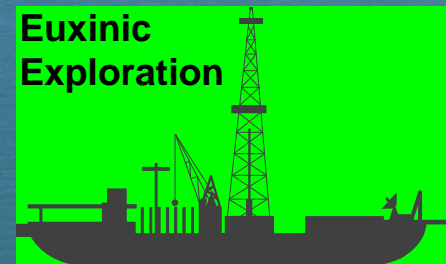


Petroleum Exploration Opportunities in Jeanne d'Arc Basin, Call for Bids NL10-01

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Euxinic Exploration**

**On Behalf of NL DNR
October 2010**





Acknowledgements

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- This work could not have been performed without information kindly provided by GSC Atlantic, Government of Newfoundland and Labrador Department of Natural Resources and C-NLOPB



★ = approximate position of CFB NL10-01-01 and -02 Parcels

Call for Bids (CFB) NL10-01

- **Two Bid Parcels.** Call for Bids NL10-01 contains two large, offshore parcels located in the Jeanne d'Arc Basin (JDB) on the Northern Grand Banks:
 - NL10-01-01 of 139,617 hectares (345,000 acres), located in 120-230 m water depth within the north-eastern Jeanne d'Arc Basin
 - NL10-01-02 of 29,783 hectares (73,595 acres), located in 100-150 m water depth within the central-eastern Jeanne d'Arc Basin
- **Call for Bids Closure.** The bid for these will be concluded on **November 17, 2010 at 4 p.m. NL time**
- **Minimum Bid:** **CAN \$ 1,000,000 (one million)** for each of Jeanne d'Arc parcel

More information on this Call for Bids can be found at:
http://www.cnlopb.nl.ca/news/pdfs/cfb10_01.pdf

Call for Bids NL10-01

- **Jeanne d'Arc Is An Oil Prolific Basin.** This Mesozoic-Tertiary basin produced 51.65 million barrels or 285,362 bopd from the Hibernia, Terra Nova and White Rose giant oil fields and North Amethyst satellite field, during the first 6 months of 2010
- **Exploration and Production Activity.** There are 14 active Exploration Licences (one consolidated EL) and 45 SDLs (some covering the same field) in the Jeanne d'Arc Basin and environs
- **New field in Production.** In May 2010 the North Amethyst field started producing and it is anticipated to rise to peak of approximately 37,000 bopd
- **Strategic Environmental Assessment (SEA).** The Board has previously conducted a SEA in the Call for Bids NL10-01 area

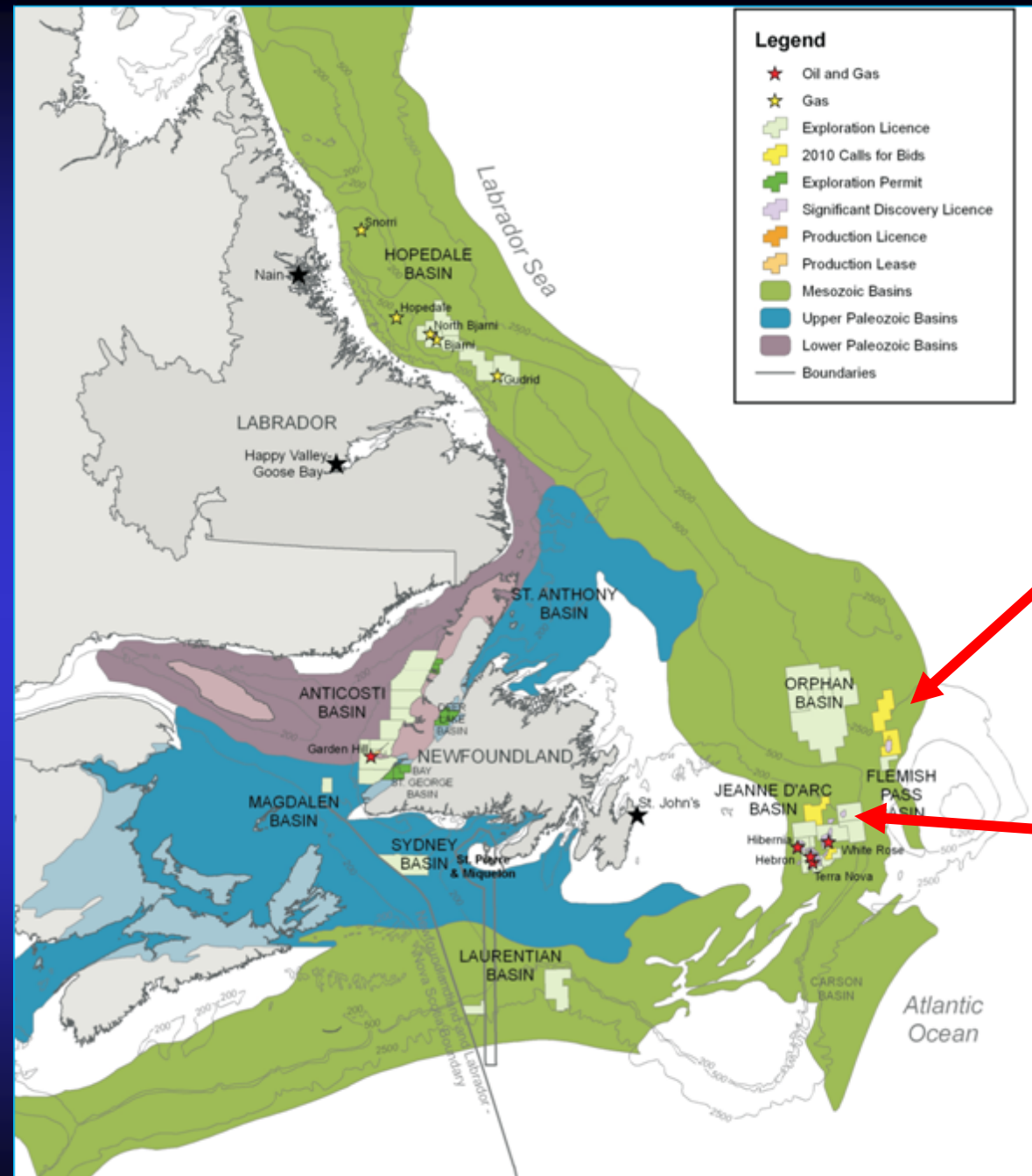
Presentation Content

- 1. Introduction**
- 2. Exploration and Development Background**
- 3. Geology Overview of the Mesozoic Grand Banks and Environs**
- 4. Geology Summary of the Jeanne d'Arc Basin**
- 5. Petroleum Geology of the Jeanne d'Arc Basin**
- 6. Petroleum Potential Call for Bids NL10-01**
 - Parcel 01**
 - Parcel 02**
- 7. General Discussion**
- 8. Conclusions**

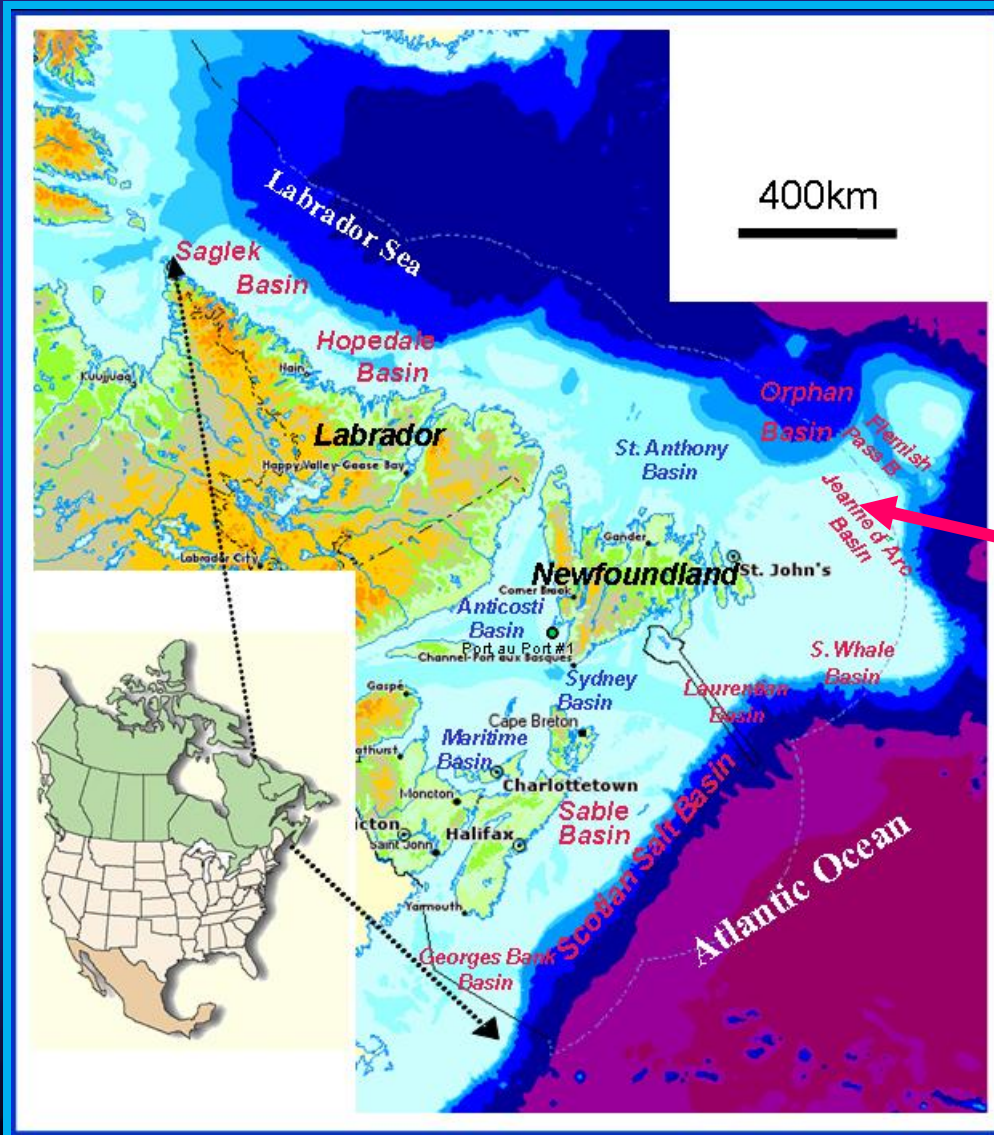
CFB 2010: Three Licensing Rounds in Three Basins

- CFB NL10-02 and
- CFB NL10-03
Flemish Pass and
Orphan Basin
- CFB NL10-01
Jeanne d'Arc Basin

*NL = Province of
Newfoundland and
Labrador, Canada*



Atlantic Canada Offshore Basins



Blue = Paleozoic Basins

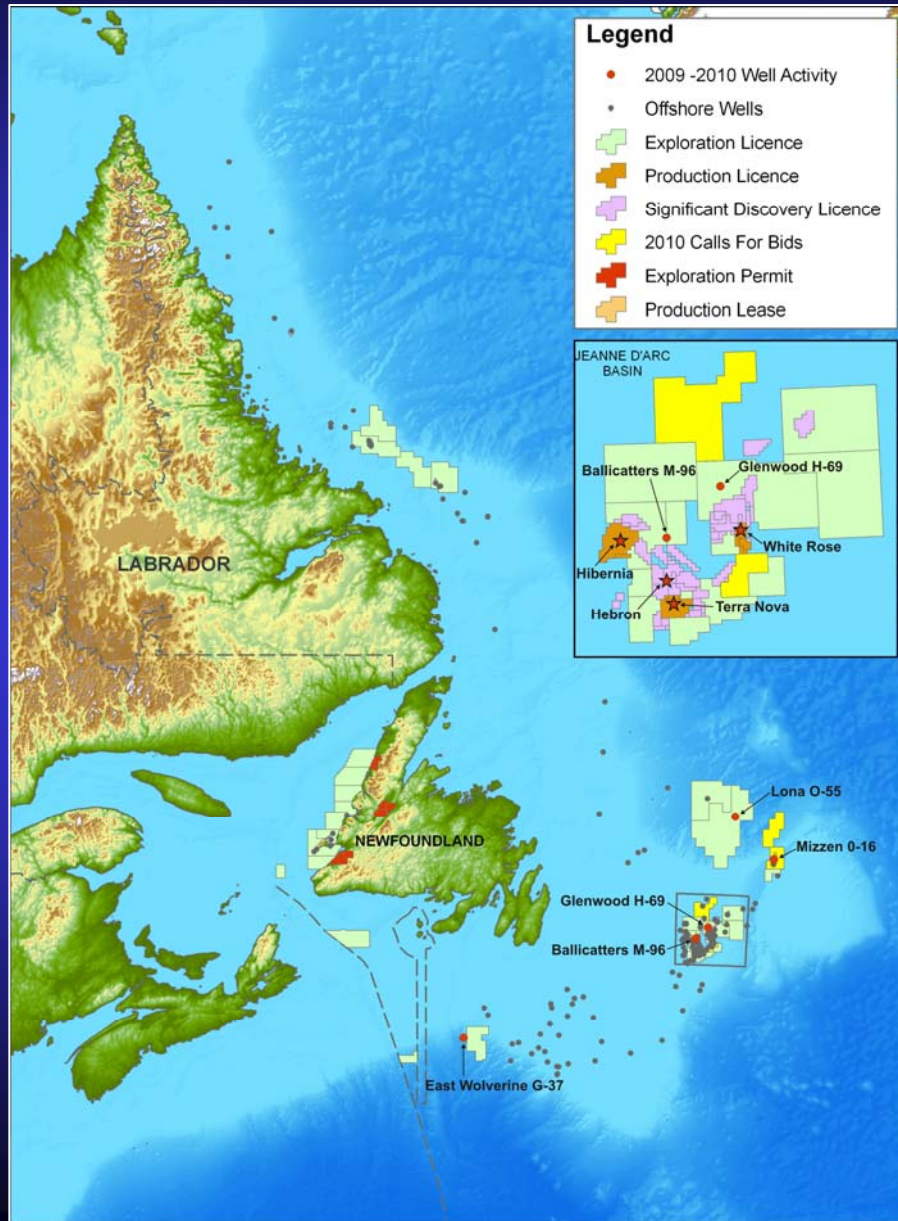
Magenta = Mesozoic Basins

NL Mesozoic Basins

- Laurentian Basin
- S. Whale Basin
- Jeanne d'Arc Basin
- Flemish Pass Basin
- Orphan Basin
- Hopedale Basin
- Saglek Basin

Yellow = Mesozoic Basins with ongoing exploration

Newfoundland and Labrador E&P Activity



Wells Drilled (to 2010)

Exploration (Total)	227
Offshore	145
Onshore	82
Delineation	53
Development	161

Discoveries

Oil	19
Gas	7

Current Holdings NL

Exploration Licences (ELs)/Permits (EPs)	42
Significant Discovery Licences (SDLs)	49
Production Licences (PLs)/Leases	9

2010 Call For Bids Jeanne D'Arc Basin

Parcels NL10-01-01 & NL10-01-02

- This is a power point presentation of the petroleum potential of Parcels NL10-01-01 & NL10-01-02 located in shallow water in Jeanne d'Arc Basin and offered for bid at the 2010 C-NLOPB call for Bids as follows:
 - **Parcel NL10-01-02 (Parcel 2)** is situated within the Trans-Basin Fault Zone and the “Golden Triangle” formed by the Hibernia-Terra Nova-White Rose oil fields (Enachescu, 1987 and 1988)
 - **Parcel NL10-01-01 (Parcel 1)** is situated in the northern Jeanne d'Arc Basin, north and east of the large Flying Foam structure and within an area with salt diapirs mini basins and on the Central Ridge

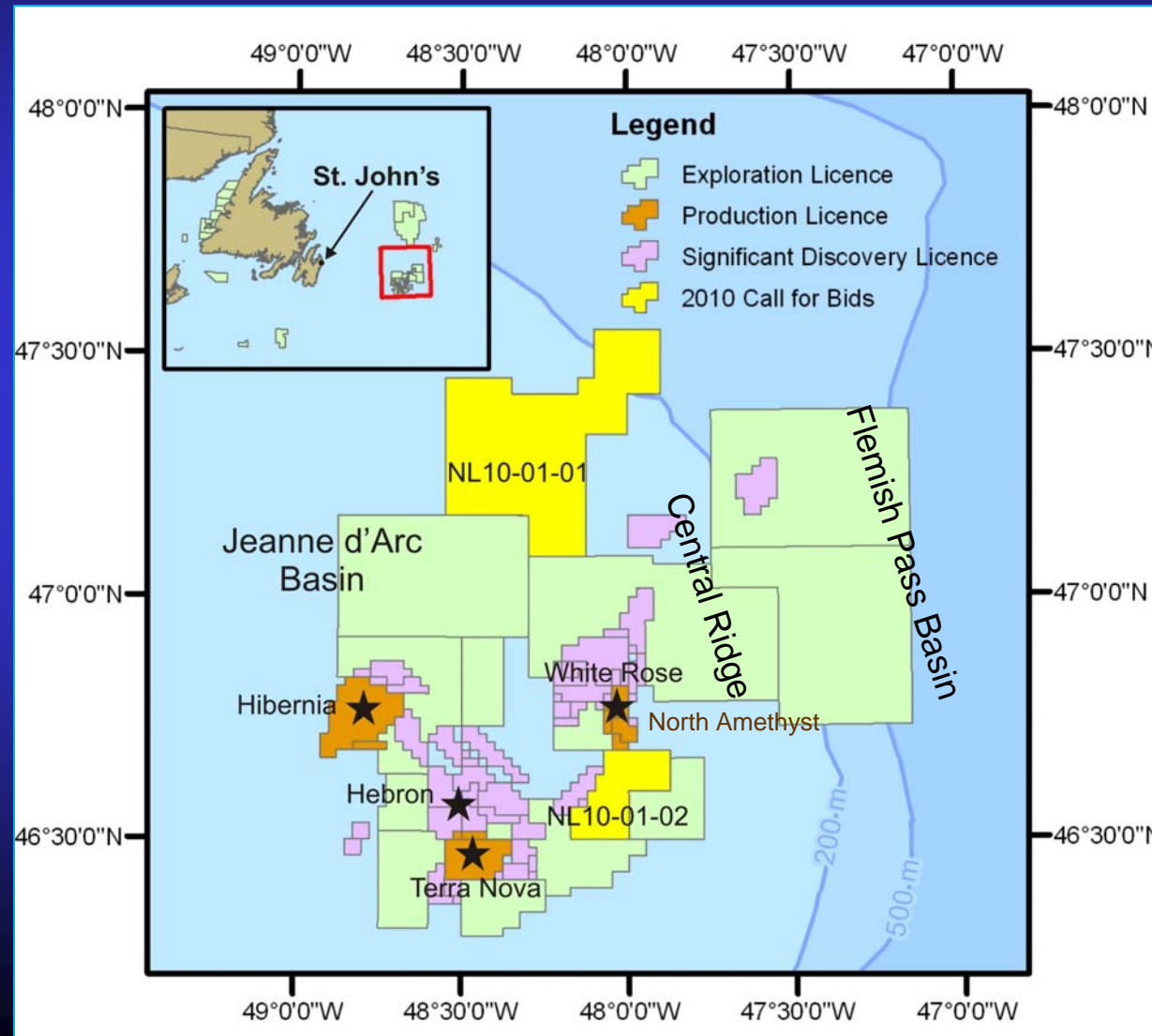
Observation. References introduced in this power point are listed in Section 2 of this presentation and are also contained in the earlier Jeanne D'Arc Basin Call for Bids reports posted on the website:

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

1. Introduction

- CFB NL10-01-01&02 parcels offered in the 2010 Call for Bids are two of the few remaining unlicensed offshore blocks located in the central part of the Jeanne d'Arc Basin
- The parcels are located immediately northwest and south respectively of the White Rose field Production Licence (PL 1007)
- In the past, several SDLs were awarded east of Parcel NL10-01-01 and several PLs and SDLs are located north, west and south of Parcel NL10-01-02
- The parcels also lie adjacent to several Exploration Licenses (ELs) where there is ongoing exploration activity consisting of acquisition of 3D seismic reflection data and exploration drilling; some of these ELs were validated by drilling and are in the second exploration term

Jeanne D'Arc Basin Call for Bids



- **CFB NL10-01** consists of two large parcels
- Both parcels are located in shallow waters of JDB on the Grand Banks of Newfoundland
- **Call for Bids closes November 17, 2010 at 4 p.m. NL time**

2. Exploration and Development Background

- **NL Petroleum Production**
- **Emergence of Nalcor Energy**
- **Large Mesozoic Under Explored Basins**
- **Grand Banks Exploration History**
- **Recommended References**
- **Newfoundland and Labrador Petroleum Industry**
- **Recent E&P Activity in Atlantic Mesozoic Basins**
- **Recent Jeanne d'Arc Basin and Environs Licensing Rounds**

NL Petroleum Production

- Jeanne d'Arc Basin fields - Hibernia, Terra Nova and White Rose - developed in 80-110 m water are some of the largest offshore producing fields in North America
- In each of the past 5 years these fields have produced in the range of $\pm 300,000$ barrels per day of light crude (30 to 35° API) from Late Jurassic-Early Cretaceous sandstones
- The largest NL oil production to date occurred in May 2007, when the fields produced 426,680 bopd
- In 2009, NL production was 268,000 bopd, a decrease of 77,000 bopd from 2008, due to production depletion and maintenance work at both Terra Nova and White Rose fields

NL Petroleum Production

- NL delivers about 35% of the light oil produced in Canada from these fields representing more than 80% of Atlantic Canada's hydrocarbon production. With this output NL is the second largest oil producing province in Canada after Alberta
- Over 1.16 Bbbls were produced to date from the Jeanne d'Arc Basin
- 100 million barrels were produced during 2009
- Jeanne d'Arc Basin developments Hibernia, Terra Nova are the only producing giants offshore oilfields on the Atlantic Coast of North America
- NL offshore oil industry now accounts for nearly 40% of the province's gross domestic product

NL Petroleum Production

- A fourth large compound field, Hebron (denoted Hebron in further discussions), estimated to contain 581 million barrels recoverable reserves/resources will be developed starting in 2012 with first oil expected in 2017
- North Amethyst field estimated to contain 68 MMbbls (C-NLOPB), started producing at the end of May 2010 and its planned peak output production will reach 37,000 bopd
- Other satellite pools located around the White Rose field are presently tested and will be developed by tie-back to the existing FPSO
- Hibernia partners are aiming to develop an estimated 223 MMbbls discovered as part of the Hibernia South Extension unit starting in 2013 using the existing concrete platform as well as a subsea tieback

Emergence of Nalcor Energy

- Legislation to create the province's energy corporation, Nalcor Energy, wholly owned by the Province of NL (<http://www.nalcorenergy.com>)
- Through Nalcor, the Province negotiated equity positions in the Hebron Project (4.9%) and White Rose Growth Projects (5%)
- Fall 2007, the NL Government released the provincial Energy Plan “Focusing our Energy” that established new policies for oil and gas exploration and production in the Province's large onshore and offshore regions (<http://www.nr.gov.nl.ca/energyplan/EnergyReport.pdf>)
- Energy Plan brought implementation of an Offshore Natural Gas Royalty Regime and introduced the concept of a “pioneer project”

Emergence of Nalcor Energy

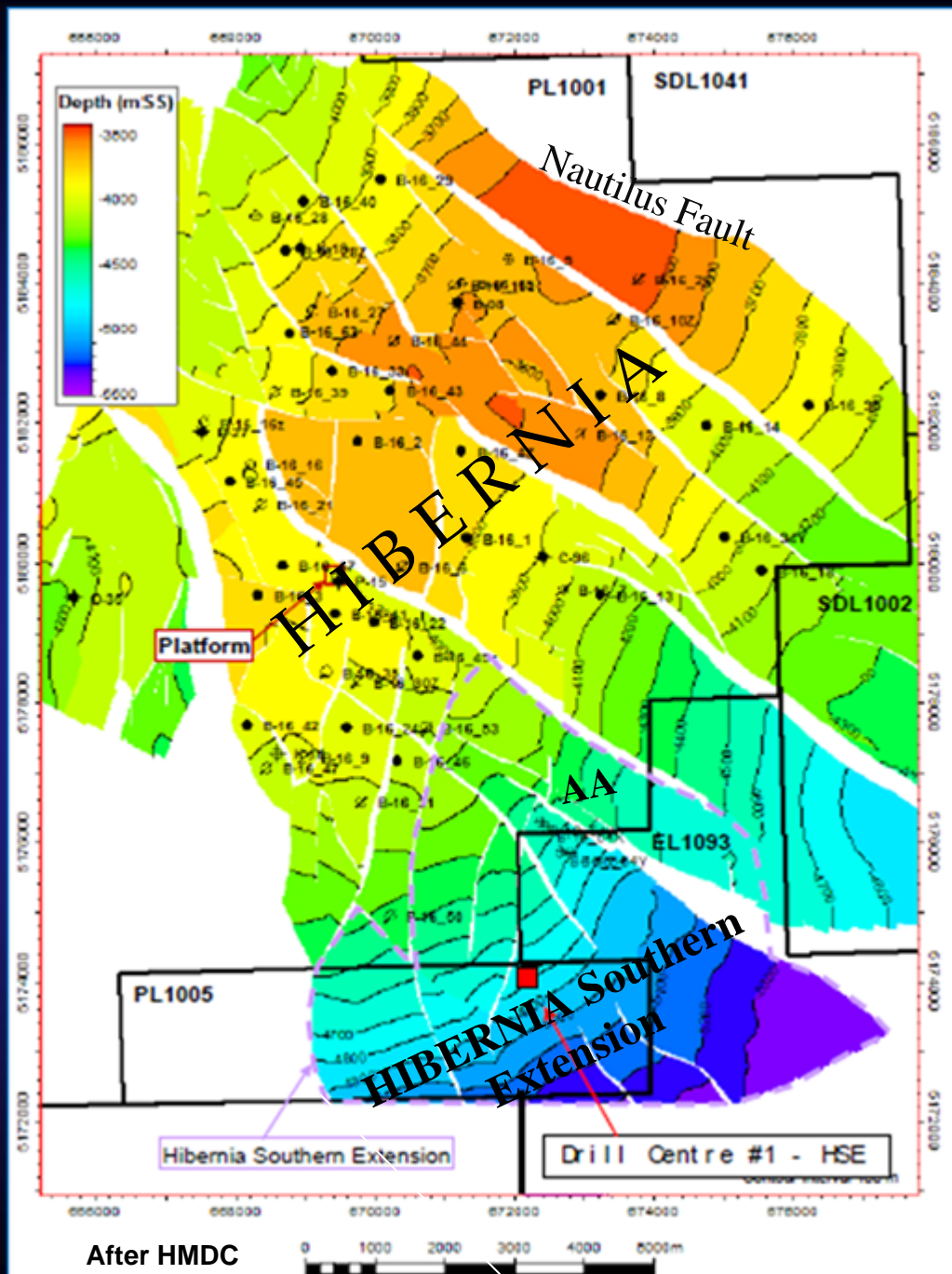
- Formation in 2007 of Nalcor Oil and Gas Inc. subsidiary that acquired interest in several offshore fields: North Amethyst, West White Rose and South White Rose Extension (5%), Hebron (4.9%) Hibernia South (10%)
- Summer 2009, Nalcor farms into the “Parsons Pond” Exploration Permits located onshore in the Appalachian Paleozoic trend; may be followed by other Nalcor direct involvement with exploration projects
- Petroleum Exploration Enhancement Program (PEEP), in 2008-9, financed a Western Newfoundland onshore aeromagnetic regional survey; PEEP is a initiative of the Energy Plan and is focused on improving geoscience knowledge of Western Newfoundland onshore
- A further \$20 million was provided to fund the ongoing Offshore Geoscience Data Project

