

**NEWFOUNDLAND AND LABRADOR
CALL FOR BIDS NL06-1
Jeanne d'Arc Basin**

Foreword

This report has been prepared on behalf of the Newfoundland and Labrador Department of Natural Resources to provide information on land parcels being offered in the Canada-Newfoundland and Labrador Offshore Petroleum Board's (C-NLOPB) 2006 Call for Bids. This year (2006) the Board has issued three separate Calls for Bids, including:

1. **Call for Bids NL06-1** (Jeanne d'Arc Basin) consisting of three parcels;
2. **Call for Bids NL06-2** (Sydney Basin) consisting of three parcels; and
3. **Call for Bids NL06-3** (Western Newfoundland and Labrador Offshore Region) consisting of five parcels.

The eleven parcels being offered comprise a total of 1,712,758 hectares. Interested parties have until 4:00 p.m. on November 15, 2006 to submit sealed bids for Call for Bids NL06-1 (Jeanne d'Arc Basin) and Call for Bids NL06-3 (Western NL Offshore Region) and until 4:00 p.m. on November 30, 2006 to submit sealed bids for the Call for Bids NL06-2 (Sydney Basin).

This report focuses specifically on the three parcels covering 746,419 hectares (1,844,441 acres) in the Jeanne d'Arc Basin – a proven petroleum province. Two separate reports available at <http://www.nr.gov.nl.ca/mines&en/> provide information on the other two Calls for Bids. This report should be referenced as *Enachescu, M.E., Call for Bids NL06-1, Parcels 1, 2 and 3, Regional Setting and Petroleum Geology Evaluation*. For information on how to submit a bid in this Call for Bids go to: <http://www.cnlopb.nl.ca/> and see the March 22, 2006 News Release on the website.

Acronyms used in this report:

NL = Newfoundland and Labrador
C-NLOPB = Canada-Newfoundland & Labrador Offshore Petroleum Board
NL06-1, 2 and 3 = identifiers for the three 2006 Call for Bids
GSC = Geological Survey of Canada
PL = Production Licence
JOA = Joint Operating Agreement
EL = Exploration Licence
SDL = Significant Discovery Licence
DPA = Development Plan Application
TD = Total Depth
HMDC = Hibernia Management and Development Company
GSI = Geophysical Services Inc.
CNG = Compressed Natural Gas
LNG = Liquefied Natural Gas
GTL = Gas to Liquid
bopd = barrels of oil per day
mmcf/d = million cubic feet per day
tcf = trillion cubic feet
bcf = billion cubic feet
mmbbls = million barrels
Mbr. = Member

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Foreword

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1. Introduction

Parcels 1, 2 and 3 Call for Bids NL06-1, which are the focus of this report, are located in approximately 100-120 metres of water on the eastern Atlantic margin of Newfoundland, in an area known as Grand Banks of Newfoundland, adjacent to major oil discoveries within the eastern Jeanne d'Arc Basin. This report provides background information on petroleum exploration and development in the Province, a general overview of geological prospectivity of Newfoundland and Labrador offshore area, and a discussion of the specific geology and petroleum potential of the three land parcels available for bidding in the Jeanne d'Arc Basin. Additional reports on the parcels in the Sydney Basin and along the west coast of the island of Newfoundland are available at <http://www.nr.gov.nl.ca/mines&en/>

More detailed information on the geology of the Jeanne d'Arc Basin and general Grand Banks petroleum potential can be accessed at:

http://www.nr.gov.nl.ca/mines&en/oil/call_for_bids_nf04_01.stm and
http://www.nr.gov.nl.ca/mines&en/call_for_bids/NL05.pdf

Additional petroleum related reports from the Department of Natural Resources are available at:

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

Selected references on the geological setting and petroleum potential are also provided at the end of this report as Further Reading.

2. Exploration and Development Background

2.1. Highly Productive Fields

With production of more than 338,000 bopd, representing around 10 million barrels per month (as of April 2006), the province of Newfoundland and Labrador is producing at the level of a world class producer from one giant field - Hibernia - and two other large fields - Terra Nova and White Rose. The White Rose field began production in late 2005 and is expected to ramp up this year to about 125,000 bopd, after already reaching 100,000 bopd. All these oil fields are located within the Jeanne d'Arc Basin, which is the only prolific offshore oil basin on the east coast of North America.

