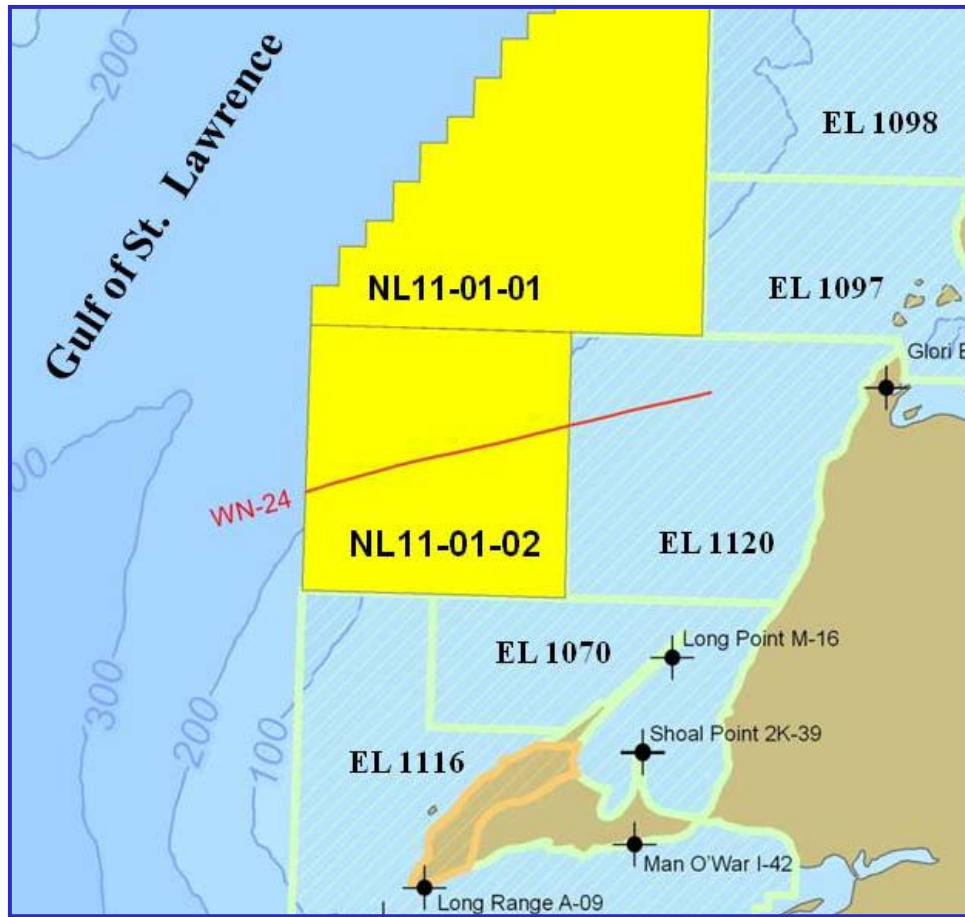
= Possible closed horst feature in Parcel NL11-01-01

Petroleum Potential of Call for Bids NL11-01 Parcel 2

- Parcel covers 135,520 ha (334,876 acres) in the western part of the Anticosti Basin seaward from ELs 1120, and north of ELs 1070 and 1116
- This shallow water parcel (30-240 m WD) is located close to proven hydrocarbon occurrences on the Port au Port Peninsula
- Parcel is located on the foreland and foredeep of the Appalachian Fold Belt and comes close to the Appalachian Structural Front