Emergence of Nalcor Energy

- During February 2010 the Government of NL and Hibernia partners signed a new participation agreement for the Hibernia Southern Extension field: Nalcor will pay C \$30 million for 10 % interest in the field to be produced mainly from Hibernia's existing GBS and a subsea tieback
- In the spring of 2010 Nalcor operated its first onshore exploration well, Seamus No. 1, in the Parsons Pond region and encountered gas in Paleozoic rocks
- On 31 May 2010 Nalcor obtained first oil production from its 5% participation in the North Amethyst field
- Currently Nalcor has interest in:
 - 1) **White Rose growth project** (5% of North Amethyst field, West White Rose pool, etc.);
 - 2) **Hebron field** (4.9%) and
 - 3) **Hibernia Southern Extension** (10% of field's subsea tieback)

Hibernia Southern Extension

- Contains 223 MMbbls
- Starting production in late 2012 from the Hibernia GBS
- Those wells that can't be drilled from the platform will be done by a separate, mobile rig from a drill centre (water injection wells)
- AA blocks of Hibernia South contained wholly in PL1001, started producing oil in November 2009 from a reserve of 48 MMbbls
- Typical example of JDB satellite field that will help maintain production levels



Large Mesozoic Under Explored Basins

- Atlantic Newfoundland and Labrador were affected by the latest Wilson cycle initiated during Late Triassic which culminated with the break up of Pangea and opening of the Atlantic Ocean which continues today
- During the initial intercontinental rifting stage and later during the break-up, numerous extensional sedimentary basins were formed on both margins of the Atlantic Ocean
- Some of these basins such as Santos, Gulf of Mexico, Orinoco, Niger Delta, Jeanne d'Arc, North Sea, etc. are prolific petroleum basins

Large Mesozoic Underexplored Basins

- The Newfoundland and Labrador offshore area contains many underexplored Mesozoic basins including Laurentian (1 well in French territory & 1 well in NL waters), Carson-Bonnyton (4 wells), Flemish Pass (6 wells), East Orphan (2 wells), Hopedale (16 wells that reached target) and Saglek (3 wells) basins
- The northern Jeanne d'Arc Basin can also be considered an underexplored basin. It is an area located in water depths between 150 m and 500 m and is only sparingly drilled
- Also a less explored area is the Central Ridge that separates the Jeanne d'Arc and Flemish Pass basins and where oil and gas were tested in early 1980s and SDLs were awarded

Grand Banks Exploration History

- 1966 - Mobil Oil conducts first seismic reflection program in Grand Banks
- 1966 - The first Grand Banks well **Pan Am Tors Cove D-52**
- 1967 - First well spudded in the Jeanne d'Arc Basin **Amoco Imperial Murre G-67**
- 1971 - First free flow of oil to surface in the Jeanne d'Arc Basin: 268 bopd, 31⁰ API gravity, 0.2 MMcfd gas from **Mobil Gulf Adolphus 2K-41**, the 4th well in Jeanne d'Arc Basin
- 1973 - First penetration of prolific Upper Jurassic source rock: Egret Member of the Rankin Formation drilled at **Amoco Imperial Skelly Egret K-36**, the 5th well in Jeanne d'Arc Basin
- 1979 - First major discovery well: Chevron et al. **Hibernia P-15**; the 45th well drilled in Grand Banks region and 10th well drilled in the Jeanne d'Arc Basin; tested between 200 and 3700 bopd, (30 to 33.5⁰ API) and between 0.2 to 4.4 MMcfd gas on several DSTs of Upper Jurassic sandstones
- 1980 - First oil discovery outside Jeanne d'Arc Basin: **Mobil et al. South Tempest G-88** well on the Central Ridge
- 1981 - First Hibernia 3D seismic survey completed (also first 3D survey offshore Canada)

Grand Banks Exploration History

- 1981 - **Hebron** field was discovered by Mobil; it is estimated to contain more than 700 million barrels of oil
- 1984 - **Terra Nova** oil field was discovered by Petro-Canada et al.
- 1984 - First **White Rose** oil well, White Rose N-22 (teaser), recovered modest quantity of oil and gas from Cretaceous sandstones;
- 1984 - Signing of **Atlantic Accord** by Canadian and NL governments establishing C-NLOPB and regulatory regime for the NL Atlantic offshore area
- 1988 - **White Rose E-09** intersects a 90 m oil pay and confirms White Rose as a major oil and gas field
- 1990 - C-NLOPB declared the giant Hibernia oilfield to be a Commercial Discovery
- 1997 - First oil production from Hibernia, production record for a Canadian well 56,000 bopd
- 2002 - Terra Nova starts producing using the first FPSO offshore NL
- 2003 - Drilling of **Mizzen L-11**, first well to intersect reservoir oil (not tested) in Flemish Pass Basin
- 2004 - White Rose start producing using the second FPSO in the basin

Grand Banks Exploration History

- 2005 - Hibernia more than double its initial recovery reserves size
- 2007 - First well in East Orphan Basin Chevron et al. Great Barasway F-66
- 2007 - Emergence of **Nalcor Energy**
- **2009 - First billionth barrel produced from the Jeanne d'Arc Basin**
- **2009 - First deep water hydrocarbon discovery in the northern Flemish Pass Basin Mizzen O-16** by Statoil/Husky
- 2010 - First SDL in Flemish Pass Basin awarded to Statoil/Husky partnership
- 2010 -The signing of the Hibernia South Development (223 MMbbls oil) that includes Nalcor 10% participation
- 2010 - First field satellite North Amethyst is tied back to White Rose FPSO and start producing in May
- 2010 - Second well drilled in Orphan Basin, Lona O-55 was spudded in 2600 m of water and establishes a Canadian water depth drilling record (well results not public at publication of this presentation)
- 2010 - First well drilled in the NL side of the Laurentian Basin East Wolverine G-37 was plugged and abandoned (well results not public at publication of this presentation)

Recommended Literature on Grand Banks

Jansa and Wade 1975; Purcell et al., 1980; Arthur et al., 1982; Hubbard et al., 1985; Parson et al., 1985; Mason and Miles, 1986; Grant and McAlpine, 1986; Srivastava and Tapscott, 1986; King et al., 1986; Grant and McAlpine, 1986; Ziegler, 1987; Enachescu 1987, 1988, 1992, 1993 ; Enachescu et al., 1993; 2005; 2006; Tankard and Welsink, 1987; Keen et al., 1987; Fowler and Snowden, 1988; Grant et al., 1988; Sinclair, 1988, 1993 and 1995; Koning et al., 1988; Ziegler, 1989; Balkwill and Legall, 1989; Tankard et al., 1989; Brown et al., 1989; Bell and Howie, 1989; Tucholke et al., 1989; McAlpine, 1989, 1990; 1991; Verhoef and Srivastava, 1989; Hiscott et al., 1990; Mackey and Tankard, 1990; Srivastava et al., 1990; Wade and MacLean, 1990; Grant and McAlpine, 1990; Keen and Williams, 1990; Sinclair et al., 1992; Maclean and Wade, 1992; Srivastava and Verhoef, 1992; Foster and Robinson, 1993; Desilva, 1993, 1994 and 1999; Enachescu and Dunning, 1994; Fowler and McAlpine, 1995; Driscoll and Hogg, 1995; Driscoll et al., 1995; Bateman, 1995; Drummond, 1998; Hubbard, 1998; Williams et al., 1999; Srivastava et al., 2000; Prokoph and Agterberg, 200; Atkinson and Fagan, 2000; Hogg and Enachescu, 2001; Loudon, 2002; Deptuck et al., 2003; Smeed et al., 2003; Enachescu and Hogg, 2005; Magoon et al., 2005; Sibuet et al., 2007; Tucholke et al., 2007; Hogg and Enachescu, 2007; Hardy, 2007 (M Sc Thesis); Fagan and Enachescu, 2008; HMDS, 2008; Enachescu, 2009; Bauer et al., 2009; Fagan, 2010 (M Sc Thesis); Lowe, 2010 (M Sc Thesis); Enachescu et al., 2010

Observation: This list is not inclusive

Enachescu, NL DNR 2010

Government of Newfoundland and Labrador Reports and Presentations

- The regional geoscience of Newfoundland and Labrador offshore and specifically the petroleum potential of the Jeanne d'Arc Basin were covered in detail in previous Government of Newfoundland and Labrador Reports
- Only a geoscience overview is contained in this presentation
- More geoscience information is included with reports and presentations available from the:

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

and

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

List of Reports and Presentations Available from the Government of NL Website:

Atkinson and Fagan, 2000;

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

Smee, 2003;

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

Fagan and Hicks, 2003;

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

Enachescu and Fagan, 2004, 2005 and 2009;

http://www.gov.nl.ca/mines&en/oil/call_for_bids_nf04_01.stm

http://www.nr.gov.nl.ca/mines&en/call_for_bids/NL05.pdf

http://www.nr.gov.nl.ca/mines&en/oil/callforbids/Final_Laurentian_Basin_Presentation.pdf

Enachescu and Foote, 2009;

<http://www.nr.gov.nl.ca/mines&en/oil/CallforBidsNL09-03.pdf>

Enachescu 2006a and b;

http://www.nr.gov.nl.ca/mines%26en/call_for_bids/cfb_nl06-1_%20enachescu_report.pdf

http://www.nr.gov.nl.ca/mines%26en/call_for_bids/CFBNL06-1_presentation.pdf

Enachescu, 2009;

http://www.nr.gov.nl.ca/mines&en/oil/Jeanne_D_Arc_Presentation.pdf

Newfoundland and Labrador Petroleum Industry

- Currently NL produces monthly between 250-300,000 bopd
- This represents 12.5% of Canada's total oil production, 35% of Canada's light oil and more than 80% of Atlantic Canada petroleum output
- \$2.5 billion oil royalty paid during 2008-9
- Offshore oil industry now accounts for nearly 40 % of NL's gross domestic product
- 7,400 annual average employment
- \$ 16.5 billion spending in E&P since 1995
- Total estimated Recoverable Reserves of NL stands at 6 Bbbls oil and 60 Tcf natural gas
- Provincial Government encourages offshore exploration with high concerns for environmental protection and safety; strict S&E regulations are in place

Offshore NL Recoverable Reserves/Resources

Field	Oil (MMbbbls)	Gas (Bcf)	NGL's (MMbbbls)
Hibernia	1244	1796	202
Terra Nova	419	53	4
Hebron/Ben Nevis	731	429	30
White Rose +sat	373	3338	96
Others	138	1000	24
Subtotal – Grand Banks	2905	6616	356
Labrador Shelf		4,244	123
Total	~3,000	10,860	479
Produced	1.168 Bbbbls	No Sales	

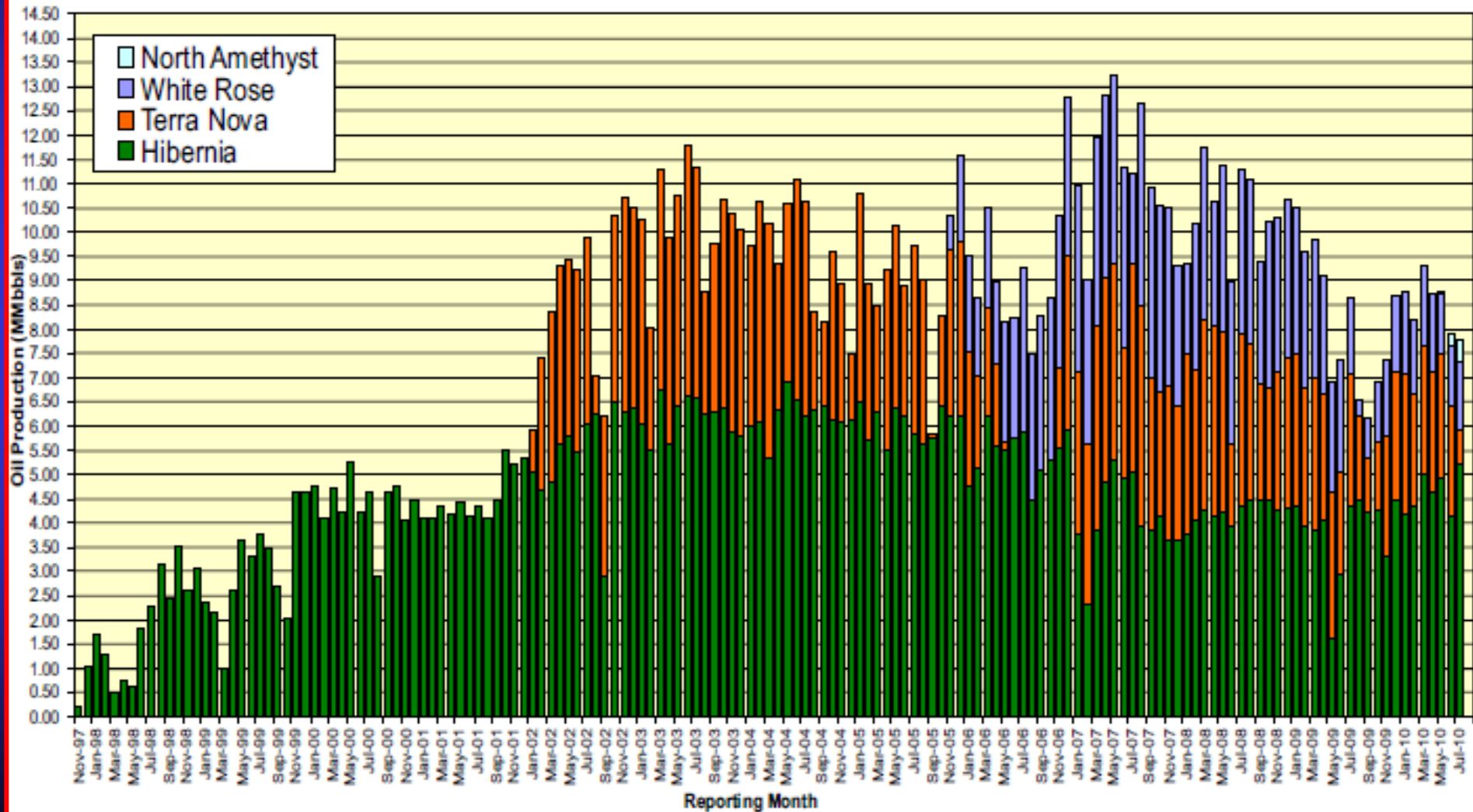
Jeanne d'Arc Basin Daily Average and Annual Production 2009

Data from C-NLOPB

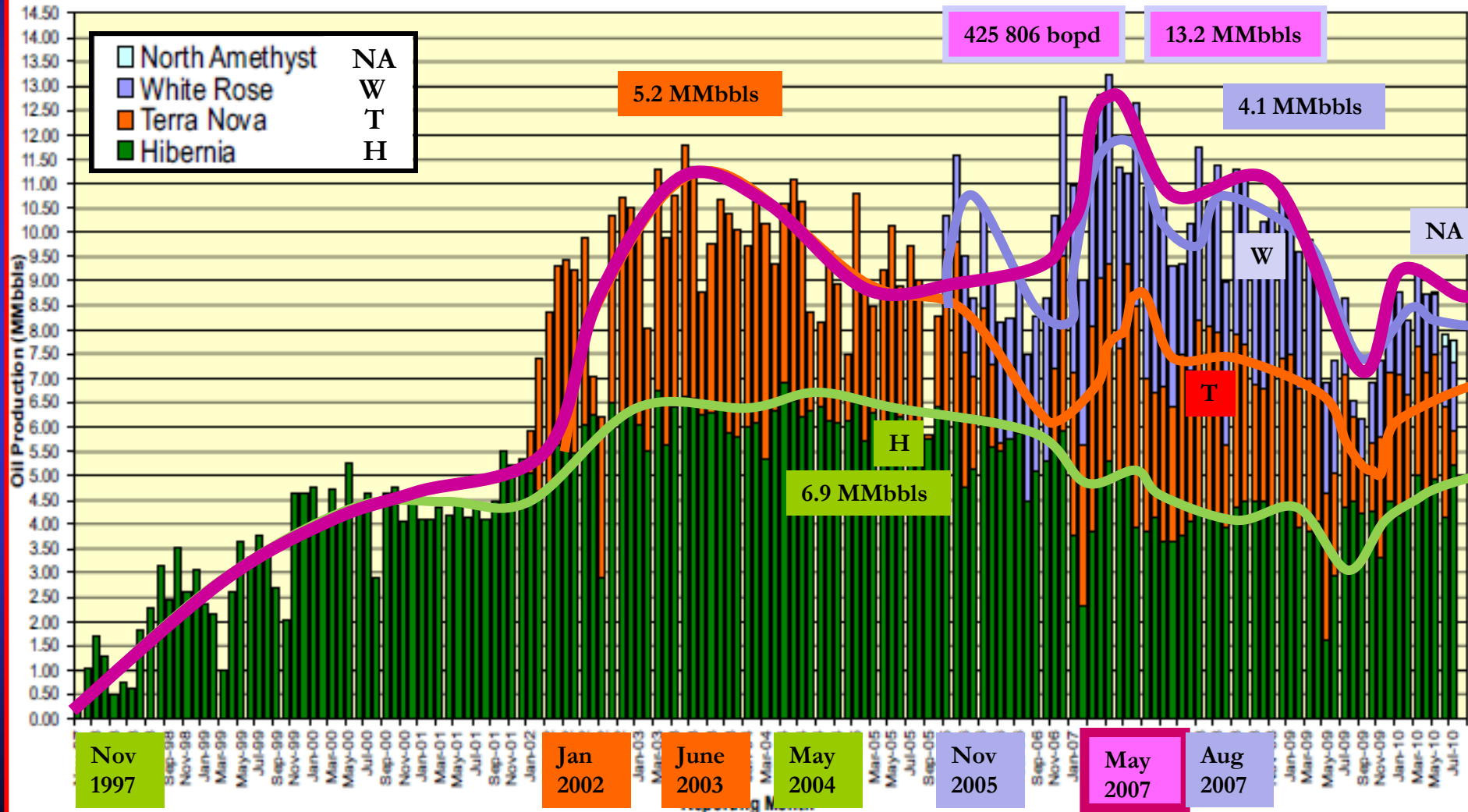
Jeanne d'Arc Basin	Total Production Oil (bbl)	Daily Average Production oil (bopd)	Total Production Gas (10 ³ m ³)	Daily Average Production Gas (10 ³ m ³ /day)
Hibernia	45,852,232	125,622.5	2,445,084 86.8 Bcf	6,698.9 238 MMcfd
Terra Nova	29,030,059	79,534.4	1,539,330 54.6 Bcf	4,217.3 149.6 MMcfd
White Rose	22,796,879	62,457.2	587,215 20.8 Bcf	1,608.8 57.0 MMcfd
Total	97,679,170	267,614.1	4,571,629 162.3 Bcf	12,525.0 444.6 MMcfd

Gross revenue @ US\$62.62 per barrel (Brent) = US \$6,116,669,625

NL Total Monthly Oil Production



Monthly Oil Production



Present JDB Production & Exploration

- Production at **280,000 bopd (August 2010)**;
- To improve after connecting field satellites to about **325,000 bopd**
- **More than 1.16 Billion barrels produced to date**
- More than 1.5 Tcf solution gas also produced, great majority re-injected, some used for manning FPSO and Production Platform
- 45,705 ha under Production License (PL)
- 722,403 ha under Exploration Licence (EL) in JDB
- 130,500 ha under Significant Discovery Licence (SDL)

How Much Oil & Gas offshore NL?

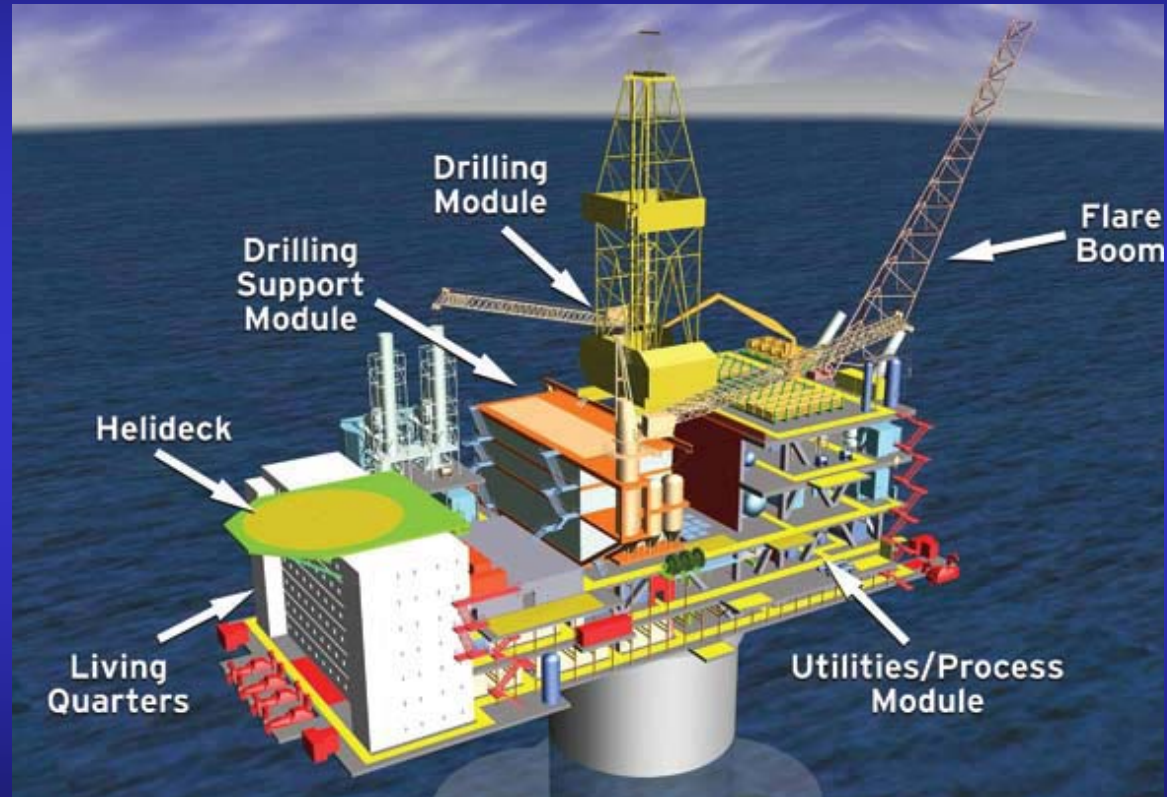
- More than **1.7 Bbbls** proven remaining recoverable reserves/resources exists in the Jeanne d'Arc Basin; approximately 11 Tcf of gas has been discovered of which **6.6 Tcf** of gas reside in JDB; however no gas sales to date
- Geoscience data indicate that a further **6 Bbbls** and **60 Tcf** undiscovered resources remain offshore Newfoundland and Labrador

Recent E&P Activity in Mesozoic Basins

- **Production.** Presently NL production is obtained from **Hibernia, Terra Nova, White Rose and North Amethyst** fields in the Jeanne d'Arc Basin. New developments are planned at the giant multi-pool **Hebron** oil field and at the satellite fields **West White Rose** and **Hibernia Southern Extension**
- **Exploration.** In the past 5 years, exploration in the **Mesozoic basins** consisted of 2D and 3D seismic data acquisition, various EMCS surveys and drilling
 - Exploration drilling took place in the **Laurentian, Jeanne d'Arc, Flemish Pass and East Orphan basins**. While 4 parcels were licenced in 2008, no drilling has yet taking place in the Hopedale Basin
 - The Mesozoic basins have also seen new exploration licensing or consolidation of older issued ELs. As the **fall of 2010 there are more than \$ 850 million in** exploration commitments to be undertaken by interest owners in these basins

Hebron Field

- Field is situated in Jeanne d'Arc Basin, about 350 km (217 miles) from St. John's in 90 to 100 m (295 to 328 feet) of water
- Development will involve a concrete gravity-based structure to be built in the Province
- Field will yield 120,000 - 176,000 bopd over 30 years



After Hebron Consortium and NL DNR

Hebron Field

- Hebron is the largest stand alone new field development in Canada; ExxonMobil is the field operator
- The Hebron larger asset is a compartmentalized area, consisting of the Hebron, Ben Nevis and West Ben Nevis oil accumulations located in several independent fault blocks
- ExxonMobil is operator of the sanctioned Hebron development with a 36% interest, Chevron Canada has 26.7 %, Suncor 22.7%, Statoil Canada 9.7%
- The remaining 4.9% is held by Nalcor Energy which has agreed to payment of C\$ 110 million for its stake in the field
- Oil and gas are contained in Ben Nevis, Hibernia and Jeanne d'Arc sandstone reservoirs
- Hebron project to be designed to overcome challenges associated with the recovery of heavier oil (~20° API) in the Hebron main pool
- Field is estimated to contain **731 MMbbls** recoverable resources of which the Hebron field is to be developed starting in 2012 with “first oil” production scheduled for 2017