Newfoundland and Labrador's area of petroleum potential extends far beyond the boundaries of the producing Jeanne d'Arc Basin. Mesozoic sedimentary basins are found all along the NL Atlantic margin running from the Laurentian Basin, across the Grand Banks basins, through the deeper waters of the Flemish Pass and Orphan basins and continuing northward into several basins along the Labrador shelf and slope (Figures 1 and 2). Paleozoic basins, occupying several large areas on the island and the entire Gulf of St Lawrence, are also present on Newfoundland's west coast (Figures 1 and 2)

The NL offshore jurisdictional area includes about 1.6 million km² of which about half is considered to have petroleum potential. A total of only 131 exploration wells were drilled in this area, more than a third concentrated in the Jeanne d'Arc Basin. The well density is very low even by offshore frontier standards. The foremost petroleum exploration region is the Mesozoic basins off the eastern coast of the Province, but under-explored areas of potential are also found in the Paleozoic basins of the Gulf of St. Lawrence (Figure 2). Paleozoic hydrocarbon plays also extend

eastward into the Province’s onshore area and to the northeast within the St Anthony Basin and beneath the Mesozoic sediments of the Labrador Sea.

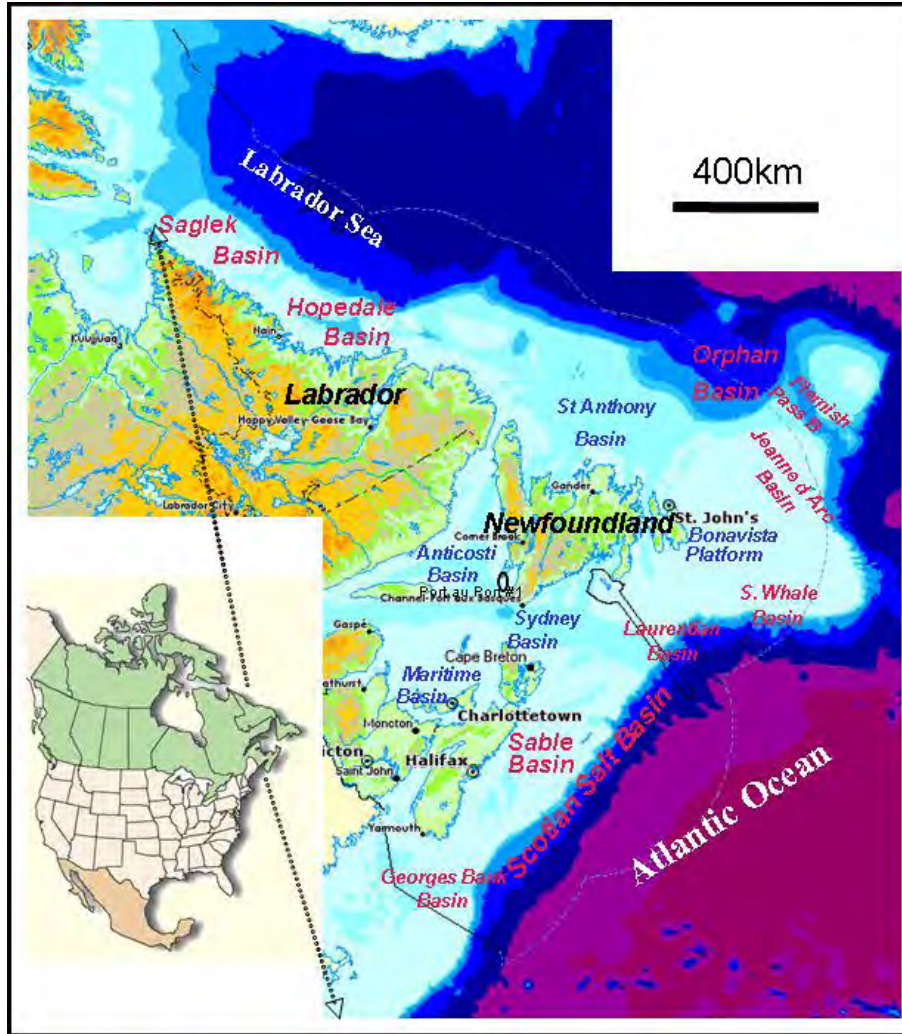


Figure 1. Offshore Atlantic Canada basins map. Mesozoic basins are labelled in red and Paleozoic basins are labelled in blue (bathymetry map from NRCan).