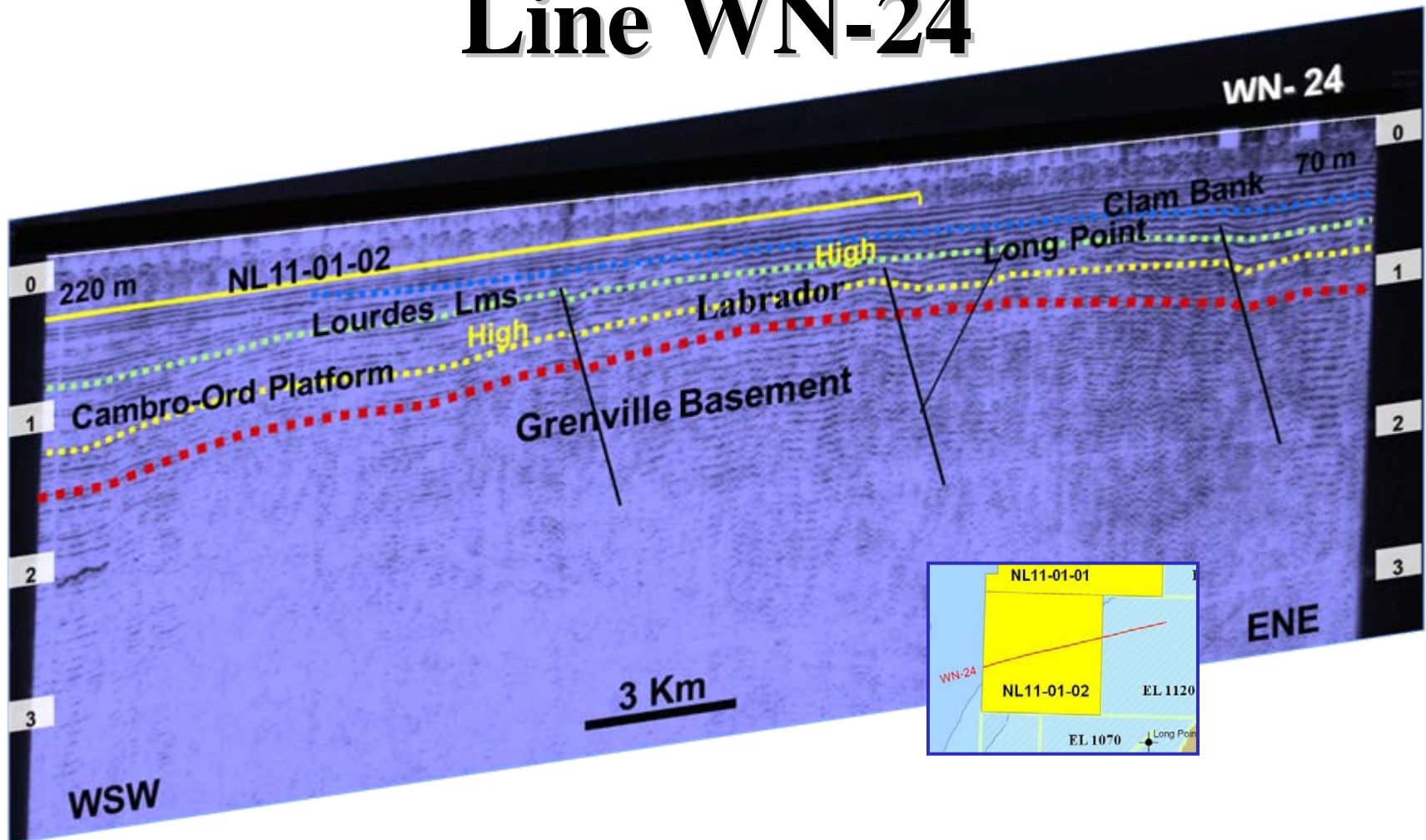


Parcel NL11-01-02



- The present seismic coverage of this parcel is generally poor
- Most of the data in this parcel is older than 1990s and is available from C-NLOPB only as hard copy of seismic line or in microfiche
- Certain lines and portion of lines in the parcel can be purchased as digital data from oil companies or data brokers in Calgary