Laurentian Basin

- The basin is a hybrid Mesozoic basin developed between the Scotian shelf and slope and the Newfoundland Transfer Zone (NTZ); during Late Triassic - Middle Jurassic the Laurentian Basin had affinity with the Scotian Basin
- Large Paleozoic extensional and transtensional structures are mapped in the northern part of the basin. In the south large Mesozoic structural and stratigraphic features are observed
- In the early eighties, several Exploration Permits were held which stretched the unsettled international boundaries of Canada and France and provincial boundaries of Newfoundland and Labrador and Nova Scotia, by Gulf, Mobil, Texaco and Imperial Oil
- The Bandol #1 well was drilled in 2001 on a shelf location and in French territory by Murphy et al.; while it was rumoured to have found good Mesozoic reservoirs, the well remains confidential until 2011

Laurentian Basin

- Jurisdictional boundaries were resolved in 1992 with France and in 2002 between provinces; existing Exploration Permits were converted into 7 ELs (1081-1087) awarded in 2004 by C-NLOPB to ConocoPhillips (CP) and EL 1088 awarded to Imperial Oil
- Basin-wide 2D seismic surveys were conducted in late 1990s and early 2000s, followed in 2005 by 2 large CP et al. 3D programs conducted in deep water; with these surveys several large structural and stratigraphic traps were seismically identified on the slope and in deep water
- A consolidation of the 7 CP operated lands into four ELs (EL1081R, EL1082R, EL1086R, EL1087R) took place in 2008; Imperial's EL 1088 has expired in April 2009
- Two new deep water exploration parcels ELs 1118 and 1119 were licensed to CP et al. at the 2009 NL licensing round by C-NLOPB
- A deep water exploration well East Wolverine G-37 was drilled during 2009/10 and declared a dry hole, but no results are yet available. While this well has validated a large EL, the partnership decided to revert the consolidated permits to Crown leaving the 2009 permits intact

East Orphan Basin

- Orphan Basin is a widely stretched Mesozoic rifted area located north of Grand Banks of Newfoundland. The shallow part of the basin was unsuccessfully explored in the late seventies-early eighties when 5 wells were drilled on basement highs
- An earlier deep water well, Blue H-28, drilled a rotated block of Late Jurassic-Early Cretaceous, without encountering hydrocarbons
- Based on new 2D seismic interpretation, the drilled eastern part of the basin is considered more prospective for gas while the East Orphan Basin situated in deep and super deep water has good oil potential as it was an earlier rift (Enachescu et al., 2004 and 2005)
- The basin was connected in Late Jurassic to Jeanne d'Arc and Flemish Pass and W. Ireland basins
- Eight large ELs (1073 to 1081) covering 21,250 km² were awarded to Chevron Canada (50%)/ExxonMobil Canada (EMC) (25%)/Imperial Oil (IO) (25%) in 2003. The partnership later included Shell Canada that took a 20% interest from EMC and IO
- During 2004-2009 the partnership conducted several large seismic 3D and CSEM surveys on their licences

East Orphan Basin

- Great Barasway F-66 well operated by Chevron was drilled in 2006/7 in EL 1076. This well set a Canadian record for deep water drilling in a water depth of 2338 m; the well TDed and was abandoned at 6749.9 m
- F-66 well found good Late Jurassic-Early Cretaceous reservoirs and possible Late Jurassic source rocks. However the reservoirs were wet and only several shows were encountered
- A consolidation of the Chevron and ExxonMobil operated lands into two ELs (EL1073R and EL1074R) took place in 2008; at the time the EL 1075 and the north-eastern part of EL 1080 were relinquished to the Crown
- The exploration well Lona O-55 was drilled during summer of 2010 but results are not publicly available until 2012
- With the two large proprietary 3D surveys and several dense 2D grids existing in the basin, at least a dozen other large structural and stratigraphic traps were identified. These prospects remain to be drilled
- A large part of the petroleum prospective basin remains un-licensed and opened for company land posting. A large parcel located just north of the Mizzen L-11 oil show and O-16 hydrocarbon discovery, and stretching the border between Flemish Pass and East Orphan basins is offered at the CFB NL10-02-01

Recent Newfoundland and Labrador Call for Bids

In 2008 several successful land rights issuance took place:

- In September 2008, C-NLOPB announced that successful bids were received for four CFB NL07-02 parcels located in Labrador Offshore Area totaling \$186,430,680. This was the first land rights issuance in Labrador since early eighties and the third largest land rights issuance in terms of total work expenditure commitment
- In November 2008, successful bids totaling \$129,892,000 were received on all three parcels offered in the Central Ridge/Flemish Pass (CFB NL08-01) area and for two parcels in the Jeanne d'Arc Basin (CFB NL08-02)
- A successful bid was received for a large parcel in the Sydney Basin (CFB NL08-03) and another in the Western Newfoundland and Labrador (CFB NL08-04) Offshore Region for an additional work commitment of \$2,400,000. This was the first land rights issued on the NL side of the Sydney Basin in 30 years

Recent Newfoundland and Labrador Call for Bids

In 2009 three successful land rights issuance took place:

- In November 2008, C-NLOPB announced that successful bids totalling \$ 47 Million were received for four CFB NL09 parcels located offshore Newfoundland as follows
 - CFB NL09-01 consisting of one parcel located in the Jeanne d’Arc Basin received a bid of \$ 36.8 Million
 - CFB NL09-02 consisting of two parcels located in Laurentian Basin received bids of \$8 million and \$1 Million
 - CFB NL09-03 consisting of one parcel located in Western Newfoundland (Anticosti Basin) received a bid of \$ 1.2 Million

OBSERVATION: Offshore NL bids are work expenditure bids. See also:

http://www.nr.gov.nl.ca/mines&en/oil/cfb10_01.pdf

http://www.cnlopb.nl.ca/exp_leg.shtml

http://www.cnlopb.nl.ca/land_issuance.shtm

http://laws.justice.gc.ca/eng/C-7.5/page-4.html#anchorbo-ga:l_II-gb:l_II

Results of 2008 Jeanne d'Arc and Environs Call for Bids

- **NL08-2 Jeanne d'Arc Basin**

Parcel 1 (19 430 ha): Suncor (50%)/Statoil (50%)	for \$ 81.90 MM
Parcel 2 (121 348 ha): Husky (67%)/Repsol (33%)	for \$ 9.48 MM

- **NL08-1 Central Ridge**

Parcel 1 (138 200 ha): Husky (40%)/Suncor (40%) Repsol (20%)	for \$ 18.60 MM
Parcel 2 (134 227 ha): Husky (67%)/Repsol (33%)	for \$ 1.19 MM

- **NL08-1 Flemish Pass Basin**

Parcel 3 (55 954 ha): Statoil (65%)/Husky (35%)	for \$ 18.72 MM
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TOTAL	\$129.9MM
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Observation. Reports and presentations on the potential of Call for Bids NL08 and NL09 are available from:

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

Results of 2009 Jeanne d'Arc and Environs Call for Bids

- **NL09-01 Jeanne d'Arc Basin**

Parcel 1 (9 558 ha) Husky (72.5%)/Suncor (27.5%)

for \$ 36.8 MM

- **NL09-02 Laurentian Basin**

Parcel 1 (290 070 ha): ConocoPhillips (55%)/BHP (45%)

for \$ 8.0 MM

Parcel 2 (73 931 ha): ConocoPhillips (64.01%)/BHP (35.99%)

for \$ 1.0 MM

TOTAL

\$45.8MM

Observation. Reports and presentations on the petroleum potential of Call for Bids NL08 and NL09 parcels are available from:

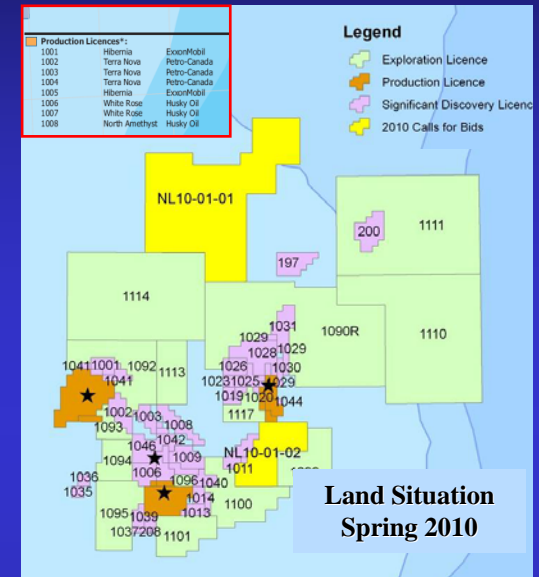
<http://www.nr.gov.nl.ca/mines&en/oil/>

NL Land Ownership Recent Events

• In the 2008 C-NLOPB licensing round, **Repsol** participated for the first time ever and succeeded in an offshore Atlantic Canada Call for Bids. Repsol is a large integrated oil company with assets in over 30 countries. Noteworthy is that NL attracted a new “name” - a large reputable multinational integrated petroleum company to explore the Grand Banks

• **Investcan Energy Canada** together with Vulcan Minerals first entered the West Coast onshore and then, in 2008 the Hopedale Basin, Labrador Sea exploration. Investcan Energy is a wholly-owned subsidiary of SCDM Energie, which is a wholly-owned subsidiary of SCDM, a privately-held French company based in Paris and controlled by Martin and Olivier Bouygues

• Also in 2008, **Suncor** was a co-bidder (with Husky) on a Labrador Sea parcel and after acquiring Petro-Canada in 2009 became operator of the Terra Nova field and owners of significant other interests in Hibernia, White Rose, Hebron, North Amethyst oil fields and various exploration areas on the Grand Banks



Presently there are: 14 Exploration Licences (ELs), 45 Significant Discovery Licences (SDL) and 8 Production Licences (PL) in the Jeanne d'Arc Basin

3. Geology Overview of the Mesozoic Grand Banks and Environs

- About a dozen Mesozoic basins, subbasins, trough and sedimented ridges are petroleum prospective on the Grand Banks and environs
- These structural units and subunits have formed during breakup of Pangea and subsequent Atlantic Ocean opening
- The area is dominated by extensional tectonics and complicated by salt tectonics and transtensional movements
- All ingredients for petroleum formation and accumulation in large structural, stratigraphic and combination traps exists for the basins that have confirmed Late Jurassic high TOC/ high HI source rock
- In other Grand Banks basins the existence of a viable petroleum systems remains to be proven
- Areas of petroleum potential extend from the shallow waters of the Banks into the deeper waters of the continental slope, as well as to ultra-deep-water areas such as the Orphan and Laurentian basins
- For now, Jeanne d'Arc is the only oil proven and producing basin in the area

Regional Geology of the Grand Banks of Newfoundland

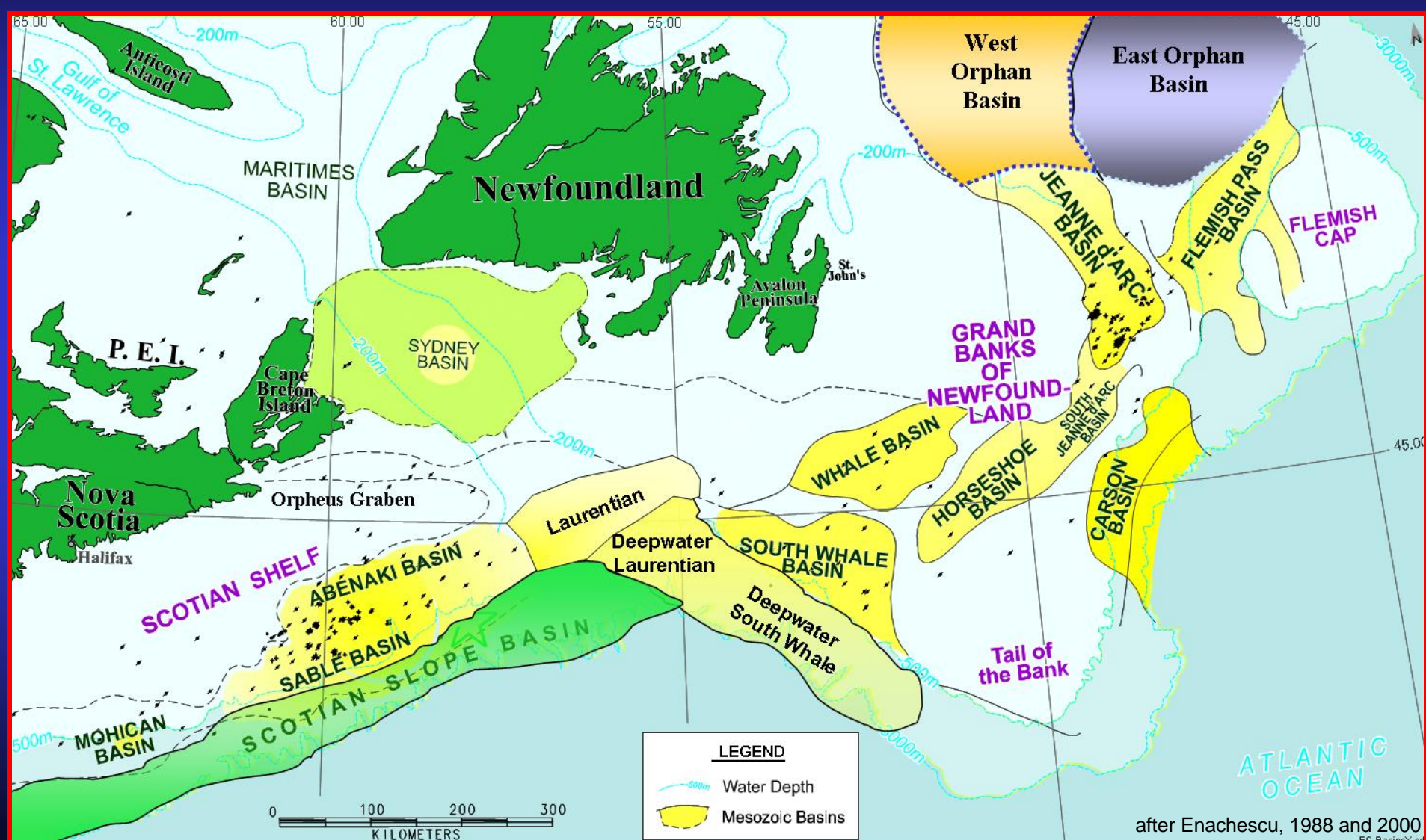
- East Coast Newfoundland and Labrador is a significant part of the eastern N. America to N. Europe extensive, once continuous Gulf of Mexico to Barents Sea, Mesozoic aged rift system developed during the Pangea intra-continental rifting and Atlantic Ocean opening
- The Grand Banks and environs basins evolved through the latest Atlantic Wilson cycle, starting 230 million years ago and continuing today
- Up to now Grand Banks and environs (Central Ridge and probably extending into Flemish Pass Basin) is the only area along the East Coast of North America containing large light oil fields, some of which producing close to world's largest consumer market

Regional Geology of the Grand Banks of Newfoundland

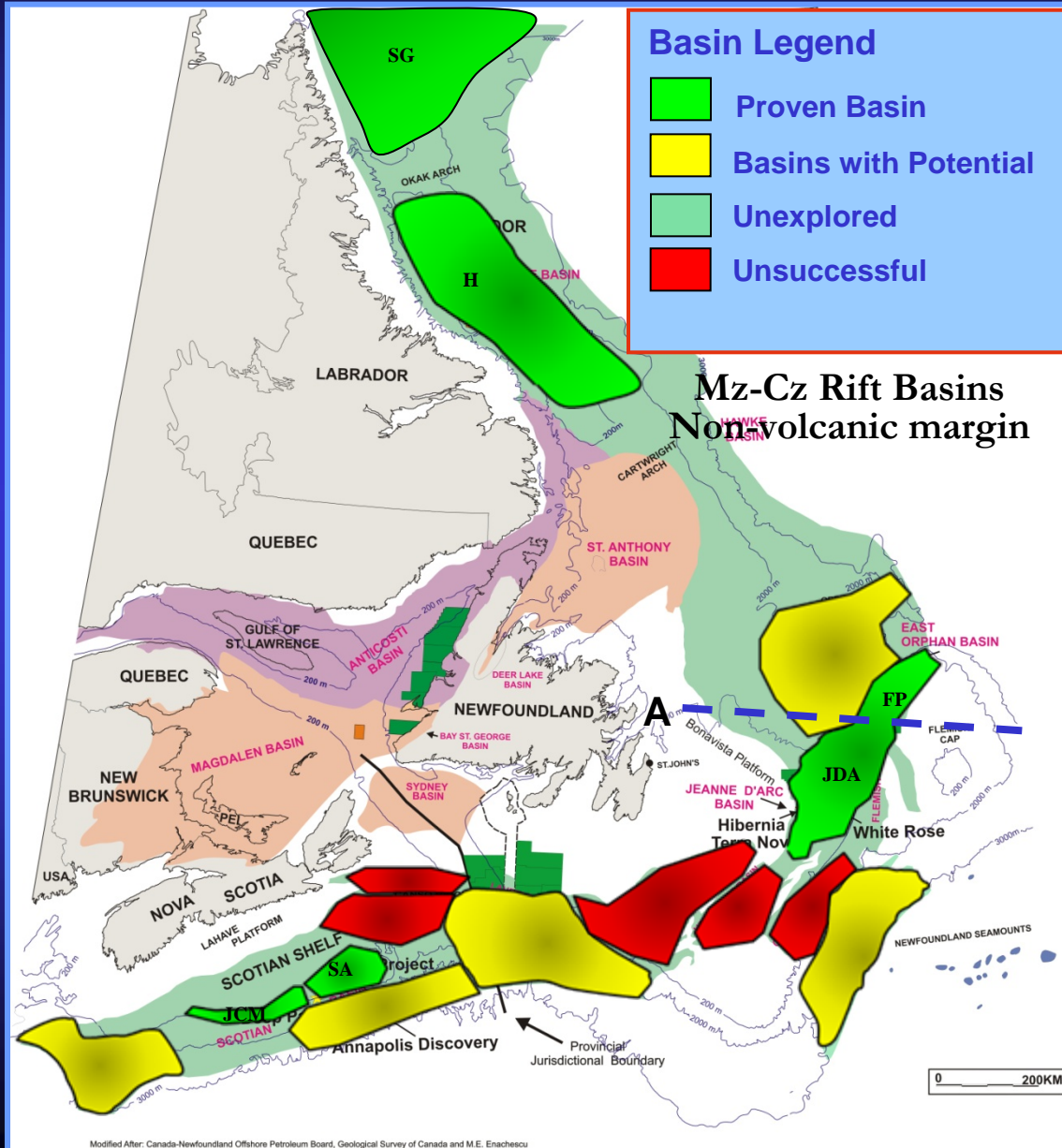
The geologic subdivisions of Grand Banks record the development of:

- Lower Paleozoic North American continental margin
- Late Triassic intra-continental rifts, incised on Grenville, Avalon and Meguma basement
- Late Triassic-Early Jurassic massive salt and other evaporite deposition
- Repeated phases of intra-continental extension (Late Jurassic-Early Cretaceous and Albian -Aptian) and intervening subsidence which included source and reservoir rock deposition
- Formation of transitional crust
- late Early Cretaceous break-up (oceanic rifting) from Iberia and later from West Ireland
- Increased thermal subsidence in Late Cretaceous
- Inversion at the end of Cretaceous-beginning of Tertiary
- Post - Paleocene widespread subsidence and basin tilting

Atlantic Canada Mesozoic Basins



Atlantic Canada Mesozoic Basins



Petroleum Geology

Basins with Oil and Gas Discoveries

Sable (SA)

Jurassic Carbonate Margin (JCM)

Jeanne d'Arc (JDA)

Flemish Pass (FP)

Hopedale (H)

Saglek (SG)

Basins Exhibiting Petroleum Potential

George's Bank

Scotian Salt

Laurentian

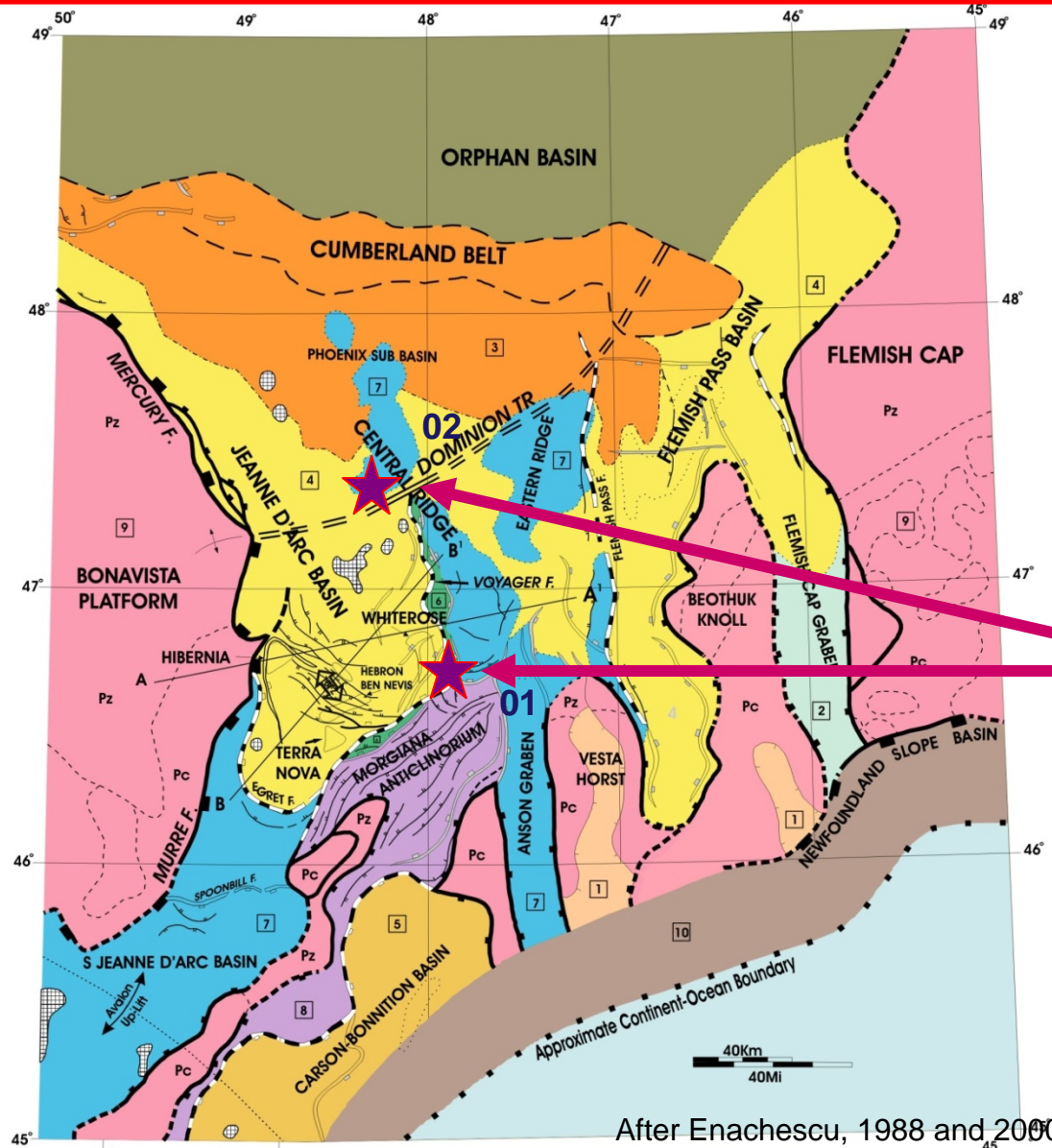
Salar

East Orphan

Modified After: Canada-Newfoundland Offshore Petroleum Board, Geological Survey of Canada and M.E. Enachescu

Grand Banks Tectono- Structural Units Map

Location of CFB
NL10-01
Parcels 01 and 02



After Enachescu, 1988 and 2000

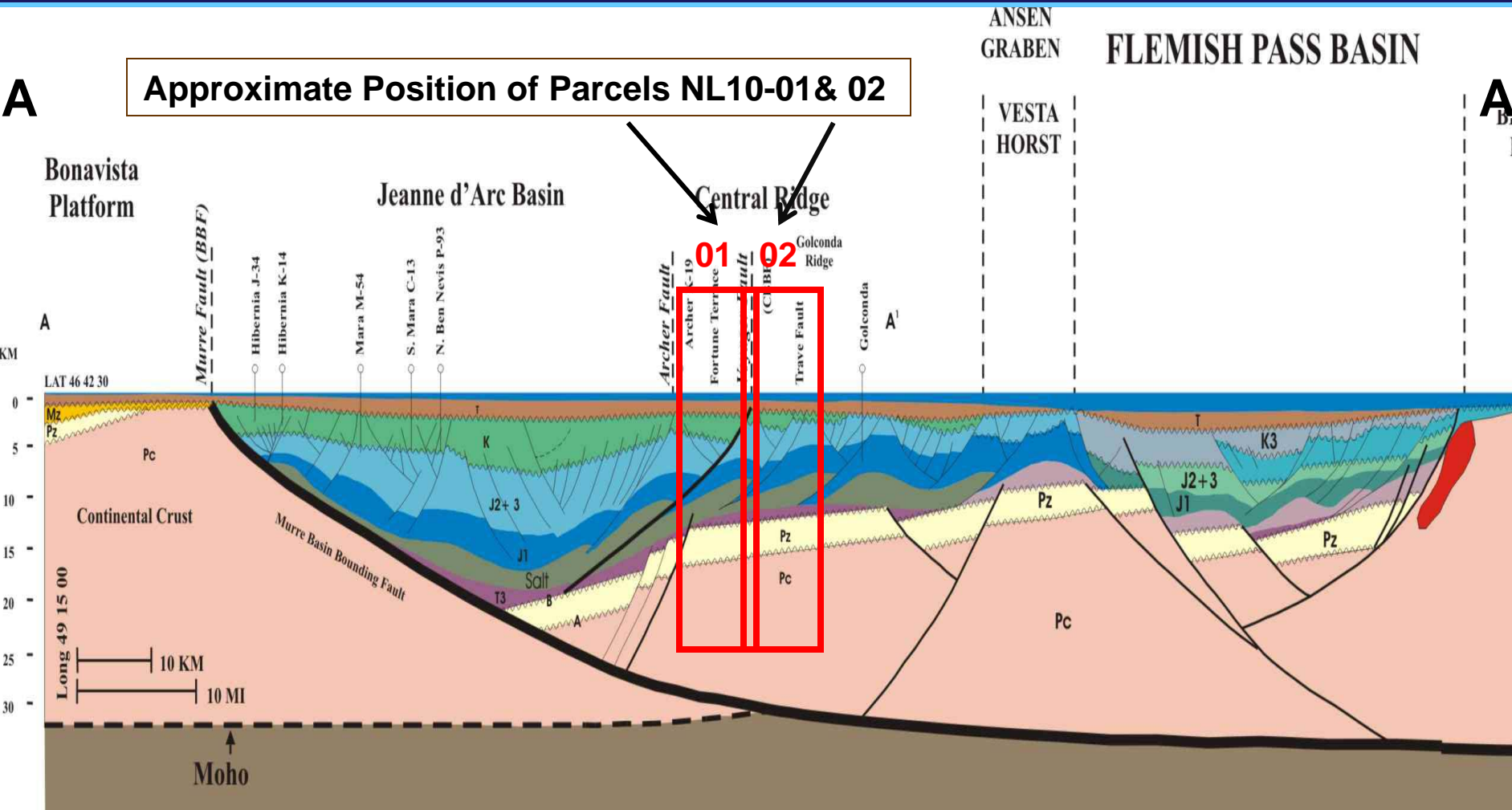
- | | | | |
|---------------------------------|---|--|--|
| Basin Bounding Fault | Secondary Sedimentary Fault | 1 Tertiary Infill | 6 Late Triassic - Late Jurassic, Thin Cretaceous |
| Basement Involved Faults | Transfer Fault | 2 Cretaceous - Tertiary | 7 Late Triassic - Late Jurassic |
| Cretaceous Basin Bounding Fault | Diapir Penetrating Subtertiary Unconformity | 3 Late Triassic - Late Cretaceous Thick Tertiary Cover | 8 Late Triassic - Mid. Jurassic |
| Major Sedimentary Fault | TBFZ- Trans-Basin Fault Zone | 4 Late Triassic - Late Cretaceous | 9 Basement Terrains |
| | | 5 Late Triassic - Early Cretaceous | 10 Transition Crust |

Observation. A-A' is the geological profile shown in the next slide and B-B' is a cross-sections shown in CFB NL06-1 report and Power Point presentation

W-E Grand Banks Structural Profile

A

Approximate Position of Parcels NL10-01 & 02



A'

After Enachescu, 1987

PART 2

Exploration Wells Drilled in Grand Banks During 2005-2010

East Orphan Basin

Great Barasway F-66 (source rock?)