2.3. Natural Gas Exploration

While exploration for offshore oil has been ongoing for over 40 years, no systematic effort has yet been undertaken to find natural gas. As it stands the approximately 10 tcf of recoverable gas that has been discovered is a by-product of oil exploration. With the recent increases in North American natural gas prices and the clear need to develop new secure supply areas, serious discussions have begun on ways and means to bring the Newfoundland and Labrador natural gas to market. Possible modes of development under consideration include pipeline, compressed natural gas, liquefied natural gas and gas to liquids technologies. The entire oil production is currently being transported from the fields by shuttle tanker. Hibernia and Terra Nova utilize a transshipment terminal located at Whiffen Head, Placentia Bay whereas White Rose production is shipped direct to market. Gas prospects are now in the drilling inventory of some of the operators and research into ways to monetize the stranded gas resource of the Jeanne d’Arc and Hopedale basins is ongoing.

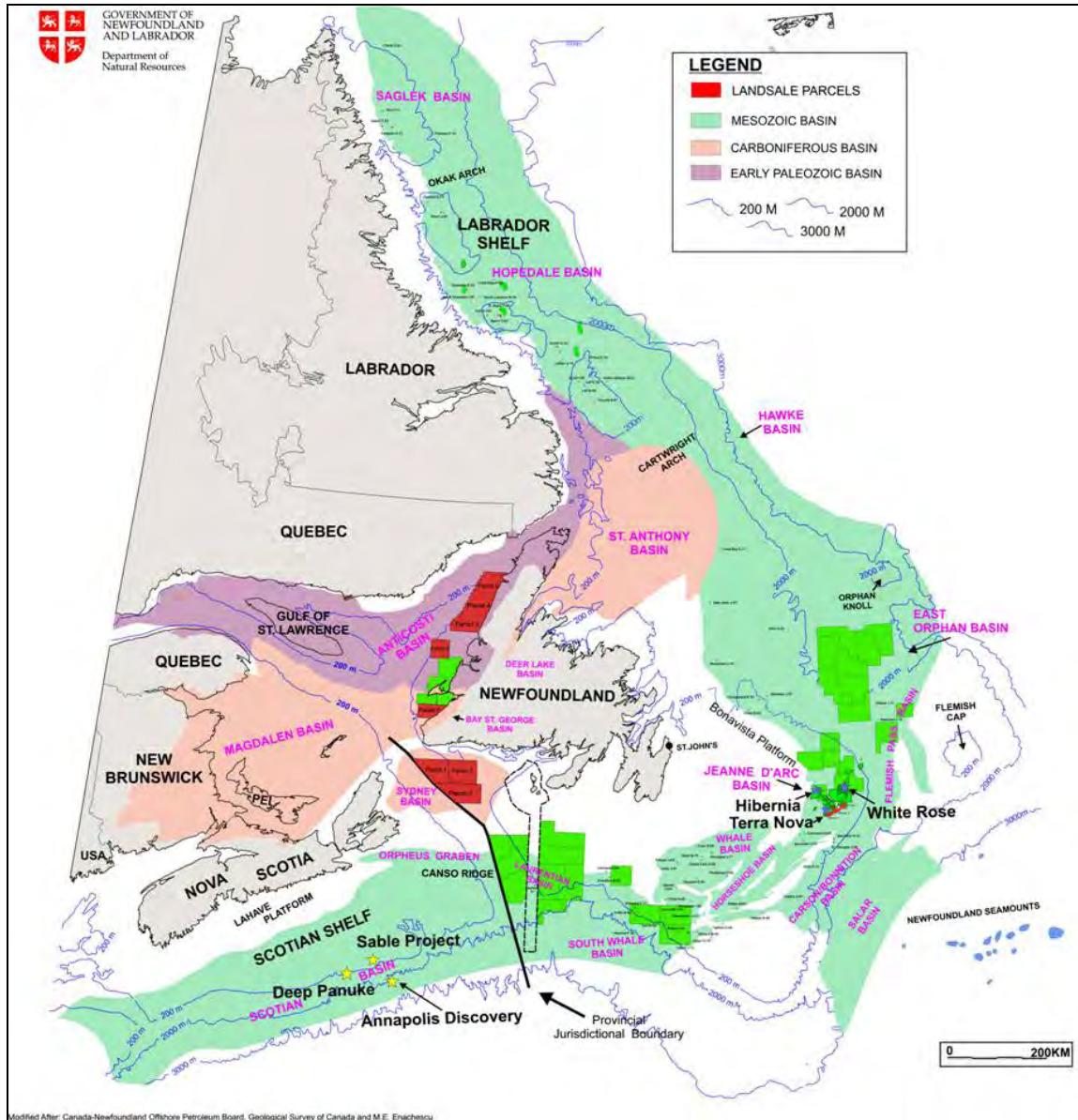


Figure 2. Regional Map of the Mesozoic and Paleozoic basins of Atlantic Canada including NL land tenure as of summer 2006 (in green) and Call for Bids NL06-01 parcels (in red) (map modified after the GSC, C-NLOPB, Government of NL DNR and Enachescu, 2005).

2.4. Exploration History