Line WN-24

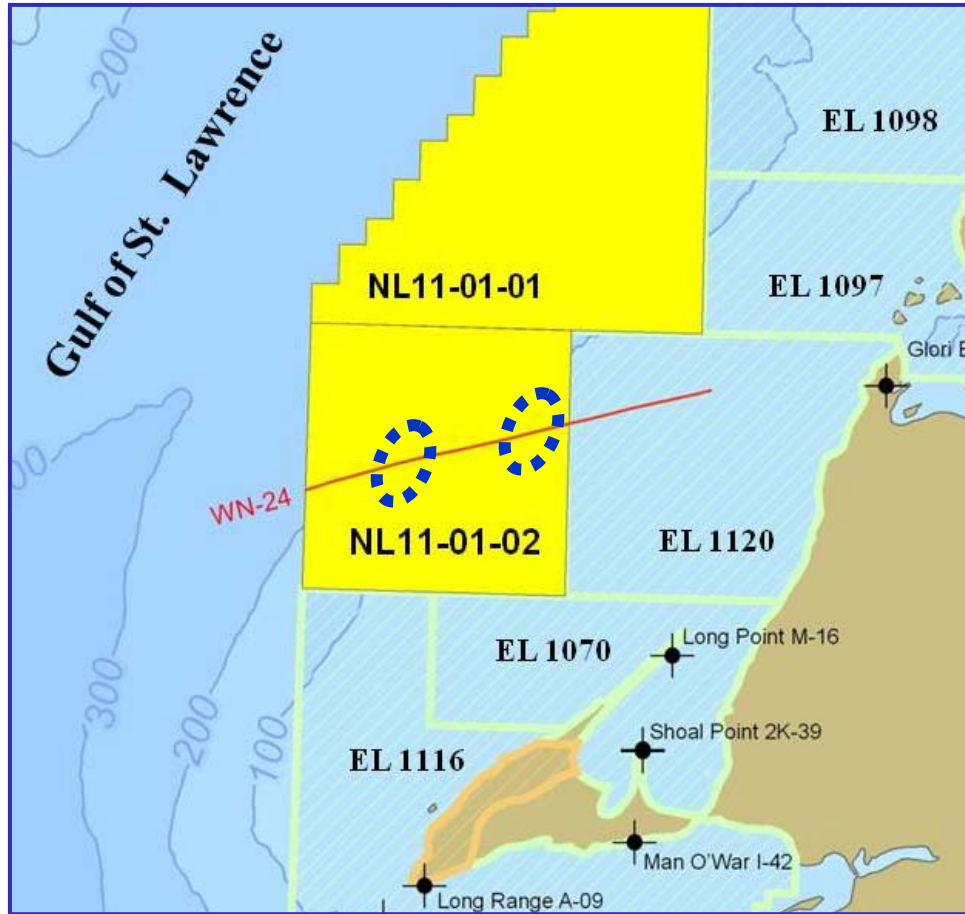


Interpreted seismic section WN-24 within parcel NL11-01-02 (line location in insert). The Carbonate Platform deepens both eastward and westward and is segmented in places by normal faults. Two large rotated blocks are interpreted. The faults segment the synrift sequence (Labrador Fm), the Cambro-Ordovician Carbonate Platform (seismic line source: C-NLOPB).

Seismic Line WN-24

- This arbitrary line (WSW-ENE) is located in the central part of parcel NL11-01-02, and has an extension toward the east in EL 1120
- The line crosses the Anticosti Basin within the foredeep of the Appalachian Fold Belt
- A basement ridge is located in the central part of the line
- The prerift basement and the Carbonate Platform deepens both northwestward and southeastward and is segmented by deep-penetrating normal faults; only some of the faults affect the Long Point Fm probably due to late reactivation
- Two major faults with throws larger than 50 m and opposite dips delineate two large rotated **blocks at the Basement and Carbonate Platform levels**. These blocks are 10 and 7 km wide and have highest possible fault dependent closures toward their eastern flanks. If closures can be proven by intersecting strike lines, these fault bound blocks may constitute large structural traps
- Potential reservoirs in Cambro-Ordovician including the proven St. George's Group and sandstones of the Labrador Group can be tested with a 2500 to 3500 m deep well
- Certain litho-stratigraphic configurations, may allow the formation of stratigraphic traps in the Long Point group (Clam Bank Gr is too shallow)

Parcel NL11-01-02



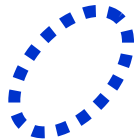
Summary

Structural leads:

- Two large rotated blocks in central portion of the parcel
- Two 3-5 km local highs interpreted on WN-24 line
- Lack of data precludes interpretation of other leads

Stratigraphic leads:

- Karst porosity developed in Aguathuna Formation
- “Granite wash” type play in Labrador Fm sandstone
- Porosity development in Long Point Gr beds



= Possible closed rotate block in Parcel NL11-01-02

Comments on Seismic Data

- Retrieving the original field data and data processing to pre-stack depth migration of older lines is needed to better image leads in the two parcels
- New acquisition of 2D reflection data is necessary to better delineate structural plays such as horsts and rotated blocks and investigated stratigraphic anomalies in carbonate and clastic sequences