Lona O-55 (results are not public)

Flemish Pass Basin

Mizzen O-16 (significant discovery)

Jeanne d'Arc Basin

North Amethyst K-15 (oil discovery)

Glenwood H-69 (suspended, not tested yet)

Ballicaters M-96 (suspended, not tested yet)

Hibernia B-16 54 (abandoned, not tested)

Laurentian Basin

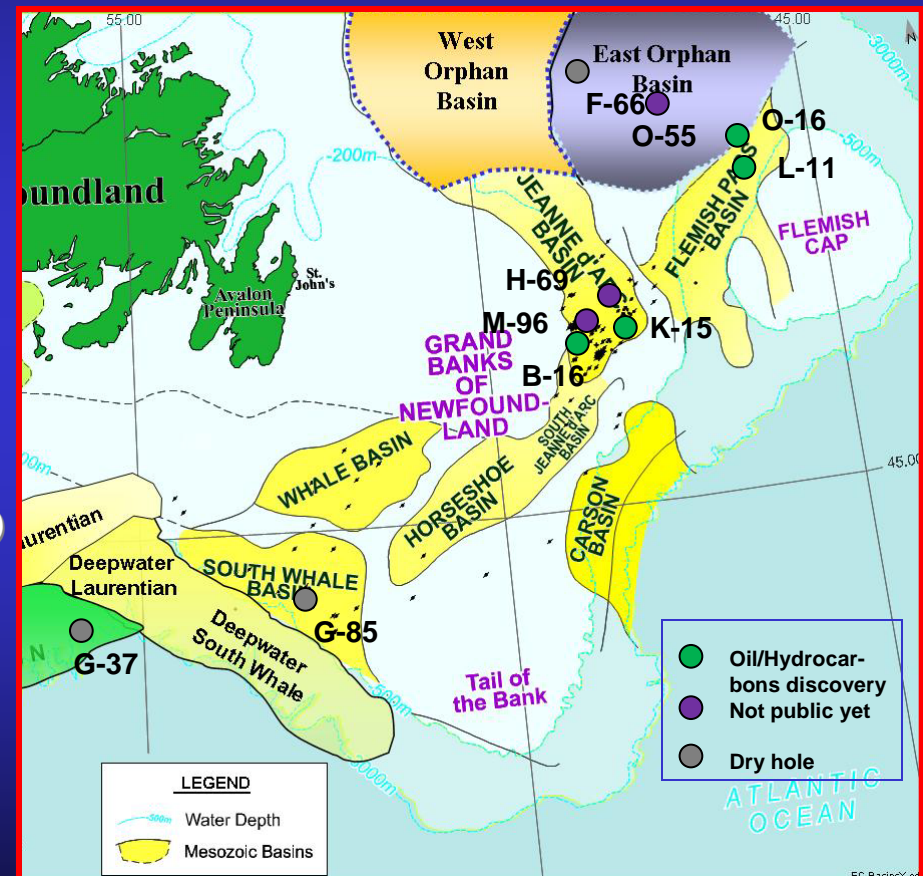
East Wolverine G-37 (dry hole)

South Well Basin

Lewis Hill G-85 (abandoned)

TOTAL: 9 Exploration Wells

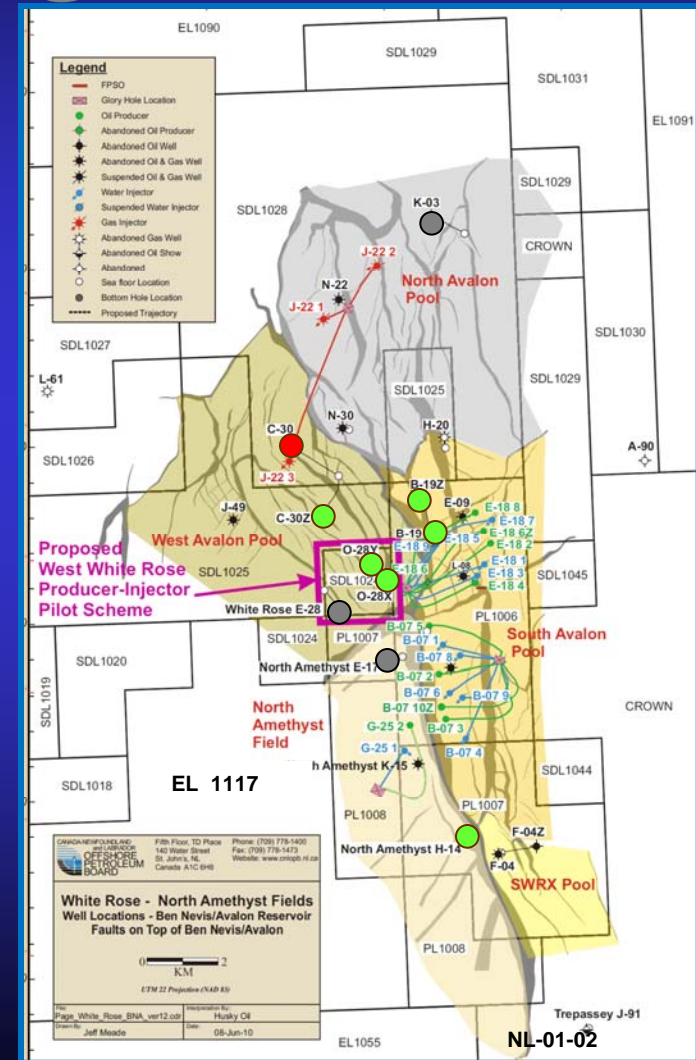
Mizzen L-11 drilled in 2003 is shown for correlation



Delineation Wells Drilled in Jeanne d'Arc Basin During 2005-2010

- White Rose B-19
- White Rose B-19Z
- White Rose O-28
- White Rose O-28 Z
- White Rose O-28Y
- White Rose O-28X
- White Rose E-28
- West Bonne Bay F-12
- West Bonne Bay F-12 Z
- Terra Nova I-66
- White Rose C-30
- White Rose C-30 Z
- White Rose K-03
- North Amethyst E-17
- North Amethyst H-14

TOTAL: 15 Delineation Wells
targeting mostly the North Amethyst and
White Rose fields



4. Geology Summary of the Jeanne d'Arc Basin

- Jeanne d'Arc Basin and adjacent Central Ridge area are host to most of the significant petroleum discoveries in the Newfoundland offshore area (there are also gas discoveries off Labrador and a hydrocarbon discovery in Flemish Pass Basin). These discoveries include the four currently producing fields, Hebron and a series of satellites and field extensions which are now developed or planned for development
- The basin forms an elongate, roughly NE trending, large half-graben, encompassing an area of about 14,000 km². It is bounded to the west by the Murre Fault, to the north by the Cumberland Belt Transfer Zone (CBTZ) lineament, to the east by the Voyager Fault and to the south by the Egret Fault. The basin deepens to the north and shallows to the south, and contains over 20 km of Upper Triassic to Cenozoic sedimentary infill in its depocentre, situated to the north of the Trans-Basin Fault Zone (TBFZ) and northeast of Hibernia
- The sedimentary fill of this area was deposited, structured and fragmented during repeated extensional episodes. Infill includes clastics, salt and carbonates. Salt tectonics, minor trans-tensional tectonic movements and several strong erosional interludes have also reshaped the basin and its associated ridges

Geology Summary of the Jeanne d'Arc Basin

The basin fill can be divided into two major stratigraphic sequences that are clearly recognizable on seismic data:

- 1. An extensional stage sedimentary sequence* (Late Triassic to late Early Cretaceous) that is strongly compartmentalised by normal fault systems and contains numerous structures
- 2. A thermal subsidence stage sedimentary sequence* (Late Albian to Present) that is tectonically undisturbed (i.e. no extension), but contains remarkable depositional and erosional features, including basin margin and floor fans

Alongside extensional tectonics, prolonged halokinesis and halotectonics played an important role in basin evolution and architecture. Prominent salt-cored structures are presently found throughout the Grand Banks. Salt pillows underlay the Hibernia, Terra Nova and White Rose oil fields and most of the other structural features in the basin and on the Central Ridge

Jeanne d'Arc Basin Lithostratigraphy and Tectonic Evolution

• 3 stages of extensions

1, 2 and 3

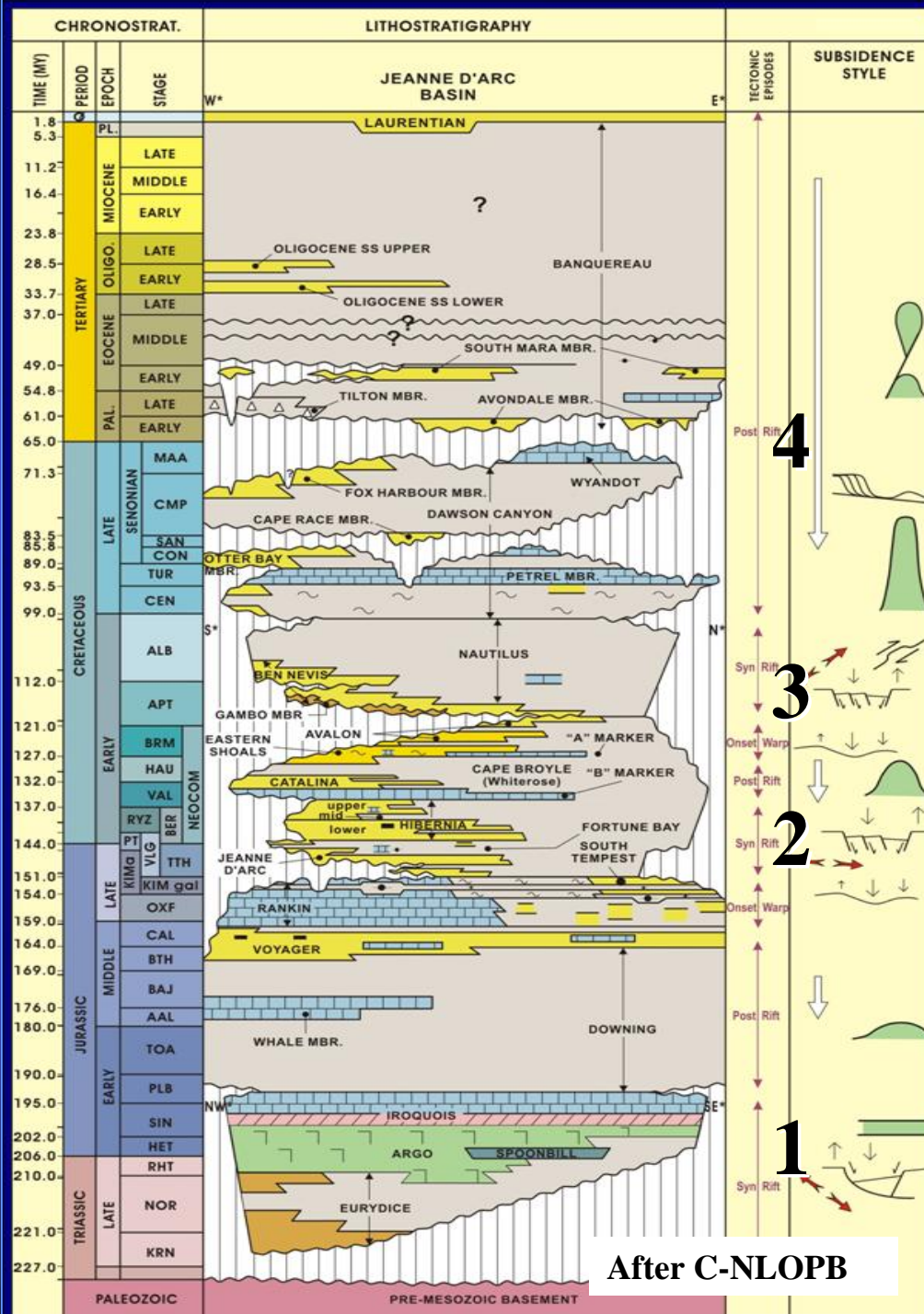
• 2 stages of transtension

2 and 3

• 1 stage of inversion

4

Variations of this chart are applied to other connected NL Mesozoic basins



Jeanne d'Arc Basin Recent Drilling

Summary Drilling Since 2005:

Development 59 wells: in Hibernia (33), Terra Nova (11), White Rose (11) and North Amethyst (4) fields

Delineation 15 wells: Terra Nova (1); White Rose (10); North Amethyst (2); West Bonne Bay (2)

Exploration 8 wells: 4 dry holes, 2 suspended and 2 oil discoveries

Observation. Rate of exploration drilling in the basin was very low but should pick up in the next few years as: 1) many ELs are getting close to expiry date, 2) development drilling is slowing down in Terra Nova and White Rose fields, 3) 2 semi submersible rigs are in the area under long term contract; 4) a new operator (Statoil operating Mizzen discovery and other exploration drilling) and a new entrant (Repsol) are looking for NL oil and gas production and 5) NL Government regulations and initiatives to streamline offshore E&P activity

Wells Drilled during 2008-10 within Jeanne d'Arc Basin

1. North Amethyst E-17 (Delineation) TD 2591 m

North Amethyst oil field is being developed as a White Rose satellite with first oil in May 2010 with an estimated production at peak of 37,000 bopd

2. White Rose E-28 (Delineation) TD 3435 m

W. White Rose pool is also being developed as a satellite tie-back to Sea Rose FPSO with first oil expected in 2010/11. A pilot development was approved by CNLOPB in August 2010.

3. Ballicaters M-96 (Exploration) TD 4017

Drilled in 2009 and targeting both EL 1113 and EL 1092; this was a multi-reservoir test for a fault-bounded rotated block within the Trans-Basin Fault Zone northeast of Hibernia field. It was suspended without testing when it probably encountered overpressure

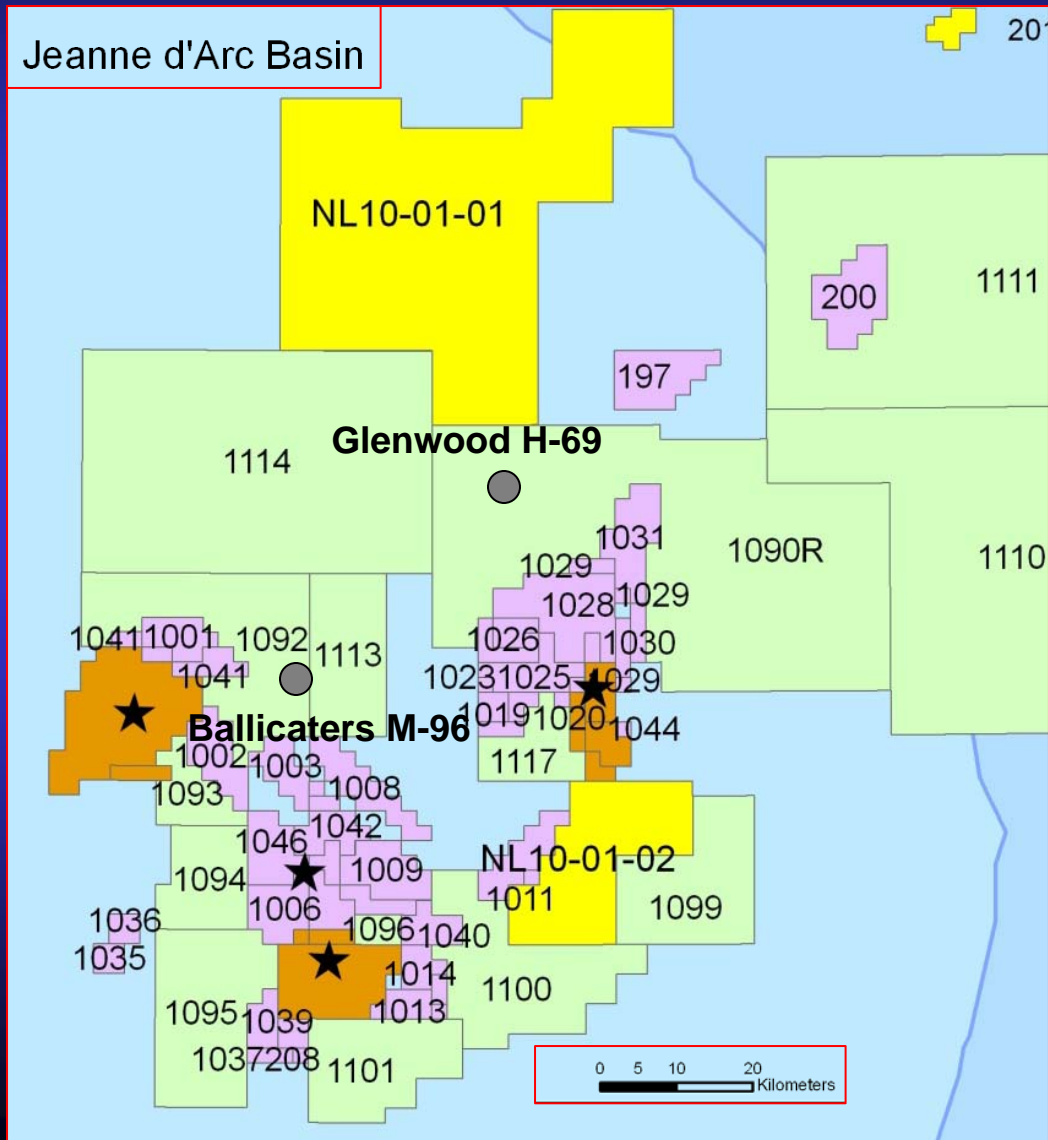
4. Glenwood H-69 (Exploration) TD 3668

Drilled in 2010 and targeting the consolidated EL 1090R; this was a multi-reservoir test for in Late Cretaceous and Tertiary submarine fans. It was suspended without testing when it probably encountered overpressure

5. North Amethyst H-14 (Delineation) TD 2611

Drilled in 2010 and targeting the southern end of the North Amethyst field within PL 1008

Jeanne d'Arc Basin and Environs Land Situation, 2008-2010 Exploration Drilling and Seismic Surveys



- Statoil has collected 738 km² 3D seismic data (2008) over ELs 1100, 1101 and the Terra Nova Field. The Terra Nova portion of the seismic survey was acquired as a 4D seismic survey over PL 1002
- In 2008 Husky Energy carried out an exclusive 3D seismic program acquiring 1437 km² over the White Rose Field, North Amethyst Field and ELs 1090R and 1099
- Except for well site surveys no seismic data was collected in 2009
- Husky Energy collected 3005 km of 2D data in Sydney Basin (Pz)

5. Petroleum Geology of the Jeanne d'Arc Basin

Source Rocks

Reservoir Rocks

Seals

Hydrocarbon Traps

Maturation and Migration

Hydrocarbon Plays and Risks

Egret Petroleum System



Petroleum Geology

- Jeanne d'Arc Basin is a prolific hydrocarbon basin that contains almost exclusively all the oil volumes discovered offshore Newfoundland
- The basin's infill contains structured synrift rock successions (includes evaporites, carbonates and coarse and fine clastics) ranging in age from Late Triassic to late Early Cretaceous (Extensional Stage sedimentary sequence)
- Oil prone source rocks are present in Late Jurassic (Callovian, Oxfordian and especially Kimmeridgian); the potential for other source rocks is recognized within the Early and Late Cretaceous and Early Tertiary
- The early sedimentary fill contains the Argo Salt that later became mobile and created salt induced structures in the overlying sediments (e.g. White Rose Diapir, Amethyst Ridge) (Enachescu et al., 2000)
- Post rift sedimentary sequence is represented by parallel, slightly deformed sedimentary layers (mainly fine clastics and thin chalk and carbonates)

Kimmeridgian Source Rock

Abundant Type II, oil prone source rock with up to 9% TOC

- Over 25 exploration wells have penetrated the Egret Mbr. source rock
- Four lithological components have been identified within the Egret Member of Rankin Fm. source interval: 1) a dark-brown laminated shale (most abundant and highest oil generation potential); 2) a grey to grey-brown shale; 3) a light brown marlstone/limestone; and 4) a fine-grained sandstone and siltstone (Bateman, 1995)
- Thickness ranging from 50 m to well over 500 m at Panther P-52
- Best marine source rock within the North Atlantic rift system
- Proven distribution in Jeanne d'Arc Basin to the south (Hibernia, Terra Nova, White Rose etc.) and to the east (Panther, S. Tempest, Bonanza)
- Proven distribution in northern Flemish Pass Basin (Baccalieu and Mizzen L-11 wells; seismically correlated around Mizzen O-16 well) (Jock McCracken et al., 2000; Enachescu et al., 2010)
- Occurs within north-south and/or northeast-southwest trending deep basins

Reservoirs

Reservoirs rocks in the Jeanne d'Arc Basin are predominantly high porosity-high permeability sandstone of Late Jurassic to late Early Cretaceous age. More than 98% of the discovered petroleum resides in these reservoir rock units.