Exploratory drilling offshore Newfoundland and Labrador began in the mid 1960’s, and to date a total of about one hundred fifty exploration and delineation wells have been drilled in twelve Mesozoic and Paleozoic basins. From a frontier exploration point of view, all the basins along the margin can be considered to have hydrocarbon potential. Some of the basins have proven source rock and others have not. The northern Grand Banks has a prolific oil and gas source rock (Kimmeridgian Egret Member) and the Labrador shelf has rich gas source rocks of Cretaceous origin. Basins along the southern Grand Banks do not yet have a proven source rock but a great deal of the sedimentary sequence has yet to be tested by the drill bit. Although drilling is sparse in many areas (e.g. West Orphan Basin) there is good regional seismic coverage, which supports the presence of similar age sequences to the source intervals in the proven areas (Fagan and

Atkinson, 2000; Hogg and Enachescu, 2001 and 2003; Enachescu, 2004a and b, 2006a; Enachescu and Fagan, 2004 and 2005).

Up to now, large discoveries have been made in two areas: the Hopedale Basin on the Labrador Shelf (gas) and Jeanne d’Arc Basin within the Grand Banks (oil and gas) (Hogg and Enachescu, 2003; Enachescu, 2004a and b; Enachescu and Fagan, 2004 and 2005a and b; Enachescu and Hogg, 2005a; Enachescu 2006d and e; Figures 2 and 3). A detailed discussion of the Jeanne d’Arc Basin fields was included in a report that was published by the Department of Natural Resources to provide information on the 2004 landsale parcels (Enachescu and Fagan, 2004 and 2005; and http://www.nr.gov.nl.ca/mines&en/oil/call_for_bids_nf04_01.stm).