Prospects and Leads

- The main hydrocarbon play in the area is structural: it involves porous Lower Paleozoic carbonates, dolomites or sandstones (Goose Tickle Sandstones & Limestone, Aguathuna Fm, Watts Bight, Catoche Dolomite and various Lower Paleozoic clastics) within large fault bounded highs. This play may have a stratigraphic component
- Several fault dependent closures can be mapped within parcels 1 and 2; closures are capable of holding several hundreds million of barrels of oil or several Tcf of natural gas
- Overlying Silurian-Devonian sandstones provide secondary targets
- Source rocks may be found in the synrift sequence above the Grenville basement and in the shales and carbonates within the Foredeep sequence. Source rocks are abundant within the flysch and overthrust sequences of the Appalachian Structural Front (situated east of the parcels)
- Seismic amplitude variations are seen in the Lower – Middle Paleozoic sequences. The variation of seismic amplitude along the Carbonate Platform markers and amplitude anomalies around faults may indicate flow of hydrothermal solutions and dolomitization

Prospects and Leads

- Good seals such as tight sandstones and carbonates, and shales are present in both parcels
- Several large petroleum leads within the Carbonate Platform were mapped by companies active in the area in the 1980s and by Mobil in the early 1990s
- A regional Mobil seismic interpretation report and annexed time structural and isochron maps at several horizons for area including CFB NL11-01, is available from the C-NLOPB archive and can be inspected and copied for bid evaluation
- Mobil relinquished its offshore ELs without developing the leads into prospects and without drilling any of them
- Main geological risks on these parcels are the quality of the reservoir and access to sufficient source rock. These risks should be mitigated by the large size of the structural traps identified in these parcels

6. Discussion

- Exploration in the Gulf of St. Lawrence region is still at a very early frontier stage
- The Anticosti Basin in Western Newfoundland is close to industrially developed regions of Central Canada, Eastern United States and Western Europe
- Numerous oil and gas prospects and leads identified offshore with modern seismic data are still waiting to be explored and drilled
- Good 1990s regional 2D grid exists over the Anticosti Basin in Western Newfoundland. Some lines were reprocessed, but denser data acquisition is needed
- Nine ELs are active offshore Western Newfoundland, two have been extended for a year (January 2012) and several are approaching Period I drill or drop date
- Parcels NL11-01-01 and -02 are located in the Anticosti Basin, include the foredeep and are 15-25 km close to the Triangle Zone of the Appalachian Fold Belt

Discussion (Cont.)

- McCully field, in New Brunswick (about 1 Tcf gas in place), recent Haldimand oil discovery in Quebec, other discoveries in New Brunswick, USA north-eastern basins and Quebec's St. Lawrence Lowlands provide encouragement for similar discoveries in Western Newfoundland
- Large gas discoveries in Ordovician carbonates have also occurred offshore Labrador (Gudrid - 924 Bcf recoverable, Hopedale - 105 Bcf recoverable), with flow rates of up to 28 MMcfd
- CFB NL11-01-01 and -02 parcels are very large when compared with a Gulf of Mexico standard block (94 and respectively 58 times larger)
- Parcels are in a region with large extensional and inversion traps, known reservoirs, mature source rocks and proven migration paths
- Parcels contains multiple targets within Paleozoic carbonate and sandstone reservoirs at depths of 2500-3500 m that can be tested by using jack-ups or semi-submersible rigs
- Offshore prospects have fully risked recoverable resource estimates of between 100 to 200 million barrels (Atkinson and Wright, 2006) and 1- to 3 Tcf natural gas

Discussion (Cont.)

- New mapping with reprocessed and newly acquired data may lower the geological risk
- Location of prospects in a shallow water environment (70-200 m water depth) with less severe climate certainly lowers the economic risk
- Seismic identification of porosity and gas filled porosity within older carbonate sequences can be challenging but it is occurring in areas such as New York State and the Western Canadian Sedimentary Basin. The technique is tentatively applied to the Old Harry structure offshore Western Newfoundland
- Geological risk associated with the Paleozoic is considered higher with regard to hydrocarbon migration, oil biodegradation, and lateral seal
- This risk can also be minimized by regional evaluation, dynamic modelling of the petroleum system, and the use of high quality seismic data, which can allow for the direct detection of porosity and fluid type
- Onshore deep wells drilled in 2009-2010 in Western Newfoundland and results of Shoal Point 39-39 and Port au Port ST#3, when released, will provide additional valuable information for evaluation of the Parcels NL11-01
- Metocean conditions are fair; the ocean has a one-year ice cover for about 3 months (February to early May)

Discussion (Cont.)