- Stacked sandstone intervals within the Jeanne d'Arc, Hibernia, Catalina and Avalon/Ben Nevis formations are proven quality reservoirs. Most of these reservoirs are alluvial or deltaic
- Individual wells have tested in excess of 50,000 bopd from the Hibernia Sandstone at Hibernia, and in excess of 40,000 bopd from the Jeanne d'Arc Sandstone at Terra Nova
- Excellent reservoirs are found in Late Jurassic Voyager and Late Cretaceous Dawson Canyon formations (Otter Bay and Fox Harbour mbrs) and the Paleocene Avondale and South Mara mbrs of the Banquereau Fm, but to date only a couple of smaller pools have been encountered at these levels
- Early Tertiary sequence has a real and effectively untested potential for large oil and gas pools (especially to the north and in deep water)

Seals

Finding good seals should not be a problem in the Jeanne d'Arc Basin as the extensional and thermal subsidence stages contains a succession of very fine clastics, tight sandstones and carbonates

- Oil and gas accumulations are sealed by thick overlying shales abundant during the Late Jurassic to Late Cretaceous (e.g. Fortune Bay, Cape Broyle (White Rose), and Nautilus shales)
- Also intra-formational shales are widespread within the rift stage clastic sequences
- Excellent regional seals are provided by fine grained Late Cretaceous Dawson Canyon Fm. and the Tertiary fine clastics Banquereau Fm
- Cross-faults sealing risk exist throughout the basin

Hydrocarbon Traps

Structural traps in the Jeanne d'Arc Basin are associated with rifting of the Newfoundland Margin, subsidence and formation of the deep extensional basin and movement of the Argo salt

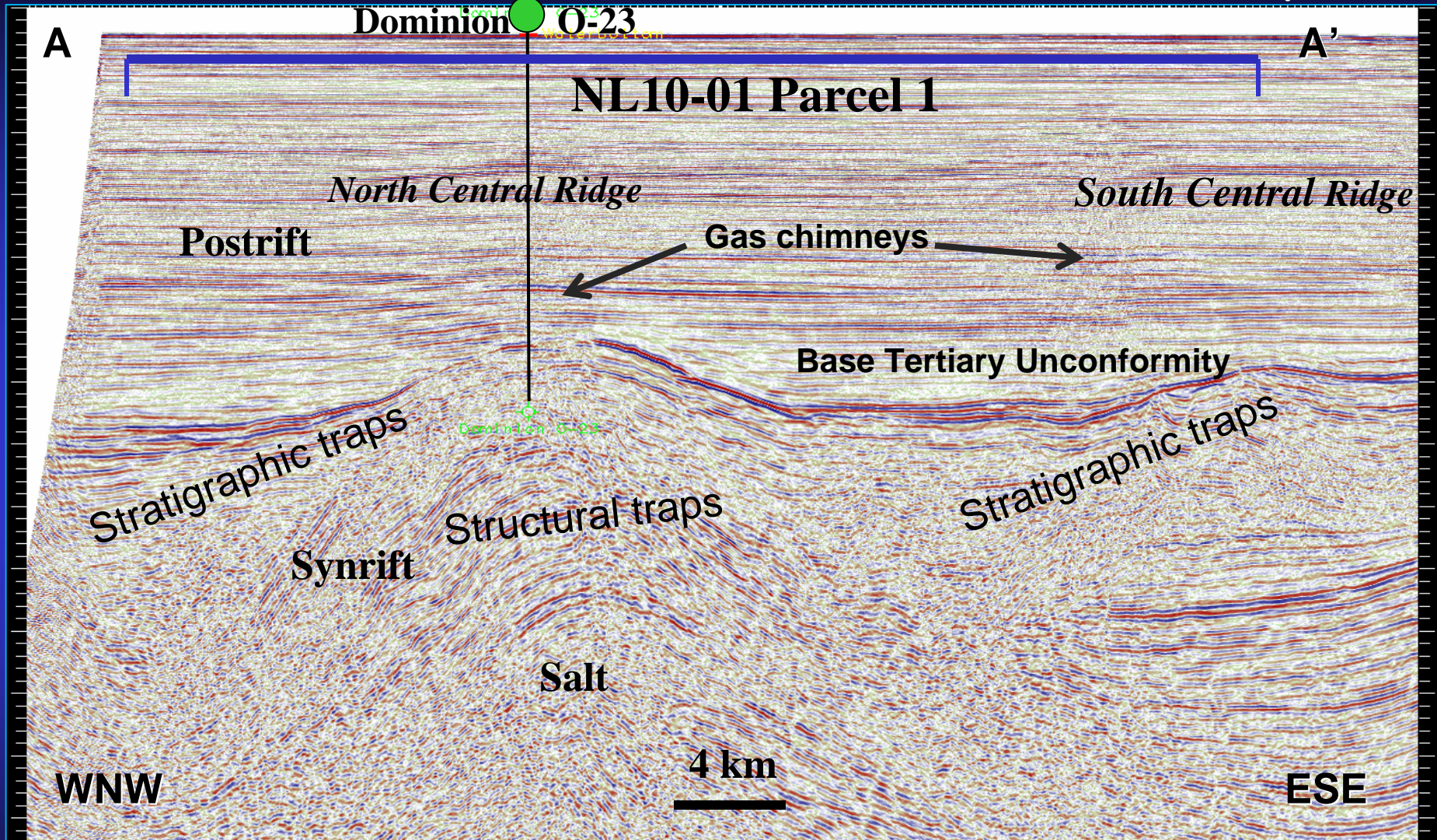
- The main structural traps are extensional anticlines, roll-overs, faulted anticlines, faulted and tilted blocks and elongated horsts
- Numerous salt induced structures such as pillows, domes, diapirs, ridges, allochthonous teardrops and turtle anticlines are common
- The great majority of faults are listric normal faults, but some transfer faults, accommodation zones and local inversions due to transtension and halokinesis are also forming traps
- Most of the discovered fields have a stratigraphic trapping component
- Stratigraphic traps are widespread. Paleo-valleys, basin margin and basin floor fans are abundant in the basin and contain some discovered resources

Hydrocarbons Traps

- All major traps have a stratigraphic component as the accumulations are contained in continental, deltaic and shallow marine sandstones onlapping or wrapped over the main structural features
- Many complex or solely stratigraphic traps remain to be drilled, as well as deeper faulted blocks and rollover structures in the central and northern part of the basin
- Historically, the basin margin plays were found to be most successful
- In the northeastern part of the basin where Parcel 1 is located deformation of reservoir beds is caused by extension along the Central Ridge margins, Dominion Transfer Zone and diapirism along the Adolphus-Conquest salt lineament
- On the east-central part of the basin, where Parcel 2 is located, the deformation of infill is due mainly to block rotation caused by the Voyager Fault and its imbricates down-stepping basinward

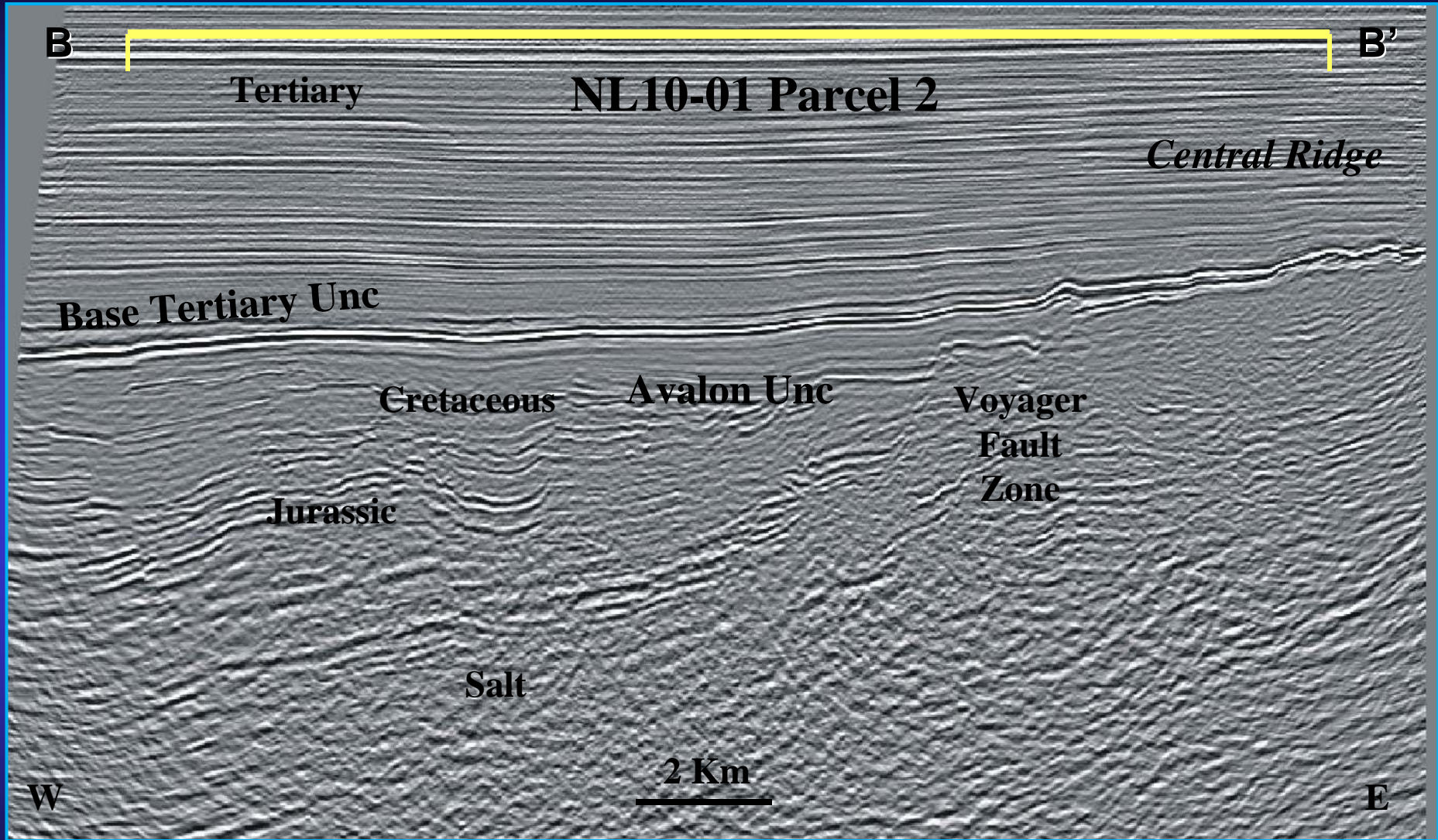
Seismic Dip Line GA01-103

Courtesy of GSI



Uninterpreted WNW-ESE regional seismic section GA01-103 showing possible hydrocarbon traps in Parcel 1

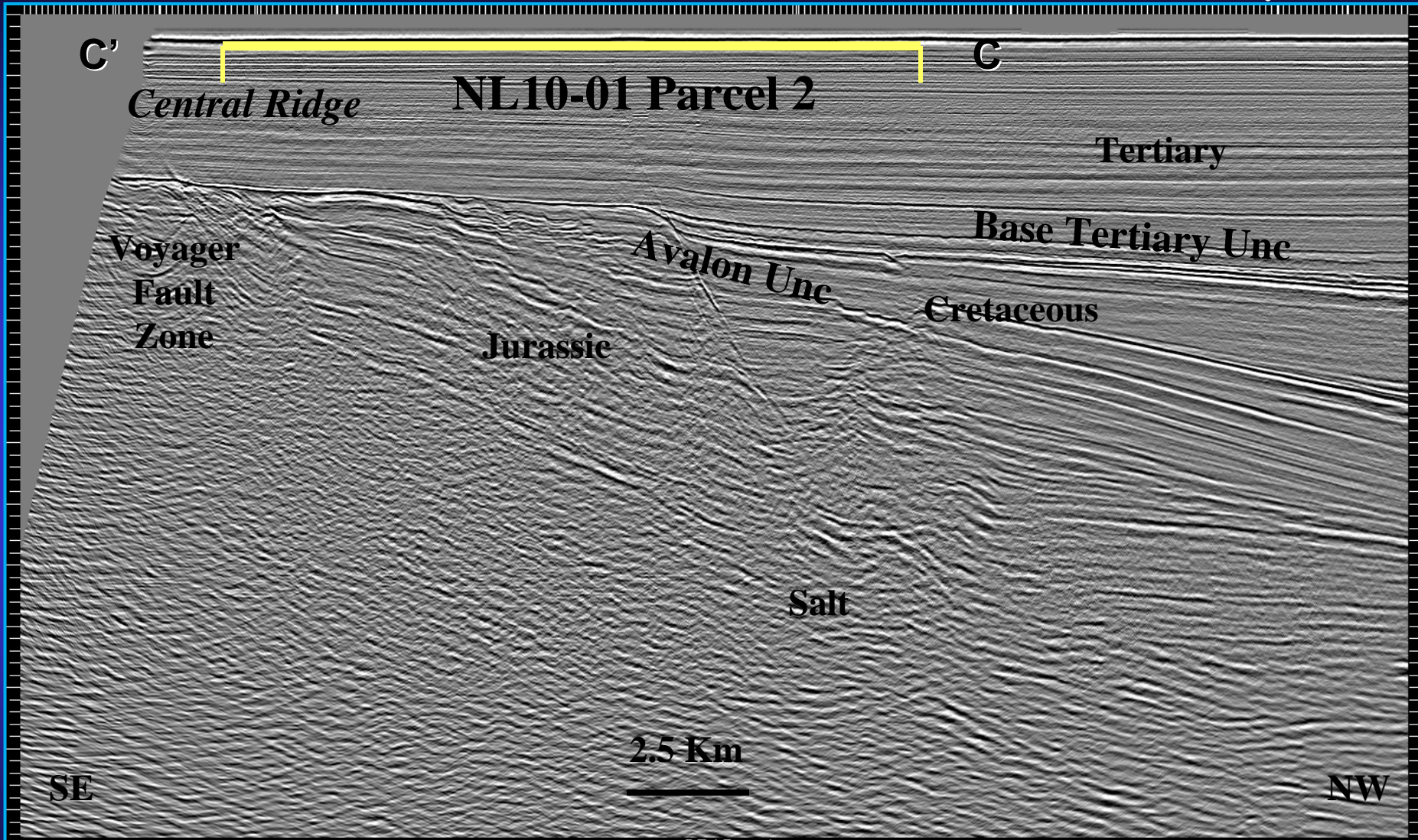
Seismic Dip Line



Uninterpreted W-E regional seismic section showing possible hydrocarbon traps in Parcel 2

Seismic Dip Line GSIGB-105

Courtesy of GSI



Uninterpreted SE-NW regional seismic section GSIGB-105 showing possible hydrocarbon traps in Parcel 2

Maturation and Migration

- Maturation of Late Jurassic source rock starts in mid-Early Cretaceous and continue into Tertiary
- Petroleum expulsion starts at approximately 3800 m and ends at 5800 m
- Expulsed hydrocarbons have migrated mainly vertically, predominantly along the numerous extensional faults
- Some lateral migration occurred locally along basin flanks, but long path migration is not common
- Late migration of hydrocarbons occurred within the Late Cretaceous-Early Tertiary basin marginal fans and sand filled canyons

Hydrocarbon Plays

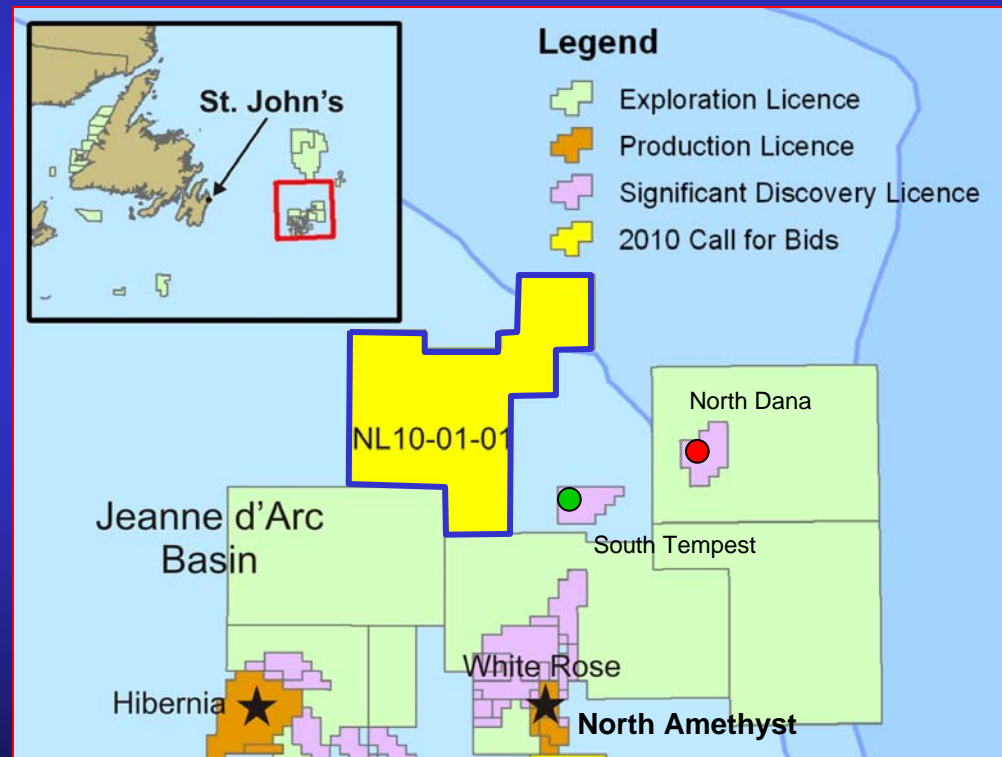
- Three main conventional plays are recognized in Jeanne d'Arc Basin (Enachescu, 1987 and 2007; Tankard and Welsink, 1987; Grant and McAlpine, 1987):
 - 1) Late Jurassic Jeanne d'Arc SS
 - 2) Early Cretaceous Hibernia SS
 - 3) late Early Cretaceous Avalon/Ben Nevis SS
- Near and on the Central and Eastern Ridges the main play is:
 - 4) Kimmeridgian Tempest SS
- Additional play may be the mid-Jurassic Voyager SS
- Other Jurassic, Cretaceous and Early Tertiary SS make secondary plays
- Sandstones are trapped in faulted blocks, parts of large, rotated blocks, salt cored anticlines or ridges

Egret Petroleum System

- All prerequisites for the formation of large oil and gas accumulations have been identified and confirmed in the Jeanne d'Arc Basin
- Egret Mbr of the Rankin Formation (Kimmeridgian aged) anchors a rich, proven petroleum system
- The most sought after drilling targets are structural or combination traps, with plays in the Jeanne d'Arc, Hibernia, Avalon and Ben Nevis formations; Tempest Sandstones are proven reservoirs in the vicinity of both Parcel 1 and 2
- Faulted blocks are particularly successful and exist on the flanks of the basin, in the Trans-Basin Fault Zone and north central part of the basin

6.1. Petroleum Potential of Call for Bids NL10-01 Parcel 1

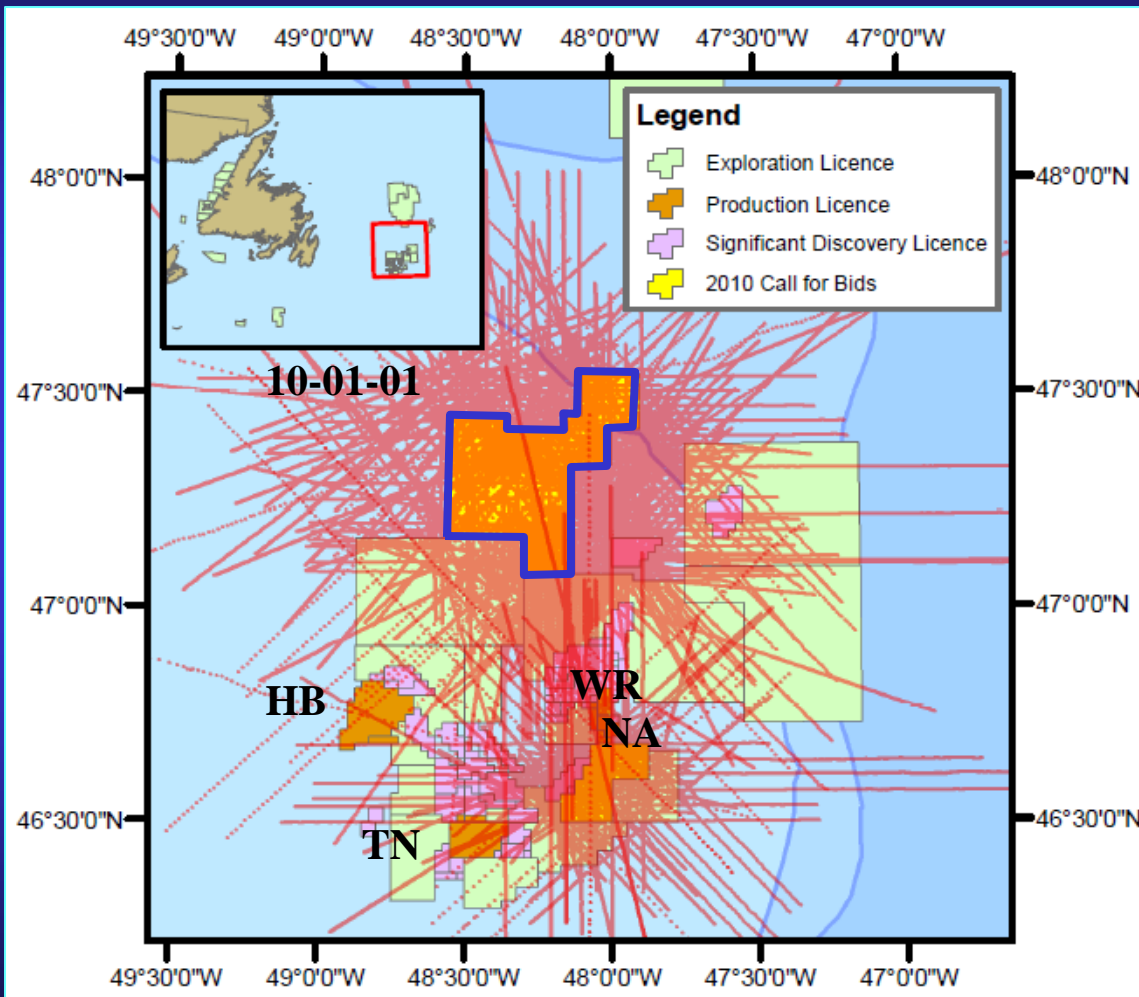
- Parcel 1 covers a very large area of 139,617 ha (345,000 acres) situated in the north-eastern part of the Jeanne d'Arc Basin
- This shallow water parcel (120 to 230 m WD) is located north-northwest of White Rose and northeast of Hibernia oil producing fields
- Parcel is closer to other oil and gas non-producing SDLs such as South Tempest oil discovery and North Dana gas discovery
- Structurally the Parcel is located within the JDB, on the Adolphus-Conquest salt diapir trend and partially on the Central Ridge (Enachescu, 1987 and 1988)



Seismic Coverage

- More than 3000 km of high quality 2D line km is available for petroleum evaluation of this parcel; a large 3D seismic program covers the southern part of parcel
- The 2D seismic grid has 0.3-1 km spacing in the dip direction and .5-1 km spacing in the strike direction
- Digital data covering the parcel and environs is owned by oil companies that acquired the data when they had exploration licenses over the area in the late 1970s-early 1980s (Husky, ExxonMobil, Suncor (Petro-Canada) etc.)
- Other seismic sets are available in digital form for licensing from seismic companies (GSI, WesternGeco, CGGVeritas, TGS, etc.)
- WesternGeco has modern 3D data in the southern part of the Parcel
- Parts of the 1980s seismic data base owned and processed by HGS and owned now by GSI cover the parcel; GSI has also new data collected from the late 1990 to early 2000s and acquired with longer cables (6 to 8 km)

2D Seismic Coverage

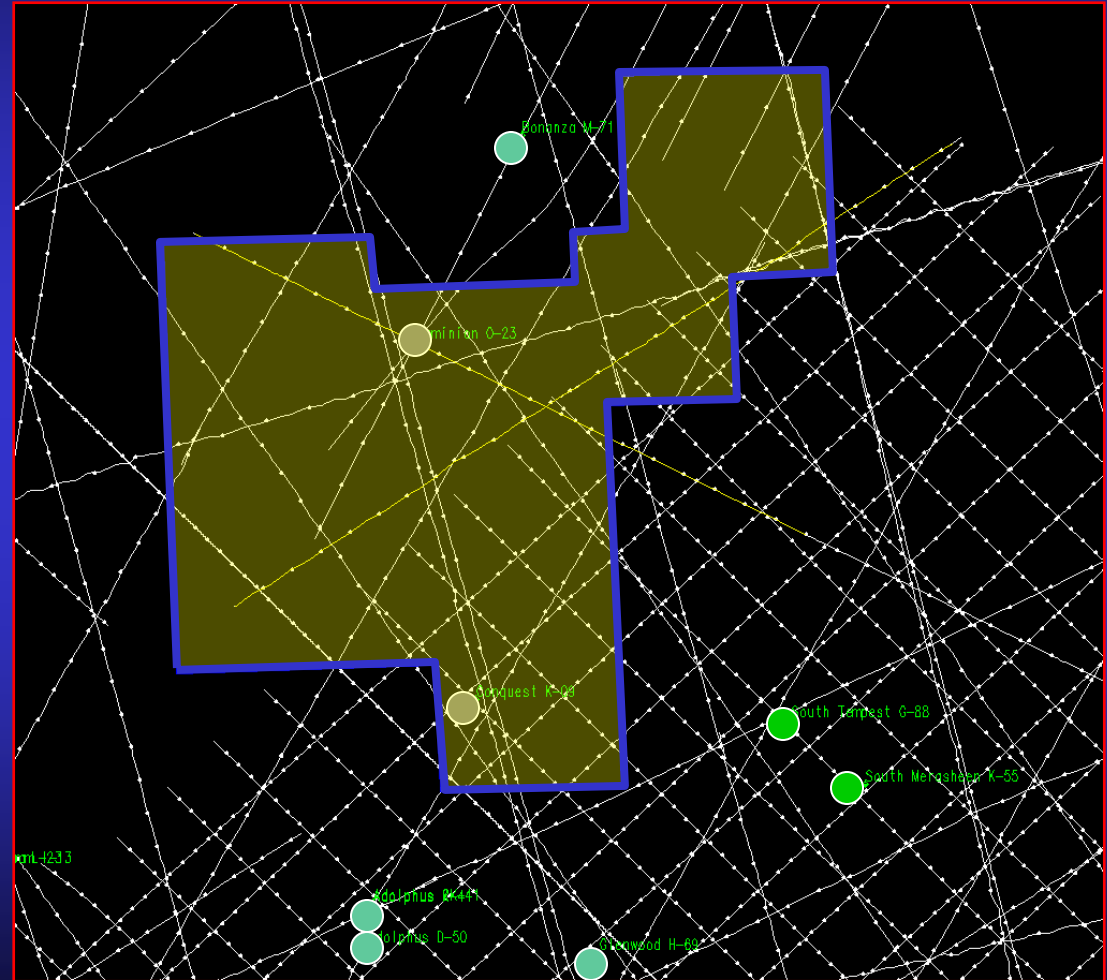


- Seismic data quality is good to excellent for Parcel 1 and environs
- Majority of lines are post-stack time migrated; most recent data and some reprocessed lines have pre-stack time migration applied
- Marine data was acquired with a 3-4.5 km streamer length during late 1970s-early 1980s and with a 6 km length during late 1990s-early 2000s
- The regional 2D grid is oriented NW-SE or W-E (dip lines) intersecting NE-SW or N-S tie lines (strike direction)
- The 2D grid provides an almost continuous coverage of the parcel; however several coverage gaps exist