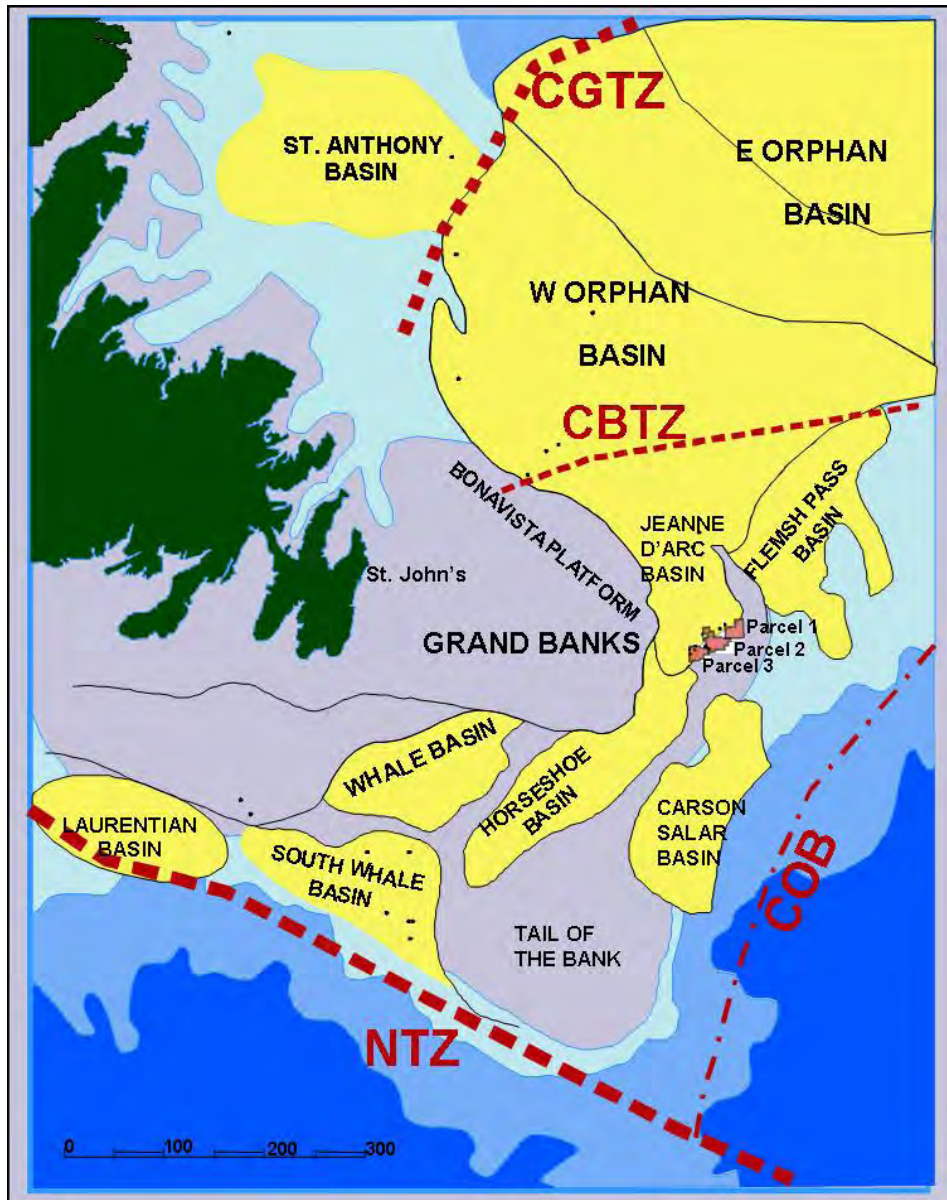


Figure 3. Distribution of Mesozoic sedimentary basins around the Grand Banks of Newfoundland. Annotations are: CGTZ = Charlie Gibbs Transfer fault Zone, CBTZ = Cumberland Belt Transfer fault Zone, NTZ = Newfoundland Transform fault Zone, COB = approximate Continent-Ocean Boundary. The locations of Call for Bids NL06-1 Parcels 1, 2 and 3 are indicated.

The major offshore exploration focus during the past three decades has been within the proven reservoirs and shallow waters of the Jeanne d'Arc Basin, but recent landsales and the locations of seismic surveys show that the industry has expanded its attention into untested areas, including the essentially untouched plays along the continental shelf of the Laurentian Basin, within the slope and deep water basins such as the Orphan, Flemish Pass, Carson-Salar and deep water Laurentian and South Whale basins, or in long dormant areas such as the South Whale Basin and Labrador Sea (Figures 1, 2 and 3). All these basins are part of a widespread interconnected network of rift basins that formed during the Mesozoic continental break-up and Atlantic Ocean opening and contain high quality reservoir and source rocks. The generalized stratigraphy of the Grand Banks identifying the sandstone reservoirs and source rock intervals is shown in Figure 4.