- Cost of an offshore well in the Gulf of St. Lawrence would likely be in the range of Can \$30 - \$40 million depending on the water depth, depth to the target and distance from shore
- Fields can be developed using tie back to shore processing facility, gravity based structures, bottom founded caisson, sub-bottom completion with FPSO (Atkinson and Wright, 2006; Wright, 2007; Foote 2008 and 2009; Hicks, 2009; Klassen and Johnson, 2010)
- Royalty regime is internationally competitive and places offshore NL in the middle to-upper tier of world's favorable areas for petroleum exploration and production
- Canada has a stable political and financial system and has a long tradition in oil and gas exploration
- The Province obtains 27.5% of the nominal GDP from the oil and gas industry and is actively encouraging exploration of offshore areas especially in Western Newfoundland
- There is a robust regulatory regime in the offshore area including HS&E. Provincial Government encourages offshore exploration, however safety of workers and protection of environment are paramount

7. Conclusions

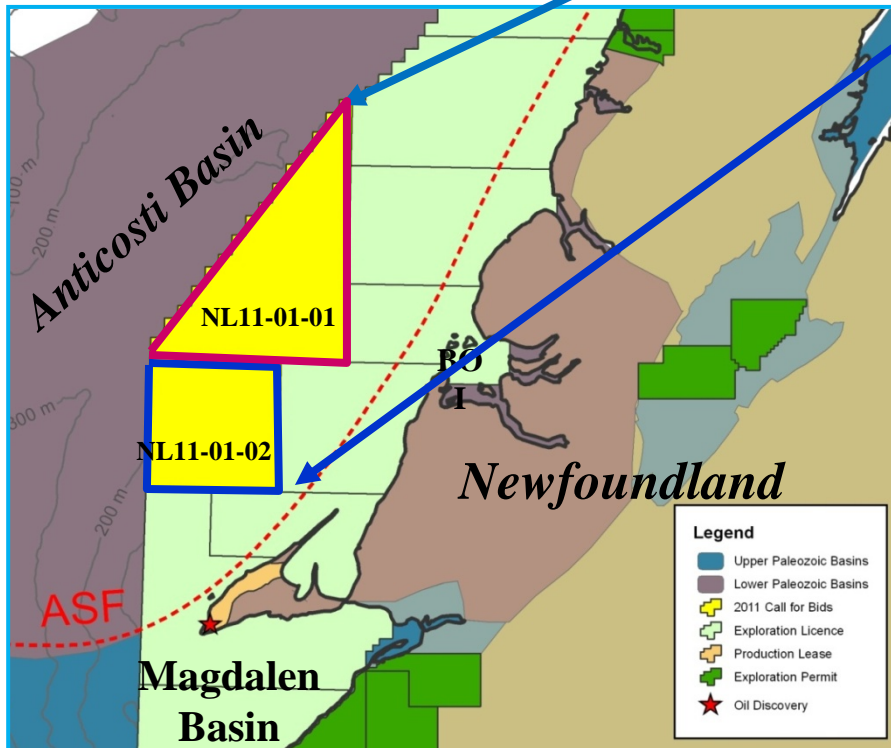
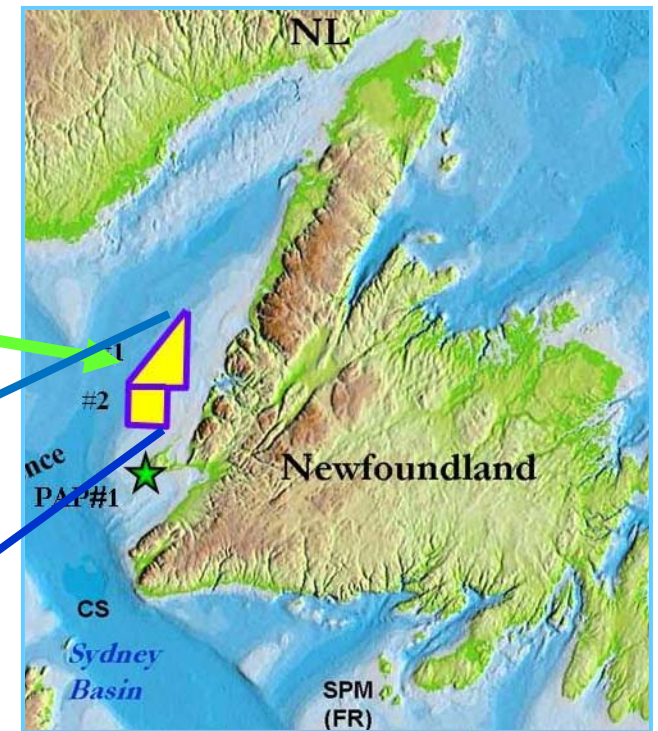