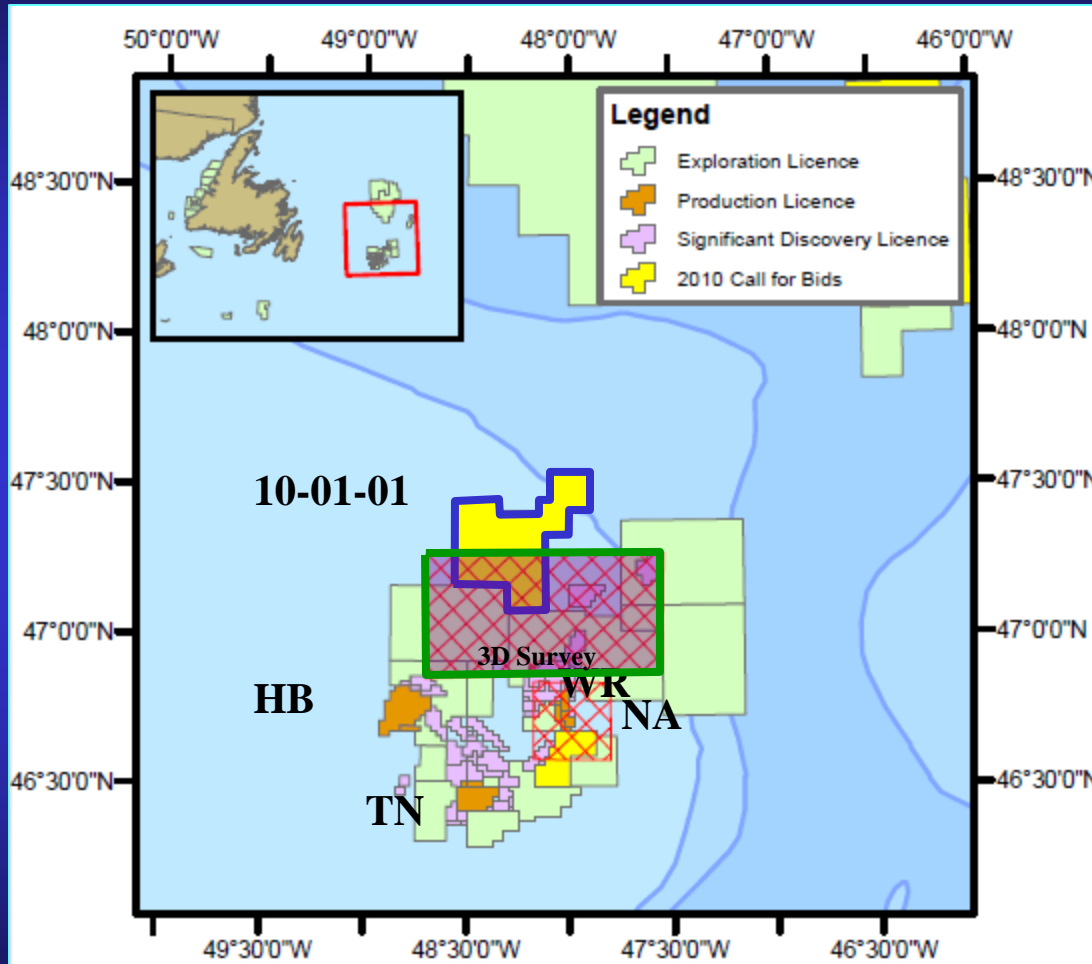
CFB NL10-01 Parcel 1, adjacent Exploration Licenses and current seismic coverage

GSI 2D Seismic Coverage

- GSI of Calgary has an extensive seismic coverage in Parcel 1 with lines mostly oriented NW-SE and NE-SW
- Seismic data quality is good to excellent
- The data is denser in the southern and eastern part of the parcel
- GSI data allows tying the exploration wells within the parcels and other important wells adjacent to the parcel
- The 1980s seismic data processing has designature applied in shot domain, velocity filters, velocity analysis every km, normal moveout and post stack Kircchoff f-k domain migration. Most lines are 40-80 fold.
- GSI has a large number of lines recorded in the late 1990 to early 2000s acquired with 6 to 8 km cable length and processed to pre-stack time migration
- Above comments are valid for GSI seismic coverage in Parcel 2 described in the next section



3D Seismic Coverage



CFB NL10-01 Parcel 1, adjacent Exploration Licenses and current 3D seismic coverage

- A large non-exclusive 3D survey was recorded by WesternGeco in the central-eastern part of the basin during 1999 and processed in 2000; a portion of this survey, the Badger Block covers the southern part of Parcel 1
- Eight 4.6 km and 2 flip/flop mode sources were used with 25 m shot point interval resulting in a 46 fold coverage
- The direction of acquisition was east-west, almost perpendicular on area's major tectonic and structural elements
- Data was recorded to 8 sec and processed with a 2 ms sampling rate
- This marine data was processed to prestack time migration
- Final processed cube has in-lines spaced at 25 m interval

WR = White Rose Field

HB = Hebron Field

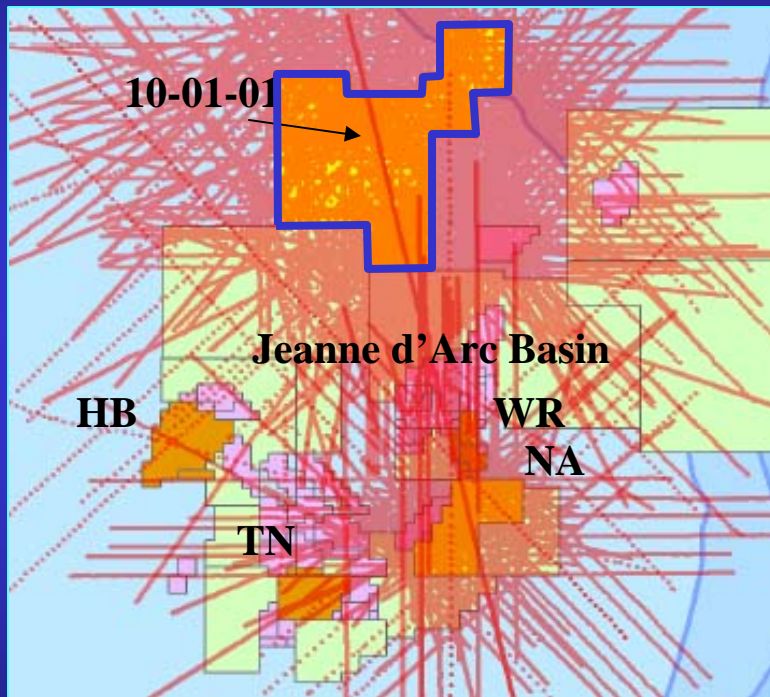
TN = Terra Nova

NA = North Amethyst

Comments on Seismic Data Quality

- Both 2D and 3D data quality is good to very good in the Late Jurassic-Tertiary sequence but deteriorates in the Late Triassic-Late Jurassic interval
- Best markers are the Mid-Miocene Unconformity, Base Tertiary Unconformity, Avalon Unconformity, A and B Markers (when present)
- Top Jurassic and Top Salt Markers have variable quality
- Major and secondary faults are easy traceable
- On some 2D lines, deep energy penetration lacks and fault and salt wall imaging are poor due to use of insufficient streamer length;
- Reprocessing might be needed on some of the lines to improve data quality at depth

Availability of Seismic Coverage



WR = White Rose Field

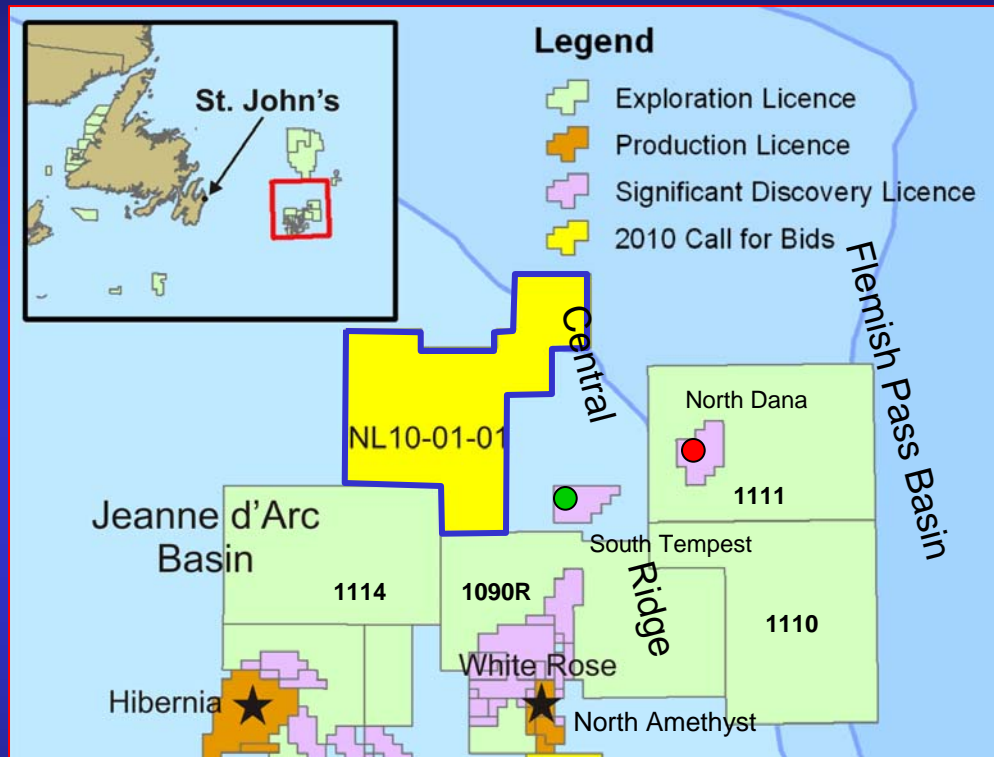
HB = Hebron Field

TN = Terra Nova

NA = North Amethyst

- Parcel NL10-01-01 seismic coverage can be purchased as digital data from oil companies owners, seismic contractors or data brokers in Calgary
- 2D line hard copies can be obtained from C-NLOPB in St. John's, NL, for the cost of reproduction
- Data grids older than 1980s are available from C-NLOPB only as individual seismic line hard copies or in microfiches

Seismic Interpretation

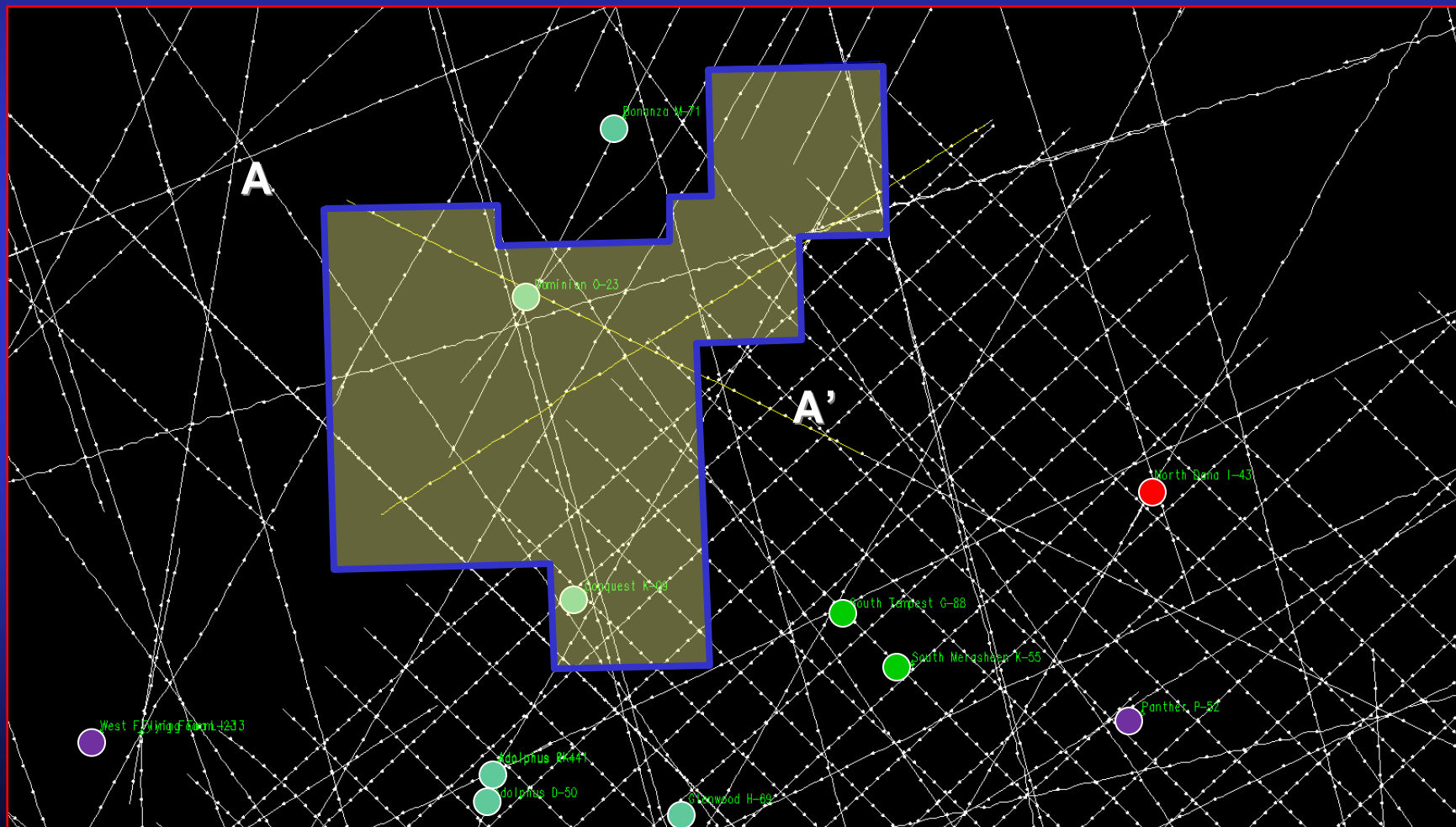


CFB NL10-01 Parcel 1, oil and gas fields, adjacent Exploration Licences and SDLs

Good quality 2D and 3D seismic coverage allows for mapping of several regional unconformities, formation tops, intra-formational markers and carbonate and sandstone horizons

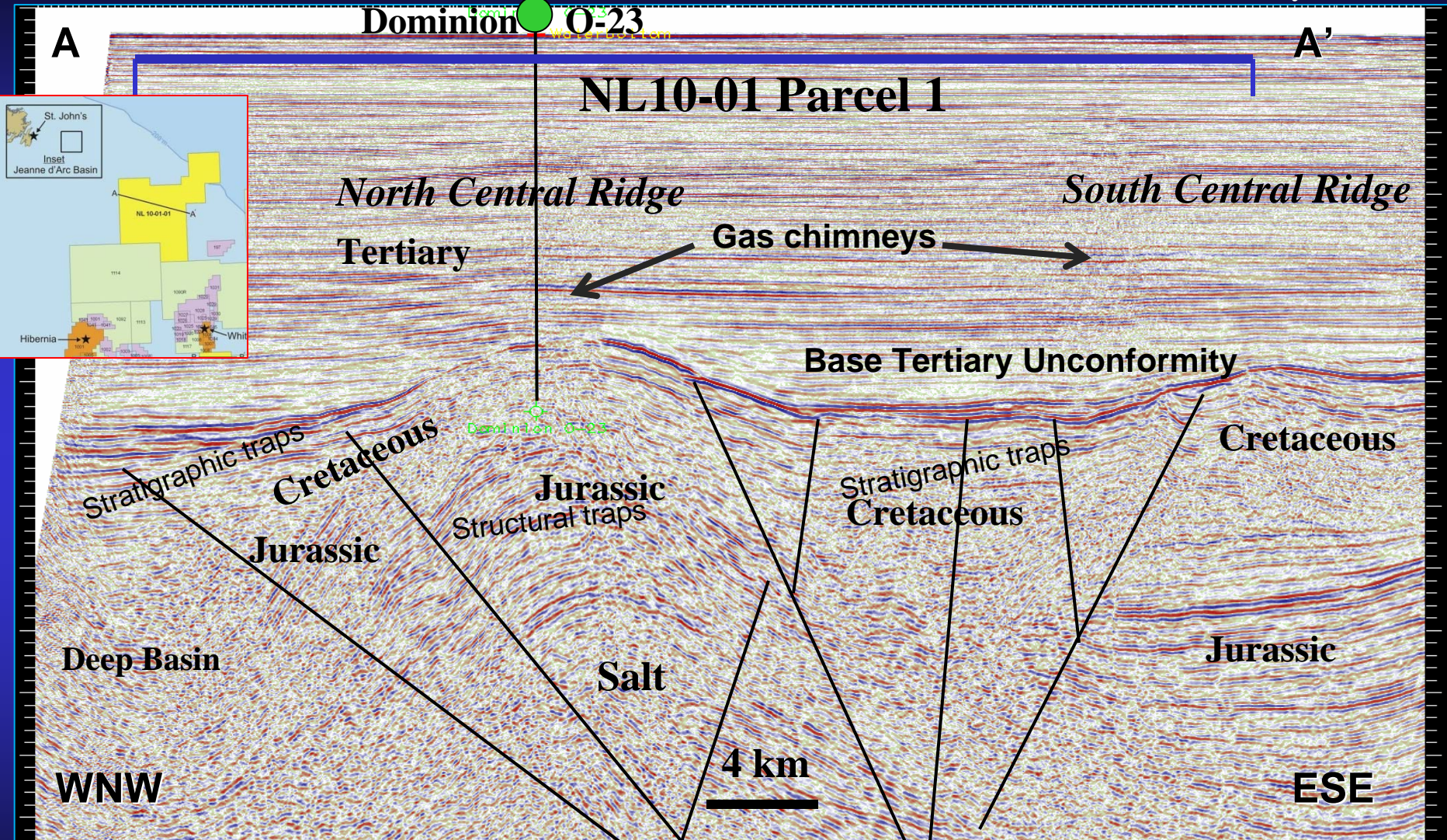
Older exploration maps are available as company reports or regional studies from the C-NLOPB archive

Significant Wells within and near Parcel 1 and GSI 2D Seismic Coverage



Seismic Dip Line GA01-103 A-A'

Courtesy of GSI



Interpreted WNW-ESE regional seismic section GA01-103 showing possible hydrocarbon traps in Parcel 1. More faults than shown affect the Central Ridge area

Seismic Line GA01-103 A-A'

- This regional dip line (WNW-ESE) starts in the west on Crown Land, crosses the central part of the Parcel 1 and terminates in Crown Land
- Structurally, the line starts in the deep basin, crosses a faulted area on the North Central Ridge, probably salt or basement cored, intersects the Ridge's crestal zone where the dry hole Dominion O-23 was drilled in 1974, then intersects a synclinal/transform area (Dominion Transform?) and finally terminates on the South Central Ridge just north of the South Tempest G-88 oil discovery
- The Dominion O-23 well TDed in Fortune Bay shales without testing possible older reservoirs; younger reservoir rocks may be present on the flank of the Dominion High and in the eastern syncline

Seismic Interpretation Discussion

- Regional seismic data can easily be tied with synthetic seismograms to several exploration wells situated inside and outside of the Parcel 1
- Full synrift sequence including reservoir sandstone of Late Jurassic to late Early Cretaceous exist in Parcel NL10-01-01; postrift sequence is thick and contain reservoirs in Late Cretaceous and Early Tertiary sandstones
- Potential reservoirs in synrift sequence include the proven Hibernia and Avalon-Ben Nevis sandstones that should be encountered on the flanks of salt structures and down dip from the North Central and South Central ridges.
- Reservoir quality Tempest Sandstones of the Rankin Formation have been encountered in five adjacent wells; Tempest Sandstone is the tested reservoir in the South Tempest and North Dana fields
- Tempest sandstone can be drilled with moderately deep wells in this Parcel (approximate 3200-4500 m)
- Faults dissect the synrift sequence; only several major faults are affecting the thermal subsidence sequence

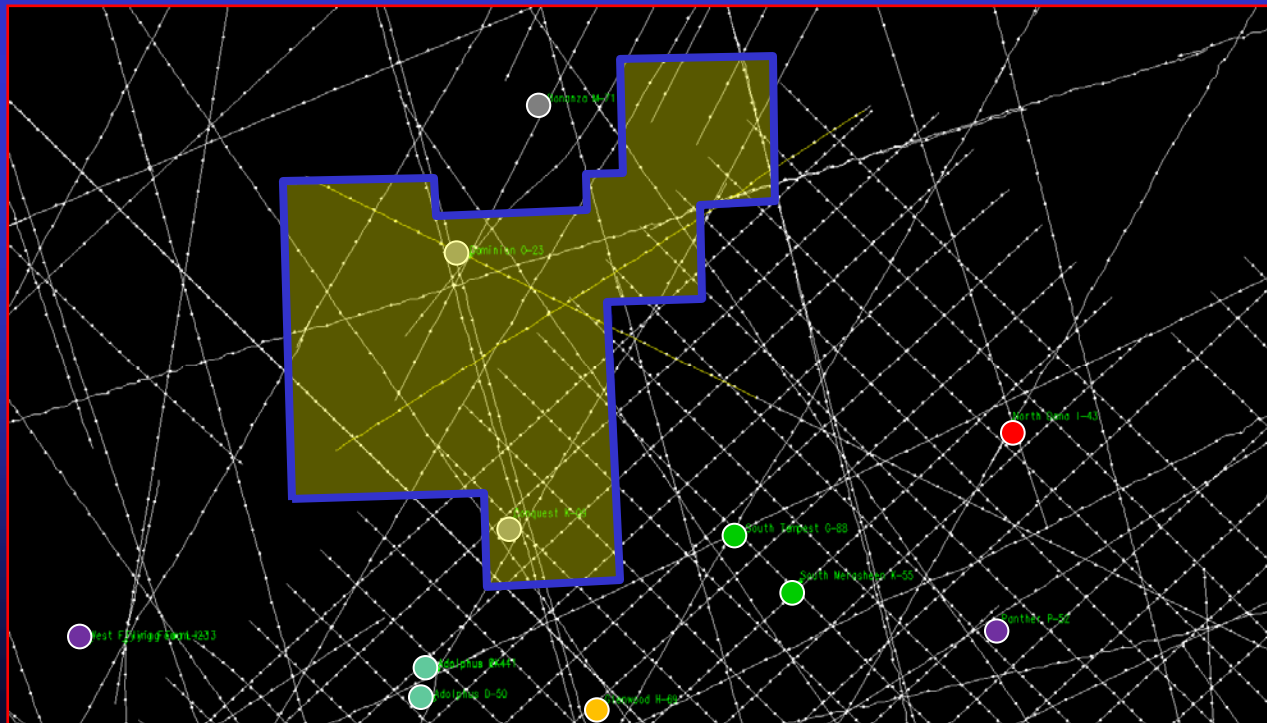
Observation: On the illustrative seismic section only a few markers, formations and faults are displayed

Hydrocarbon Traps in Parcel 1

- A multitude of traps exists in the parcel. The synrift sequence is rich in structural traps; the postrift sequence contains mostly stratigraphic traps; combination traps may exist on the northern and easterly plunge of the salt-cored Conquest Ridge and surrounding the Central Ridge
- All accumulations found to date in the basin are normally pressured in structural/combination traps; however, due to increased drilling depths in the northern part of the basin, where parcel is partially located, overpressure may be encountered
- Structural Traps are extensional features such as: rotated blocks, horsts and faulted rollover or salt induced anticlines. Within the basinal part of the parcel these traps may contain Late Jurassic to late Early Cretaceous coarse clastics. On the fringes of the Central Ridge, Kimmeridgian and early sandstones (Tempest, Voyager, etc.) may be trapped
- Stratigraphic traps are of the pinchout, onlap, truncation, lens, basin floor fan types containing predominantly Early to Late Cretaceous age and possibly Early Tertiary sandstones

Significant Wells within Parcel 1

Well	Drilled	WD m	Status	Location	TD m	Ben Nevis	Avalon	Hibernia	Test	Producer/Dry	Source rocks
Conquest K-09	1985	136	Aband	South Parcel	4968	NP	NP	NP	No	Dry	Not penetrated
Dominion O-23	1974	161	Aband	North Parcel	3998	2814 m	?	NP	No	Dry	Not penetrated



Well Legend

- Gas Discovery
- Oil Discovery
- Oil Show
- Dry Hole
- Not Public Yet
- Thickest Source Rock Intersected

Significant Wells Discussion

- Conquest and Dominion dry wells were drilled within the Parcel 1
- Conquest targeted a salt induced anticline while Dominion drilled a basement dome; both highs were bald of the main Late Jurassic-Early Cretaceous reservoirs, but had younger wet reservoirs; they did not reach Tempest and Voyager sandstones
- 10 wells were drilled in vicinity of Parcel 1
- 5 wells were abandoned without encountering hydrocarbons
- 2 wells encountered oil shows (**South Merasheen K-55** and **Adolphus 2K-41**); 2K-41 tested 268 bopd of 31° API gravity oil
- **South Tempest G-88** tested 1250 bopd of 42° API gravity and 5MMcf/d. An estimated oil reserve of 8 MMbbls is given by C-NLOPB to this field, however evaluation was performed by taking into account only a few fault blocks in the vicinity of discovery well location
- **North Dana I-43** tested 12.8MMcf/d and 292 bopd condensate. An estimated gas reserve of about 0.5 Tcf and 11 MMbbls condensate is given by C-NLOPB to this gas field
- The producing interval for both discoveries is the “Tempest Sandstone” of Kimmeridgian age

Maturation and Migration in the Parcel 1

- In most of Parcel 1 the Late Jurassic rocks should be at depths between 3 and 6 km; thus the Egret source rocks should be in the mature range
- In several parts of the parcel the source rock may be even deeper and therefore overmature and may have generated both oil and gas
- The South Tempest G-88 well, drilled closed to Parcel 1 on the South Central Ridge, proved that mature source rock and migration of oil into fault traps took place on the Grand Banks' intra-basinal ridges
- After trap formation during the synrift stage, there were direct migration routes through porous sandstone beds and numerous normal faults from the Egret Mbr. shale into younger sandstone reservoirs
- On ridges, migration also took place into sandstone reservoirs older than Kimmeridgian
- Source rocks older than Egret source rocks (e.g. Oxfordian) are also mature in the parcel