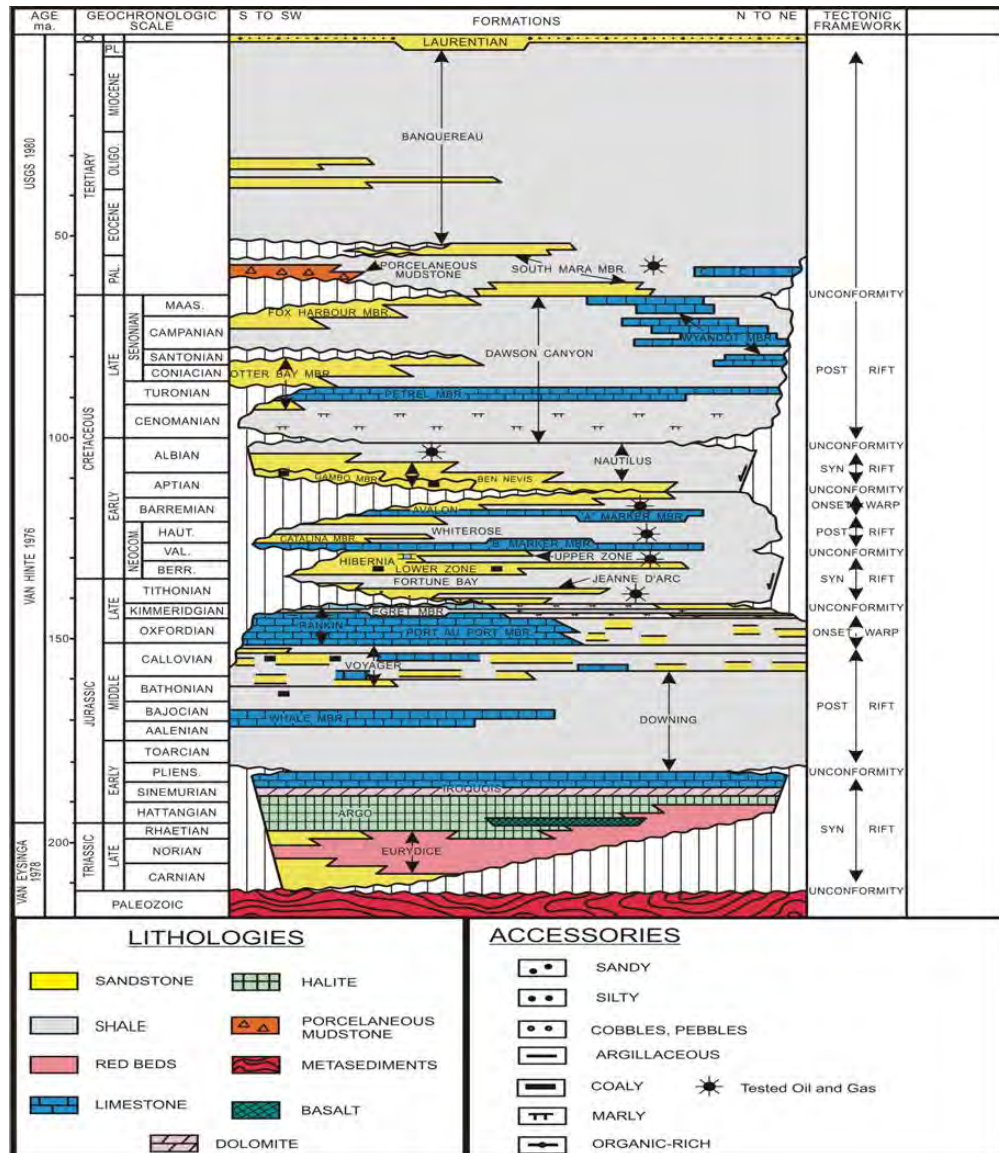


Figure 4. Generalized stratigraphy of the Jeanne d'Arc Basin and environs (modified after Sinclair, 1994 and C-NLOPB).

Most exploration to date has focussed on large Late Jurassic-Early Cretaceous structural prospects. Although many such prospects and leads remain to be tested in several basins, it is

worth noting that about twenty large and undrilled stratigraphic prospects (Late Cretaceous-Early Tertiary basin margin and floor fans) have been mapped within the Jeanne d'Arc Basin and environs, some of which are located in the parcels discussed in this report. Considering that the basin has a proven petroleum system and extensive infrastructure in the existing developments, these stratigraphic plays represent an exceptional exploration opportunity for current and new players to the area.