Conclusions

- Two large parcels located offshore Western Newfoundland, at the approximate latitude of the town of Corner Brook are available for licensing in the C-NLOPB's Call for Bids NL11-01 which **closes on November 15, 2011, 4 p.m. NL time**
- Parcels contain Cambro-Ordovician Carbonate Platform rocks of the Anticosti foredeep basin and synrift Cambrian formations above the extended Grenville Basement
- **This basin has all the prerequisites to become an important petroleum province**
- Carbonate sequences of similar age and setting were found to be productive elsewhere in the North American Appalachian trend
- Closer to the Call for Bids area, Paleozoic carbonate rocks flow-tested oil and gas at the Port au Port #1 discovery well (presently known as Garden Hill Field)
- Large fault-bounded blocks such as horsts and tilted blocks, at the Cambrian synrift and Cambro-Ordovician Carbonate Platform levels provide sizable targets on the CFB parcels
- Platform sequence is overlain by predominantly clastic sequences of the Long Point and Clam Bank groups which may provide additional reservoir potential in stratigraphic and structural traps

Conclusions (Cont.)

- Main source rock for the area is the Green Point shale located deeper and eastward within the Appalachian thrust sequence. This shale may provide lateral charge to the foreland basin structures
- Other potential source rocks such as the autochthonous Cape Cormorant/Black Cove and the McCasty shales are likely to be present in the foreland basin and in the foredeep
- Both source and reservoir rocks may exist within the lesser known, synrift sequences present under the Cambro-Ordovician Carbonate Platform
- Good quality and relatively dense 2D seismic coverage is available in Parcel 1 to image and map hydrocarbon traps within the Carbonate Platform and Carboniferous successor basin
- Less seismic coverage exists in Parcel 2, and therefore the parcel would greatly benefit from modern data acquisition
- Several large leads were identified on the seismic lines introduced in this presentation
- All these leads are located in water depths varying between 70 m and 200 m. The leads are located at distances of 40 to 70 km from the shore line



- Two large parcels in the Appalachian foreland (NL11-01-01 parcel is the largest of the Western NL CFB blocks posted in the past 8 years)
- Proven Petroleum systems
- **Call for Bids closes on November 15, 4pm, NL time**

Conclusions (Cont.)

- The half dozen + leads located in parcels NL11-01-01 and -02 are situated in a practically unexplored basin, close to NE American and Canadian markets
- Recognized risks in regard to reservoir quality, source rock and migration are mitigated by the presence of very large undrilled features
- Seismic data indicates that reservoir and source rocks are preserved at depth in large rotated fault blocks within the foreland basin
- Drilling thus far both onshore and offshore has only occurred within the more disturbed rocks of the thrust belt while the essentially undisturbed rocks of the foreland basin have never been drilled offshore Western Newfoundland
- These parcels are very large exploration blocks situated in shallow water suitable for jack up rigs, in an area where drilling can be performed year-round
- Estimated sizes of unrisks reserves are up to several billion barrels of oil or several Tcf of natural gas, that may be present in the structural leads identified in the area
- These parcels provide excellent petroleum resource prospects to seasoned operators with available funds for new seismic data collection and exploration drilling in a truly North American under-explored basin

Thank You for your Attention!