Hydrocarbon Plays in Parcel 1

- Located south and east of the Parcel, the White Rose oil and gas field, the South Tempest oil discovery and the North Dana gas discoveries indicate that a working petroleum system anchored by *the Egret source rock might extend to the north and northwest into Parcel 1*
- The late synrift Ben Nevis succession including reservoir sandstones deepens north-westward into the basin through numerous steps, as extension has created local horsts and rotated blocks bounded by deep penetrating faults
- Late Jurassic and Early Cretaceous sandstones are present in the synclines between the salt and basement cored ridges, and are trapped in the parcel. The sandstone reservoirs may be sourced from Kimmeridgian or older source rocks
- The northern plunge of the Flying Foam Anticline with its associated deep plays are also present in the southwestern part of Parcel 1

Prospects and Leads – Parcel 1

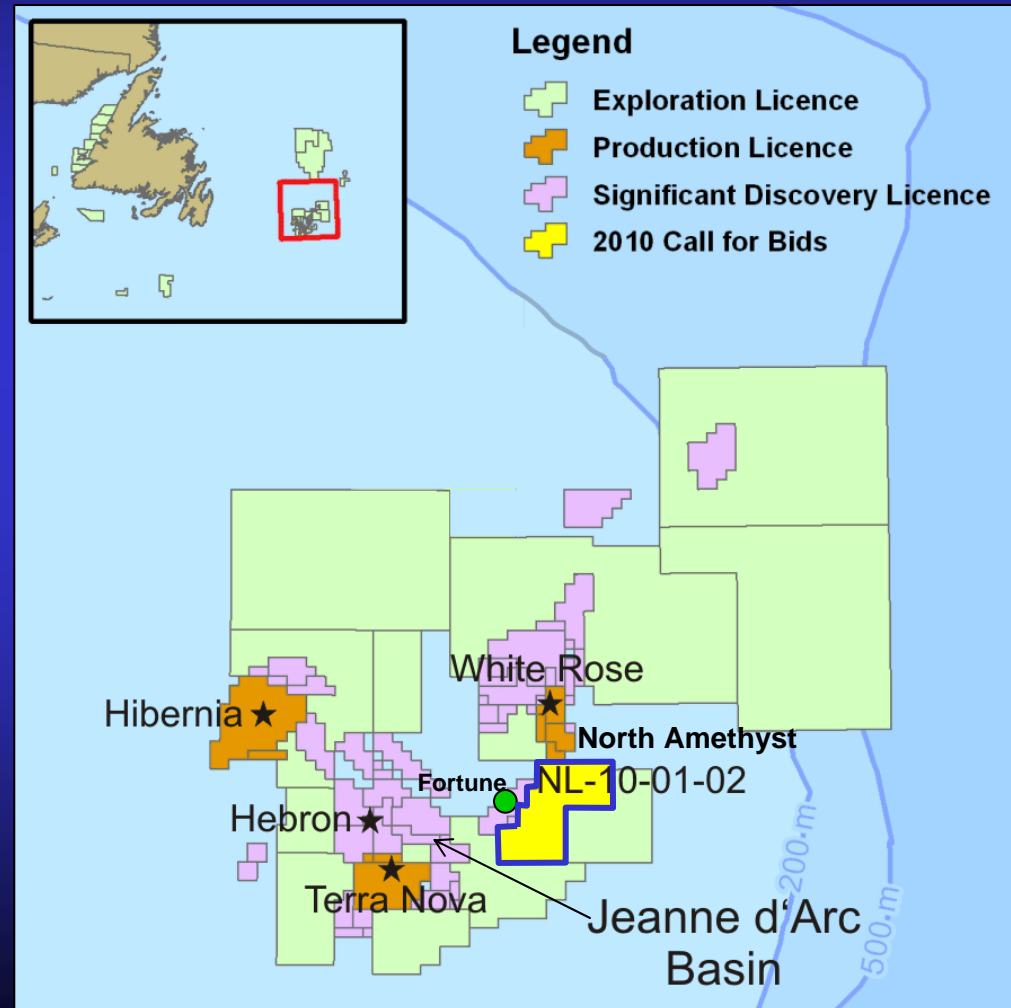
- Several large rotated blocks within the Dominion High and the synclinal area between the North and South Central ridges are the most important structural leads in the parcel. They may involve porous synrift sandstones trapped within multi-sided fault bounded blocks
- Several fault dependent closures that may include the Tempest and Voyager sandstone as pay zones can be mapped within the parcel
- Large fault dependent closures each capable of holding over 100 MMbbls oil recoverable are interpreted on the 2D seismic grid
- Stratigraphic leads exist on the flanks of salt induced anticlines and on the flanks of the Central Ridge
- Source rocks are found at expulsion depths of 3800-5800m beneath the synclines and some of the rotated blocks which may source the leads; Source rock may be eroded on some of the ridges and high blocks
- Seismic amplitude variations are seen in the late Early Cretaceous, Late Cretaceous and Early Tertiary sequences; The variation of seismic amplitude within some of the markers, amplitude anomalies around faults and gas chimneys and curtains may indicate hydrocarbons flow

Discussions – Parcel 1

- There is no production infrastructure in this part of the basin
- The closest production on this side of the Jeanne d'Arc Basin exists at the White Rose field, which has three glory holes and producing wells tied back to the Sea Rose FPSO
- An oil field larger than 100 million barrels recoverable found in this parcel can be a candidate for a stand alone development
- Exploration in this part of the Jeanne d'Arc Basin is light; many large to medium size leads are visible on seismic data
- Several oil prospects and leads identified in the parcel with post-1985 2D and 3D seismic data are still waiting to be completely mapped and drilled
- Parcel NL10-01-01 is well covered by good quality speculative 2D and partially by 3D non-exclusive seismic data
- This data can be easily reprocessed for better structural and stratigraphic imaging; moreover, prestack and poststack analysis of the data as well as Controlled-Source EM surveys may help reduce drilling risk

6.2. Petroleum Potential of Call for Bids NL10-01 Parcels 2

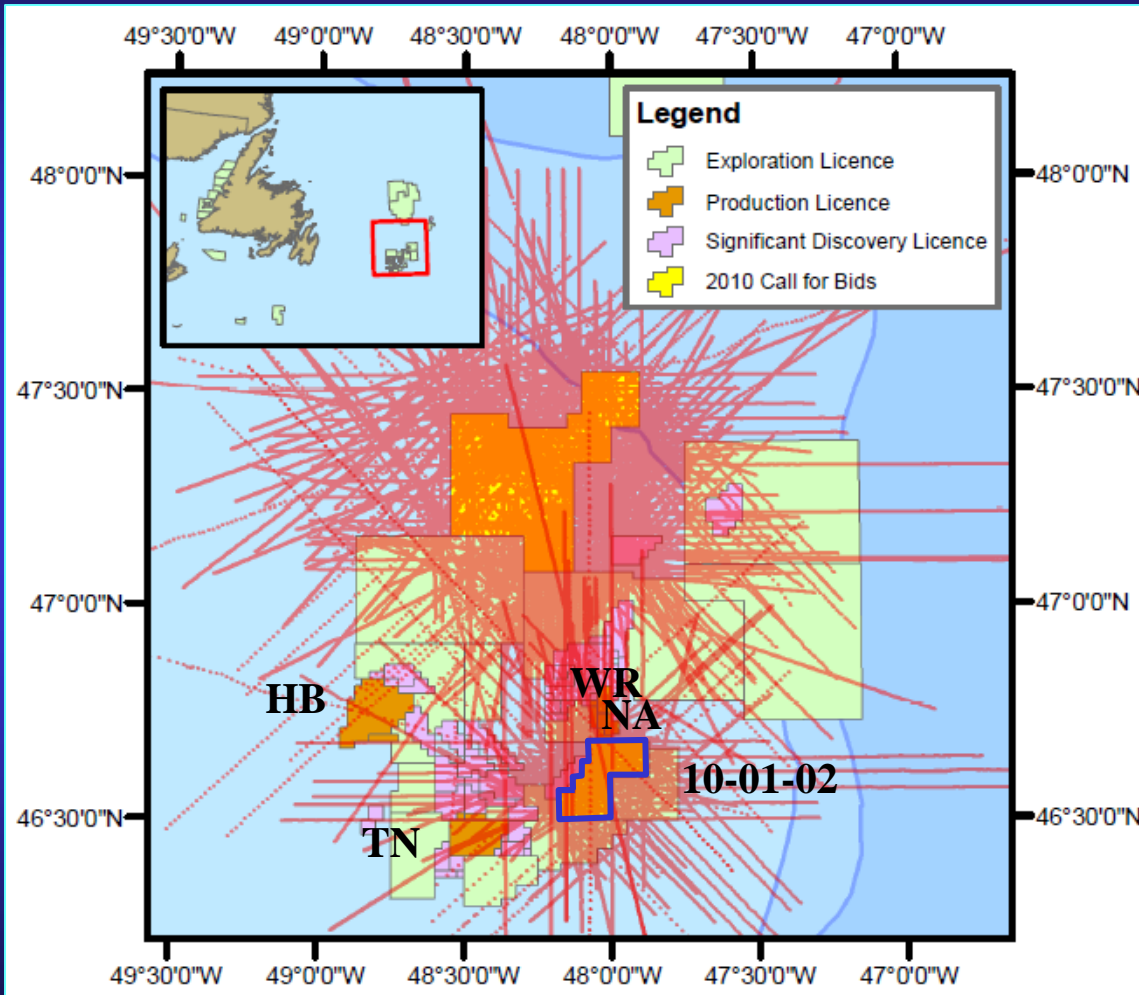
- Parcel 2 covers 29,783 hectares (73,595 acres), in the central-eastern part of the Jeanne d'Arc Basin
- This shallow water parcel (100 to 150 m WD) is close to oil producing White Rose field and situated immediately south of the newly producing North Amethyst field
- Parcel 2 is closer to other significant oil discoveries such as the North Ben Nevis and Fortune fields
- Parcel 2 is located on the Central Ridge, the north-westerly plunging, downthrown block of Voyager Fault and partially within the deep basin



Seismic Coverage

- More than 4000 km of high quality 2D and E 3D is available for petroleum evaluation of Parcel 1; A 3D program covers the northern part of parcel
- The 2D seismic grid has 0.2-0.5 km spacing in the dip direction and .5-1 km spacing in the strike direction
- Digital data covering the parcel and environs is owned by oil companies that acquired the data when they had exploration licenses over the area in the late 1970s-early 1980s (Husky, ExxonMobil, Suncor (Petro-Canada) etc.); these line were collected with short 3-4 km cable lengths
- Other seismic sets recorded with longer cables are available in digital form for licensing from seismic companies (GSI, WesternGeco, CGGVeritas, TGS, etc.)
- Modern 3D data acquired by a group of companies (Esso operator) exists in the northern part of the parcel
- GSI has Exploration 3D data in the western part of the parcel that was acquired with one streamer-one source in the late 1980s and was interpolated to 50 m spacing between lines
- GSI has also new 2D data from the late 1990 to early 2000s acquired with longer cables (6 to 8 km)

2D Seismic Coverage

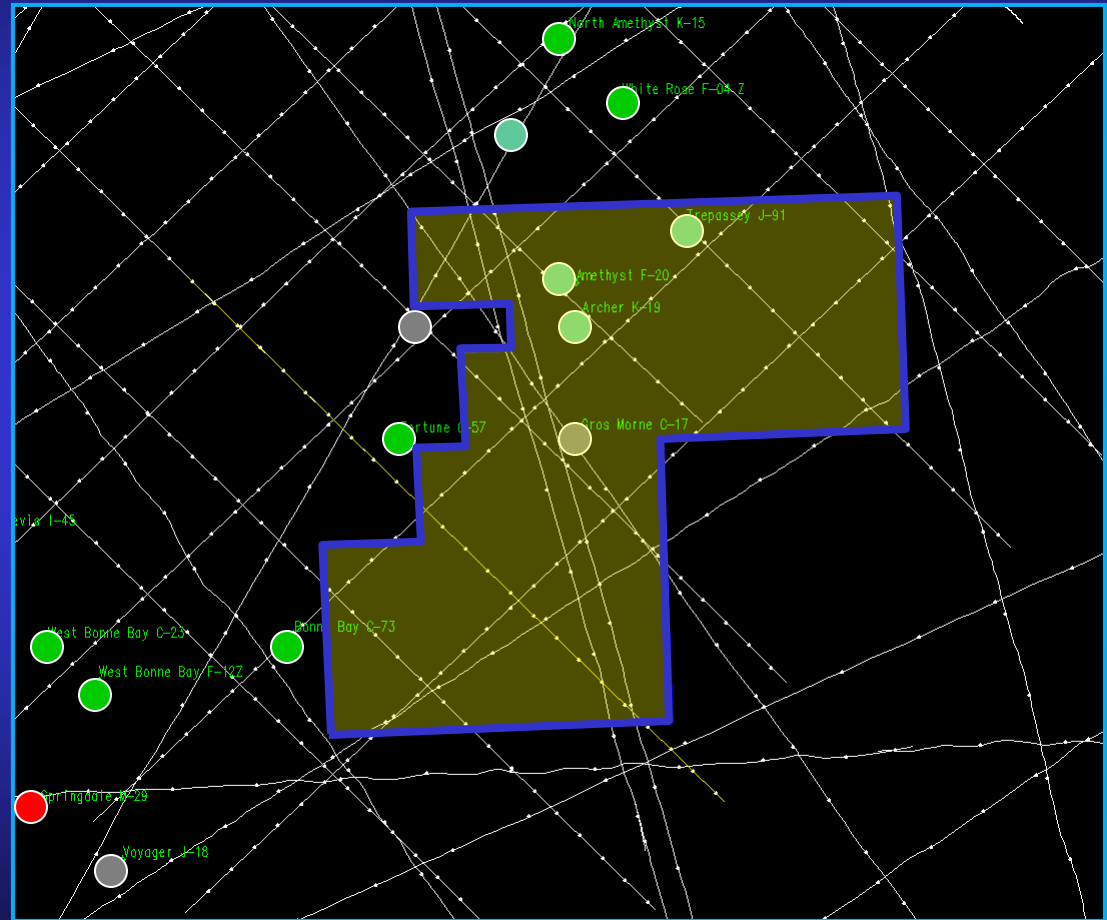


- Seismic data quality is generally good to excellent for Parcel 2 and environs
- Most lines are post-stack time migrated; most recent data and some reprocessed lines have pre-stack time migration applied
- Marine data was acquired with a 3-4.5 km streamer length during late 1970s-early 1980s and with a 6 km length during late 1990s-early 2000s
- The regional 2D grid is oriented W-E (dip lines) N-S tie lines (strike direction)
- Another regional 2D grid is oriented NW-SE (dip lines) intersecting NE-SW tie lines (strike direction)

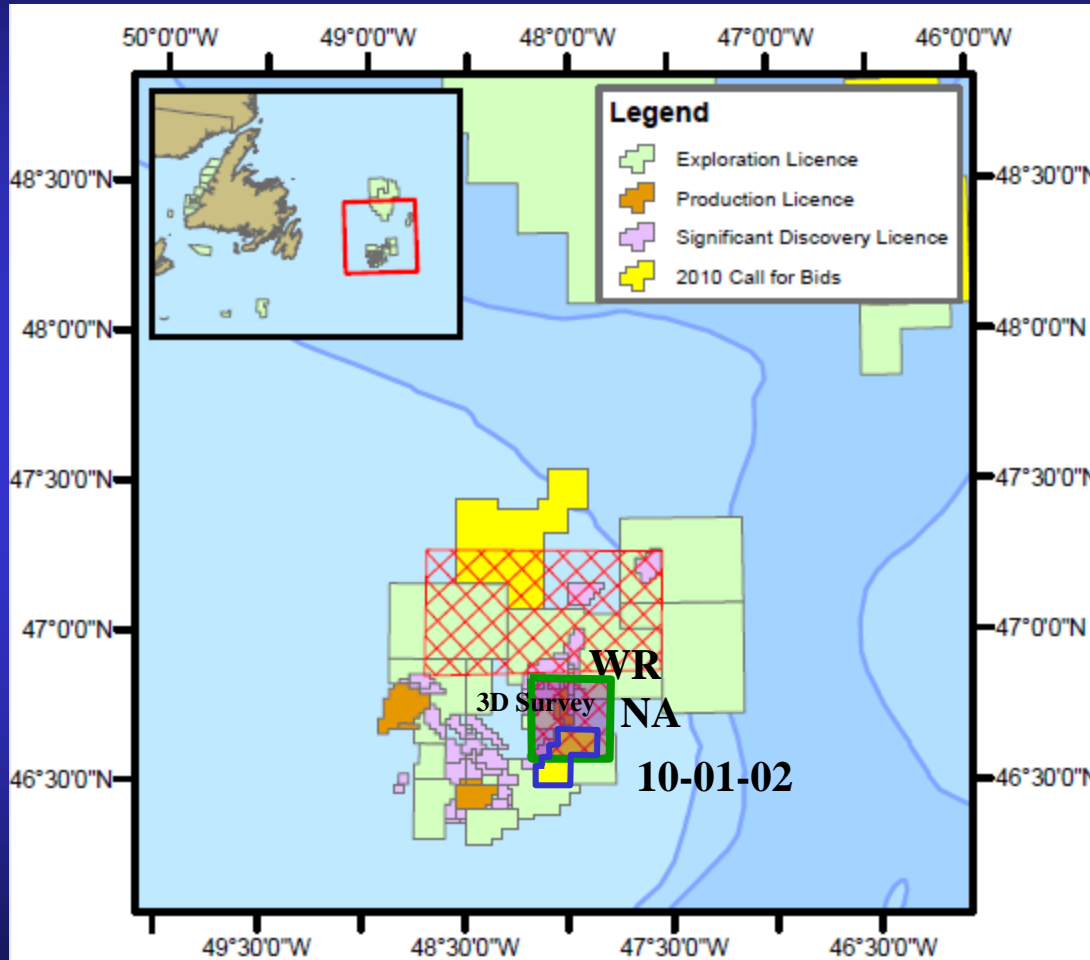
CFB NL10-01 Parcel 2, adjacent Exploration Licenses and current seismic coverage

GSI 2D Seismic Coverage

- GSI of Calgary has good seismic coverage in Parcel 2; most 2D lines are oriented NW-SE and NE-SW
- Seismic data quality is fair to excellent
- Their data allows tying several of the exploration wells within the parcels and other important wells adjacent to the parcel
- The 1980s seismic data processing done by HGS and owned now by GSI has designature applied in shot domain, velocity filters, velocity analysis every km, normal moveout and post stack Kirchoff f-k domain migration. Most lines are 40-80 fold
- GSI also has lines recorded in the late 1990 to early 2000s acquired with 6 to 8 km cable length and processed to pre-stack time migration



3D Seismic Coverage



CFB NL10-01 Parcel 2, adjacent Exploration Licenses and current 3D seismic coverage

In 1990 a 3D survey was acquired by WesternGeco for a group of companies led by Esso Resources Canada

This survey covered the southern part of White Rose and North Amethyst fields and includes the northern part of Parcel 2

The 3D survey was recorded in an east-west direction using two 3.3 km long streamers and 2 sources fired at 18.75 shot point interval, resulting in a 37.5 m line interval

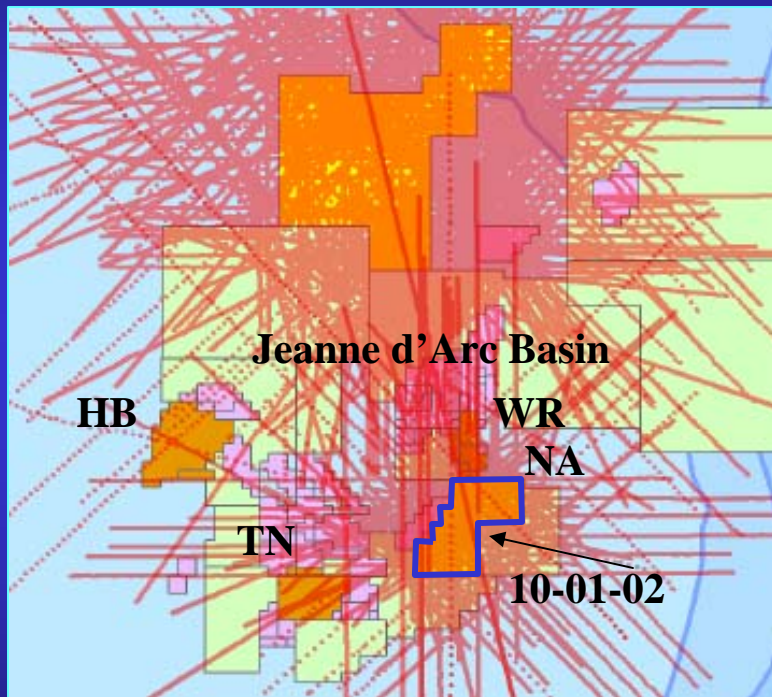
Record length was 6 sec and sampling rate 2 ms

This marine data was processed to post-stack time migration using a Kirccoff algorithm

Comments on Seismic Data Quality

- Both 2D and 3D data quality is good to very good in the Late Jurassic-Tertiary sequence but deteriorates in the Late Triassic-Late Jurassic interval
- The existent 2D grid provides an almost continuous coverage of the parcel; however several coverage gaps exist
- The 3D survey acquired with modern in-sea layout and processed to post-stack time migration has good quality and is available from the data owners
- GSI Exploration 3D extends only over the western part of the parcel; it has good quality and is available for licensing
- Best seismic markers are the Mid-Miocene Unconformity, Base Tertiary Unconformity, Avalon Unconformity, A and B Markers (when present) and Top Jurassic
- Top Basement and Top Salt Markers have variable quality
- Main and secondary faults are easy traceable
- Imaging is poor on some 2D lines acquired with short streamer length; data is also poor in the high velocity sequence under the Central Ridge
- Reprocessing might be needed on some of the lines to improve data quality at depth and on the ridge

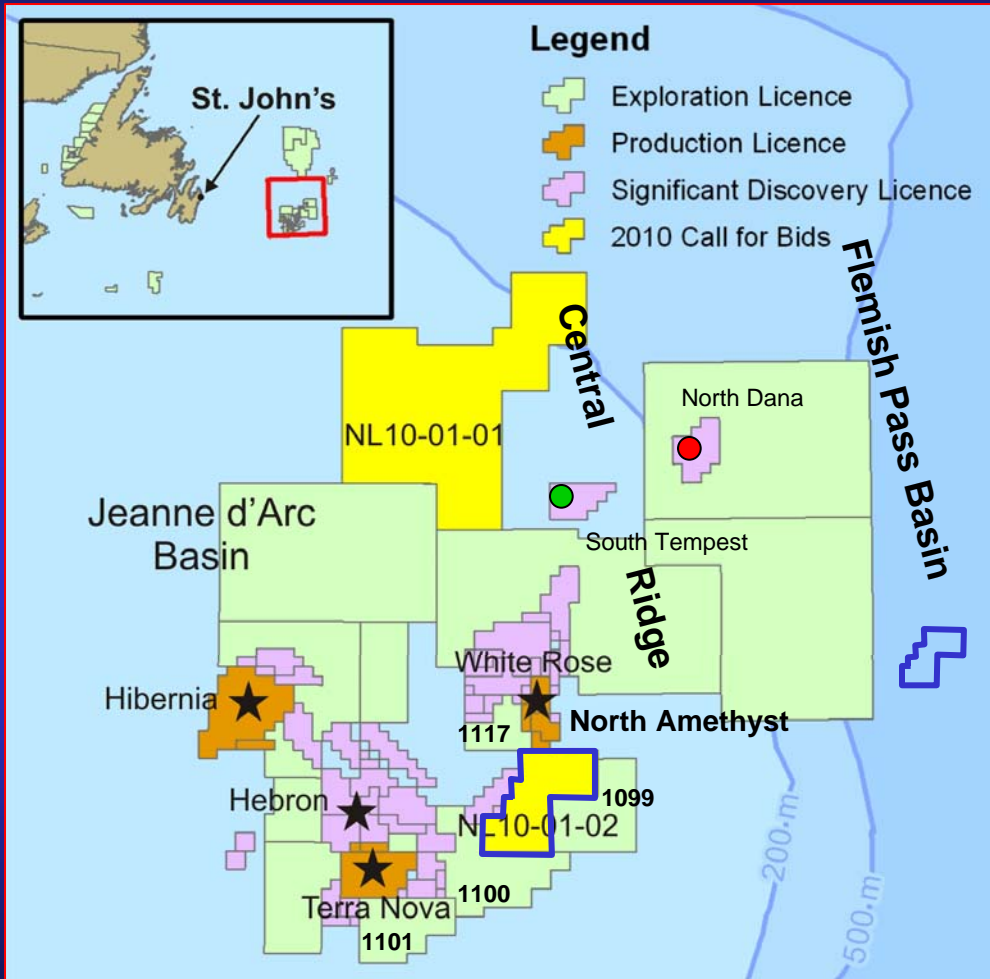
Availability of Seismic Coverage



WR = White Rose Field
HB = Hebron Field
TN = Terra Nova
NA = North Amethyst

- Parcel NL10-01-02 seismic coverage can be purchased as digital data from oil companies owners, seismic contractors or data brokers in Calgary; 3D data is available from data owners; some exclusive data (e.g. proprietary 3D) may not be available
- 2D line hard copies can be obtained from C-NLOPB in St. John's, NL, for the cost of reproduction
- Data grids older than 1980s are available from C-NLOPB only as individual seismic line hard copies or in microfiches

Seismic Interpretation

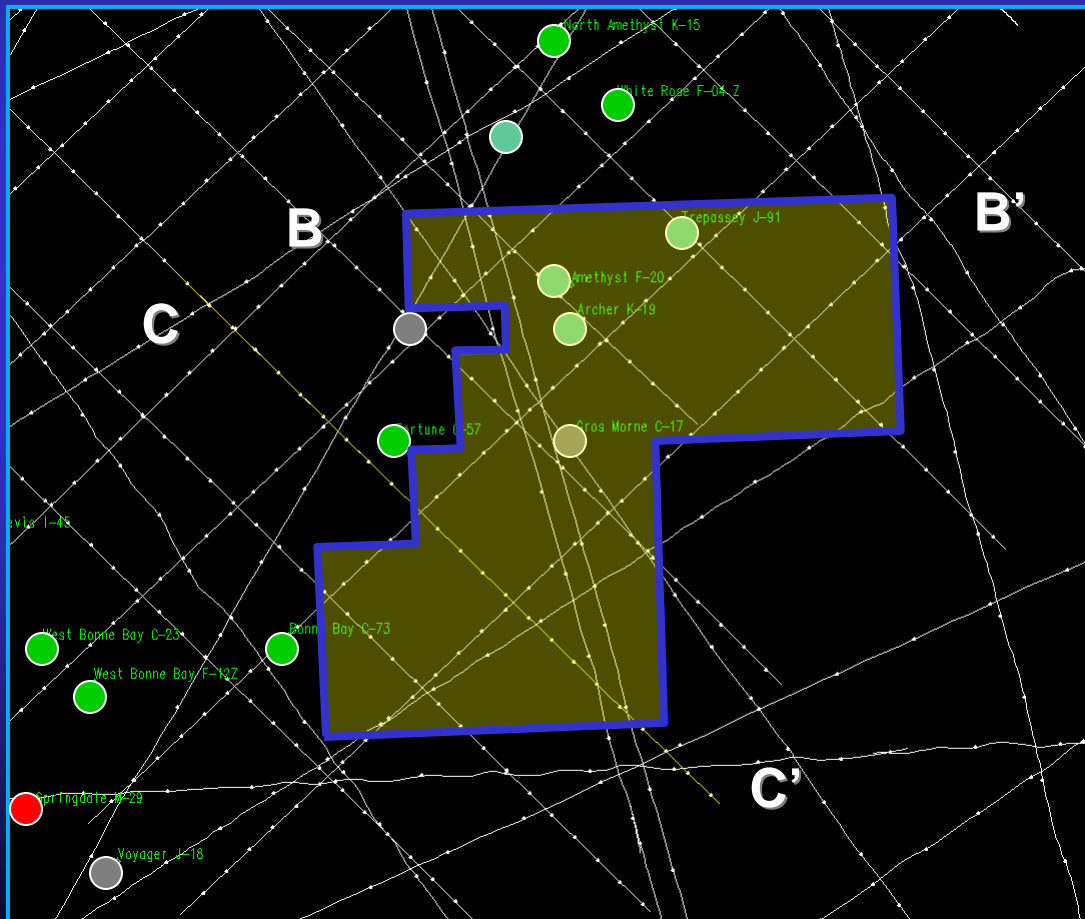


Good quality 2D and 3D seismic coverage allows for mapping of several regional unconformities, formation tops, intra-formational markers and carbonate and sandstone horizons

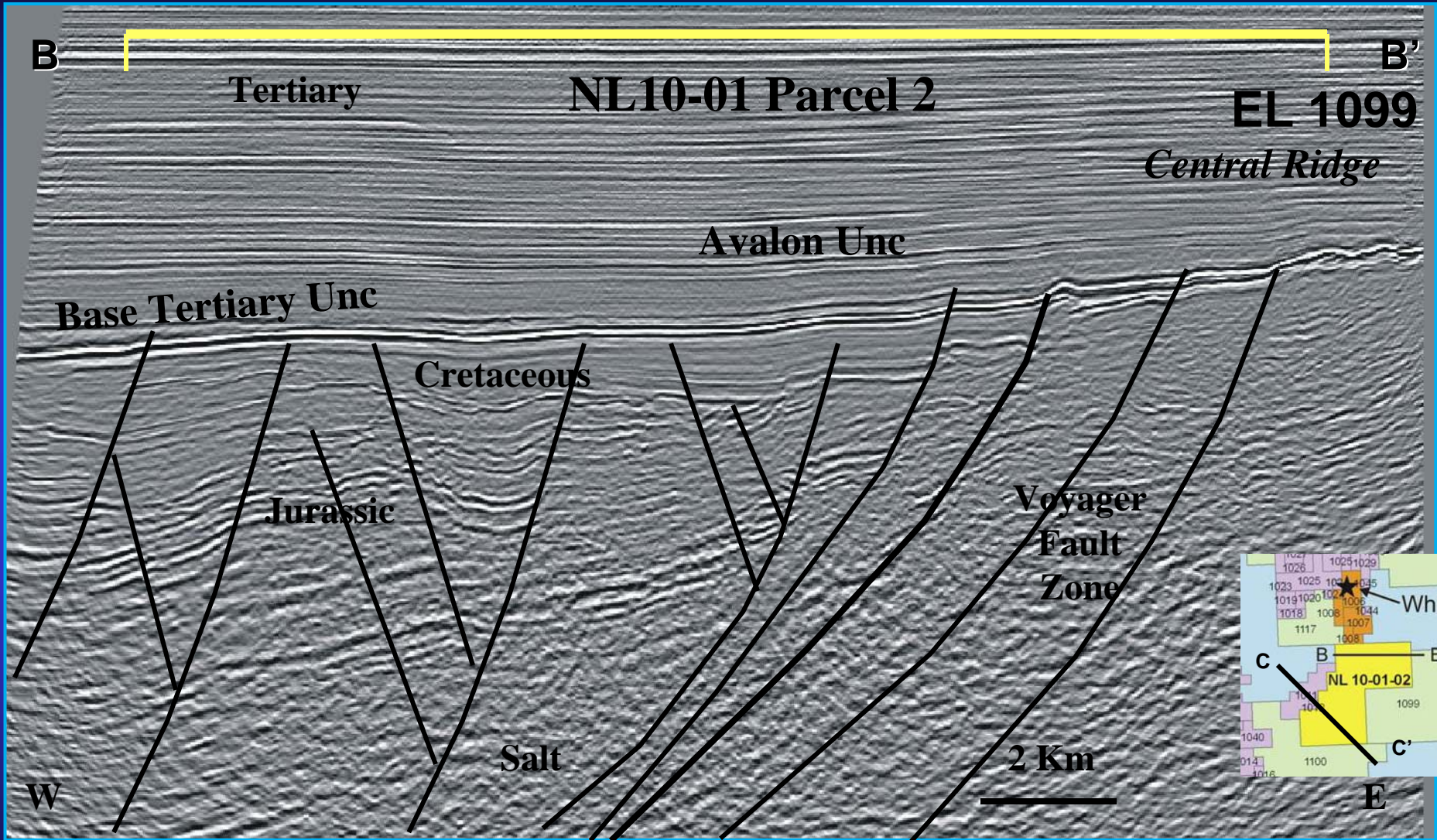
Older exploration maps are available as company exploration reports or regional studies from the C-NLOPB archive

CFB NL10-01 Parcel 2, adjacent Exploration Licences, oil and gas fields and SDLs

Significant Wells within and near Parcel 2, GSI 2D Seismic Coverage and Representative Seismic Lines



Seismic Dip Line



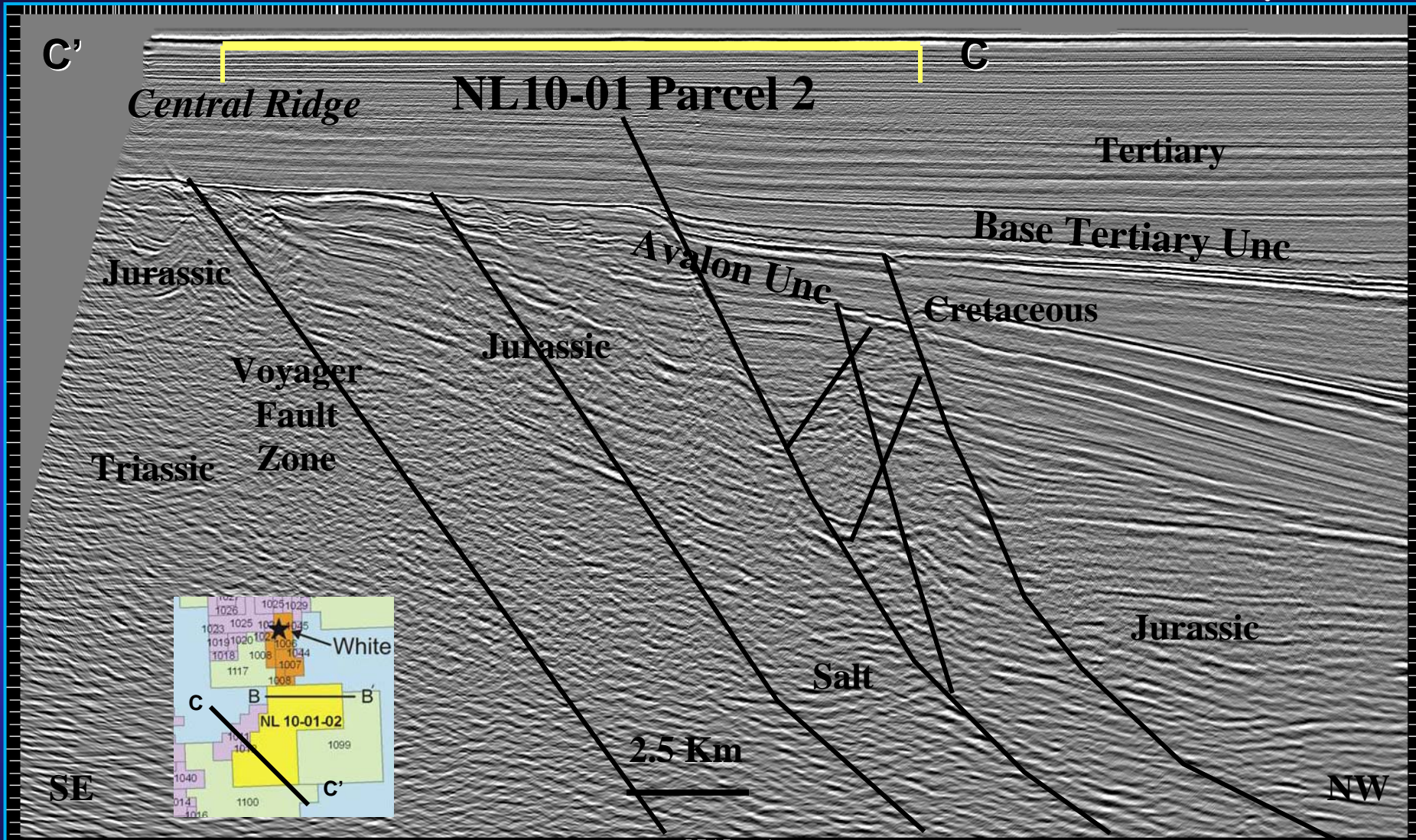
Interpreted W-E regional seismic section showing possible hydrocarbon traps in Parcel 2

Seismic Dip Line B-B'

- This regional West-East dip line starts in the west on Crown Land, crosses the northern part of the Parcel 2 and terminates in EL 1099
- Structurally, the line starts in the deep basin, crosses a densely faulted area on the basinward flank of the Central Ridge, and terminates on the Ridge
- The line passes close to the locations of the Amethyst F-20 and Trepassey J-91 abandoned wells, which both have penetrated good reservoirs
- Several other untested rotated blocks and horst are interpreted on this and other neighboring seismic lines

Seismic Dip Line GSIGB-105 C-C'

Courtesy of GSI



Interpreted SE-NW regional seismic section GSIGB-105 showing possible hydrocarbon traps in Parcel 2

Seismic Dip Line GSIGB-105 C-C'

- This regional NW-SE dip line starts in the west on Crown Land, crosses the Fortune SDL, then the central and southern part of the Parcel 2 and terminates in EL 1100
- Structurally, the line starts in the deep part of the JDB, crosses the faulted area where the Fortune G-47 discovery was made in a rotated block (SDLs 1011 and 1012), intersects several other higher rotated blocks on the flank of the Voyager Fault Zone and terminates on the South Central Ridge, where older rocks subcrop under the Base Tertiary Unconformity
- On this and several other neighboring lines, several blocks with good petroleum potential remain undrilled

Seismic Interpretation Discussion

- Regional seismic data can easily be tied with synthetic seismograms to several exploration wells situated inside and outside of the Parcel 2
- Full synrift sequence including reservoir sandstone of Late Jurassic to late Early Cretaceous exist in the western side of the Parcel 2; postrift sequence is thin in this parcel and reservoirs contained in Late Cretaceous and Early Tertiary sandstones are relatively shallow with increased risk of oil biodegradation (heavy oil in reservoir)
- Potential reservoirs in synrift sequence include the proven Jeanne d'Arc, Hibernia and Avalon-Ben Nevis Sandstones that should be encountered on the western flank of the Central Ridge. Reservoir quality Tempest Sandstones of the Rankin Formation may exist in the ridge area
- These reservoirs sandstone can be drilled with moderately deep wells in this Parcel (approximate 2200-4500 m)
- Faults densely segment the synrift sequence; only Voyager Fault affect the postrift sequence

Observation: On the illustrative seismic section only a few markers, formations and faults are displayed

Proprietary 3D Seismic Data

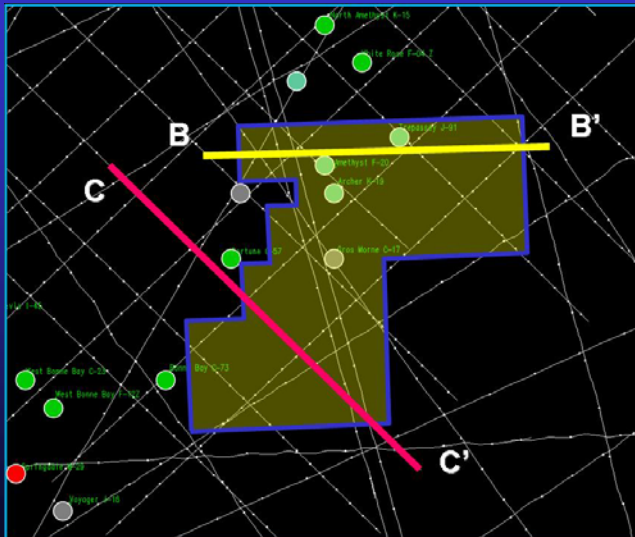
- This data was not available to the author and therefore in this presentation there are only general comments on the quality of the 3D data
- No comments can be made on the identification of regional and local seismic markers and traditional reservoirs
- No presentation on interpretation of 3D data, and on 3D mapping of leads and prospects can be made at this time

Hydrocarbon Traps in Parcel 2

- Several NE-SW elongated structural traps exist in the western part of the parcel. The synrift sequence is segmented by faults into several structural traps; the postrift sequence contains only stratigraphic traps
- All accumulations found to date in the basin are normally pressured in structural/combination traps; the traps in this parcel should be normally pressured
- Structural traps are extensional features such as: rotated blocks, horsts and faulted rollover or salt induced anticlines. Within the basinal part of the parcel these traps may contain Late Jurassic to late Early Cretaceous coarse clastics. On the fringes of the South Central Ridge and on the ridges, Kimmeridgian and early sandstones (Tempest, Voyager, etc.) may be trapped
- Traps are bound by multiple faults (2 to 4 faults)
- Stratigraphic traps are of the pinchout, onlap, truncation, lens, basin margin fan types, containing predominantly Late Cretaceous age and possibly Early Tertiary sandstones

Significant Wells within Parcel 2

Well	Drilled	WD m	Status	Location	TD m	Ben Nevis m	Hibernia m	Tempest m	Test	Producer/Dry	Source rocks
Amethyst F-20	1989	118	Aband	North Parcel	3305	2146	2306	Not Penetrated	No	Dry	not penetrated
Archer K-19	1984	119	Aband	North Parcel	4299	2091	2218	3640	No	Dry	Yes
Gros Morne C-17	2002	117	Aband	Central Parcel	2273	1922	2041	Not Penetrated	No	Dry	not penetrated
Trepassey J-91	2002	120	Aband oil show	North Parcel	2995	2692	Not Penetrated	Not Penetrated	No	Dry	not penetrated



Well Legend

- Gas Discovery
- Oil Discovery
- Oil Show
- Dry Hole
- Not Public Yet
- Source Rock Intersected

Significant Wells near Parcel 2

Well	Drilled	W D m	Status	Location	TD m	Ben Nevis m	Avalon m	Hibernia m	Jeanne d'Arc m	Tempest m	Test	Producer/Dry	Source rocks
Voyager J-18	1984	101	Abandoned	10 km SW	3743	1451	Not present	1675	2172	2841	No	Dry	Yes
Springdale M-29	1989	99	Abandoned oil and gas	12.5 km WSW	3192	1482	Not present	1848	2731	NP	377 bopd heavy oil	Ben Nevis	Yes
West Bonne Bay F-12	2006	101	Abandoned	9 km W	4600	2474	3471	3914	Not penetrated	NP	No	Dry	NP
Bonne Bay C-73	1987	107	Abandoned oil show	1 km W	3719	2319	2669	3137	3955	NP	RFS oil	Hibernia Jeanne d'Arc	NP
West Bonne Bay C-23	1998	101	Abandoned oil and gas	11 km W	4418	2471	2631	3277	4219	NP	3245 bopd 30.2 API 4.4 MMcfd	Hibernia	NP
Ben Nevis I-45	1980	100	Abandoned oil and gas	13.5 km WNW	4933	2377	2713	3889	NP	NP	1598 bopd 12 MMcfd	Ben Nevis & Hibernia	NP
Fortune G-57	1986	113	Abandoned oil well	1 km NW	4995	2413	2695	3294	faulted	4589	12.8 MMcfd/d 292 bopd condensate	Hibernia Tempest	Yes
White Rose F-04	2003	119	Abandoned oil and gas	4 km N	2994	2779	NP	NP	No	No	No test	Ben Nevis	NP
North Amethyst K-15	2006	119	Abandoned oil and gas	7 km N	2566	2312	NP	NP	NP	NP	No Public	Ben Nevis	No

Significant Wells Discussion

- 4 wells drilled in the Parcel 2 are all abandoned; of significance Trepassey J-91 had an oil show and Archer K-19 intersected source rock
- 9 wells were drilled in vicinity of Parcel 2; the first well I-45 was drilled in 1980, the last well K-15 in 2006
- 6 out of the 9 wells encountered oil, another one was an oil show, another one encountered gas and heavy oil and the ninth, while dry, drilled through source rock
- Several wells west of the parcel flow tested between 1400 and 7000 bopd with restrictive equipments
- Wells in the South White Rose pool and North Amethyst field located north of Parcel 2 are capable of producing 25-35,000 bopd
- The best test among wells located near the parcel was from the West Bonne Bay well which flow tested 3245 bopd of 30⁰ from a Hibernia reservoir
- Significant oil volumes were discovered immediately west and north of Parcel 2 (more than 100 MMbbls)

Maturation and Migration in the Parcel 2

- In most of Parcel 2 the Late Jurassic rocks should be at depths between 3 and 6 km; thus the Egret source rocks should be in the mature range
- In the eastern part of the parcel the source rock has been eroded and therefore exploration has to rely on long path migration or an older source rock interval
- The oil and gas discoveries made west and north of the parcel prove that hydrocarbons were generated and migrated into viable traps in the vicinity of Parcel 2
- After trap formation there were direct migration routes through porous sandstone beds and numerous normal faults from the Egret Mbr. shale into Late Jurassic late Early Cretaceous sandstone reservoirs
- As proven in the northern Central Ridge, migration also took place into sandstone reservoirs older than Kimmeridgian
- Source rocks older than Egret source rocks (e.g. Oxfordian) are also mature in the parcel

Hydrocarbon Plays in Parcel 2

- The White Rose and North Amethyst oil and gas fields located north of the parcel, the Terra Nova oil field located southwest of the parcel and all other smaller discoveries located west of the parcel clearly indicate that a working petroleum system anchored by *the Egret source rock should extend into Parcel 2*
- As presented in the significant wells table and discussion, the Late Jurassic and Early Cretaceous sandstones are present in the rotated blocks triggered by extensional faults and may be trapped in the parcel. The sandstone reservoirs should be sourced from Kimmeridgian or older source rocks
- The late rift Ben Nevis succession that contains reservoir rocks toward the north is also present in the parcel
- The Tempest sandstones, intersected in the Voyager J-18 well at relatively shallow depth is a potential play in the eastern parcel
- Postrift reservoirs while stratigraphically trapped in the parcel have high risk for heavy oil presence

Discussions-Parcel 2

- There is production infrastructure in this part of the basin both toward the north where North Amethyst and White Rose fields are located and toward the southwest where the Terra Nova field is located
- An oil discovery in the Parcel 2 might be developed using sub bottom well completion and tying to the northern producing fields where a FPSO is stationed and available for additional oil flow
- An oil field larger than 100 million barrels recoverable found in this parcel can be a candidate for a stand alone development
- Discovery wells in the vicinity have flow tested between 300 and 3200 bopd
- Several oil prospects and leads identified in the parcel with post-1985 2D and E3D seismic data are still waiting to be completely mapped using higher quality 3D data and to be drilled
- Parcel NL10-02 is well covered by good quality speculative 2D and partially by 3D non-exclusive seismic data; this data can be easily reprocessed for better structural and stratigraphic imaging; moreover, prestack and poststack analysis of the data as well as Controlled-Source EM surveys may help reduce drilling risk
- Mapping with modern 3D surveys is key to exploring this parcel

Prospects and Leads-Parcel 2

- Several structural leads can be seen on 2D seismic data; with 3D data these leads can be elevated to drilling prospect status
- Area's main hydrocarbon play is structural; it involves porous and permeable Late Jurassic to late Early Cretaceous sandstones trapped within multi-sided fault bounded blocks
- Several fault dependent closures can be mapped within the Parcel; closures are capable of each holding 25 to 50 MMbbls oil recoverable depending on trap size and thickness of pay zone
- A group of fault blocks with oil pay would make for a significantly larger field
- As proven by several wells in vicinity, multi-pay play is also possible in the area
- Stratigraphic trapping of Ben Nevis sands may also occur within the parcel
- Source rocks are found at expulsion depths of 3800-5800 m beneath the westerly located rotated blocks and within the downdip NW depression
- Seismic amplitude variations are seen in synrift and postrift sequences. The variation of seismic amplitude within some of the markers, amplitude anomalies around faults and gas chimneys and curtains may indicate hydrocarbon flow

7. General Discussions

- The presence in vicinity of several large oil and gas fields and several smaller discoveries provides encouragement for the potential of both Parcel 1 and 2
- The neighbouring White Rose producers are capable of up to 35,000 in production tests
- The smaller fields have flown at rates of 1,400-7,000 bopd in discovery tests
- Both parcels are many time larger when compared with a Gulf of Mexico standard block or North Sea offerings
- Parcels are located in a basin with large extensional traps, known reservoirs, mature source rocks and proven migration paths
- Risks are recognized in regard to reservoir quality and fault sealing
- Parcels contains multiple reservoir targets within synrift sandstones reservoirs at 2500-4500 m depth that can be drilled year round and tested using jack-ups or semi-submersible rigs
- Location of prospects in a shallow water environment certainly lowers the economic risk
- Cost of an offshore well in these parcels would likely be in the range of Can \$25 - \$50 million depending on the depth to the target

8. Conclusions

- One large parcel, NL10-01-01, and one medium size parcel, NL10-01-02, located within the oil prolific Jeanne d'Arc Basin are available for licensing in the C-NLOPB's **Call for Bids NL10-01** which closes on **November 17, 2010, 4 p.m. NL time**
- 1.16 Billion barrels of oil were produced to date from the JDB; at least 1.8 Bbbls of recoverable oil remain to be produced
- **Parcel 1** is located in the northern part of the JDB and on the Central Ridge close to the South Tempest oil discovery and North Dana gas discovery; the parcel is situated 40 km northeast of Hibernia field and 25 km northwest of White Rose oil field
- **Parcel 2** is located in the eastern part of the JDB and on the Central Ridge close to the Fortune and West Bonne Bay oil discoveries; the parcels borders toward the north the North Amethyst oil field, is situated 7 km south of White Rose field and 17 km northeast of Terra Nova oil field
- Both Parcel 1 and Parcel 2 contain synrift clastics and carbonates including proven source and reservoir rocks and numerous structural trapping configurations triggered by extensional faults and salt movements

8. Conclusions

- Similar fault bounded, rotated block trap-type identified within the White Rose and North Amethyst fields are present in Parcel 2 and some in Parcel 1
- In both Call for Bids parcels there are favourable stratigraphic trapping possibilities for Late Cretaceous sandstone reservoirs
- Multiple leads are present in both parcels
- Main source rock for the area - the Egret Member - exists in the mature range within the identified tilted blocks or in adjacent depressions
- Good quality and dense 2D, 3D and E 3D seismic coverage is available in the parcels to image and adequately map hydrocarbon traps
- Recognized risks in regard to reservoir quality and fault seal are mitigated by the presence of relatively large, multiple undrilled features and the presence of adjacent oil and gas accumulations
- Geological risk can also be reduced by using pre-stack and post-stack seismic analysis and CSEM methods
- All the prospects and leads in the parcel are located in shelfal water depth varying between 120 -230 m in Parcel 1 and 100-150 m in Parcel 2
- Prospects in the two offered parcels can be drilled with relatively shallow/ medium depth wells (2500-5000 m) using jack up or semisubmersible rigs

8. Conclusions

- Parcels are located relatively close to existing infrastructure at White Rose and Terra Nova oil fields and close to several other smaller discoveries
- A new discovery may be developed by tying back to producing fields or bounding together several small and medium size discoveries into a new development project
- Acquiring either parcel will give a new entrant operator in the area an excellent opportunity of participating in a proven oil play located in the most rewarding basin of Canada's East Coast
- For an existing operator or non-operating company licensing either parcels will provide a great occasion to increase its prospective portfolio and add significant oil reserves
- The Government of Newfoundland and Labrador actively encourages oil and gas exploration in the area with utmost regards for safety and environmental protection
- The C-NLOPB 2010 Jeanne d'Arc Basin Call for Bids provides oil companies with a great opportunity to participate to exploration and acquire large tracts of exploration lands in a proven petroleum province where a further **6 Bbbls** and **60 Tcf** of offshore undiscovered resources remain to be uncovered

Thank You for your Attention and
Good Luck Exploring!