2.5. Recent and Planned Drilling Activity

The most recent exploration drilling programs offshore NL were concentrated in the shallow South Whale Basin, within the on shelf Jeanne d'Arc Basin and in the deep water (1100 m) of the Flemish Pass Basin. In the Flemish Pass Basin, source rocks and quality reservoirs were encountered in drilling but no commercial discovery has yet been made (Hogg and Enachescu, 2004; Enachescu et al., 2005). One well in the basin (Mizzen L-11) has intersected Early Cretaceous (Hibernia equivalent) oil pay, excellent Late Jurassic reservoirs and also has re-confirmed the presence of thick Jurassic source rocks. These findings have important consequences for elucidating the petroleum system in the Flemish Pass Basin and the neighbouring East Orphan Basin (Enachescu et al., 2005; Enachescu and Hogg, 2005a; Enachescu et al., 2005).

The newest offshore exploration well, Lewis Hill G-85, was spudded in 100 m of water in July 2005, and tested a large structural prospect in the South Whale Basin. This is a basin that has seen no drilling since 1987 and the new well should bring some new insight into the remaining petroleum potential of the basin. The Lewis Hill G-85 was abandoned and land was relinquished to the Crown but under the data confidentiality provisions of the Atlantic Accord, no well results will be released by the Board until the summer 2007. The Lewis Hill well was drilled by the jack-up Rowan Gorilla VI, marking the first time a jack-up had been used on the Grand Banks. The Gorilla VI was also used during 2005 to drill two successful delineation wells in the South White Rose oil pool (White Rose B-19 and B-19Z). Successful utilization of jack-up rigs introduces new potential for reducing drilling costs in the Grand Bank area. The jack-up is also the best operating solution for drilling on the shallow waters offshore western Newfoundland and in the Sydney Basin (see Call for Bids NL06-2 and 3 reports at <http://www.nr.gov.nl.ca/mines&en/>). Another exploration well Hibernia B-16 54 was spudded during 2005 by Hibernia Management and Development Company from the Hibernia platform with a dual objective of evaluating hydrocarbon presence in EL 1093 in the southern fault blocks and completing a potential producer within Production Licence 1001. To date, two sidetracks of this well, B-16 54X and B-16 54Y, were required due to operational challenges, and the current well B-16 54W is still being drilled at the time of writing. Results of these are not yet available.

Several locations are now prepared for drilling exploration wells in the ultra-deepwater of the east Orphan Basin. Following their successful leasing of almost the entire East Orphan Basin, Chevron and its partners will drill during summer-fall of 2006 one or possibly two wells, to test very large Mesozoic structures. The partners will use the Eirik Raude, a fifth-generation semi-submersible. The first well in the program is named Great Barasway F-66 and is located on EL 1076 (Figure 5) in 2350 metres of water. The well will be operated by Chevron on behalf of the other partners and will set a new water depth record for Canadian waters. The previous record in this region, was the Texaco et al. Blue H-28 well (water depth 1486 m; TD 6103 m) drilled in 1979 approximately 50 km west of Great Barasway structure.

Another area that has been subject to intense 2D and 3D seismic mapping in recent years is the Laurentian Basin off the south coast of the island of Newfoundland. At the time of writing the partners (ConocoPhillips, BHP and Murphy Oil) were still interpreting the data and no drill rig had been contracted and no definitive drilling plans announced. This basin is a true Frontier basin with only one well drilled in an area of 60,000 km². The area was off limits to drilling for many years because of a boundary dispute between Canada and France (the French islands of St. Pierre and Miquelon lie off the south coast of Newfoundland). After the international boundary dispute was settled, an inter-provincial boundary was established allowing drilling to proceed in Canadian waters. To date, only one well has been drilled in the basin. The Bandol #1 well was drilled five years ago within the 17 kilometre-wide strip under the French jurisdiction - known as the "baguette" (Figure 6) and was reported by the partners to be a dry hole where good reservoirs have been encountered - although no records have yet been released. During the 1980s the Geological Survey of Canada mapped the basin using a reconnaissance seismic grid and concluded that it contained similar stratigraphy to the Sable Basin to the west and should therefore have significant potential for both oil and gas.

In the Jeanne d'Arc Basin delineation well is planned by Petro-Canada and its partners in the south-eastern part of the Terra Nova's Far East Block where a small structural closure with Jeanne d'Arc reservoir potential was identified. A multi-well drilling program for 2006, including delineation and exploration wells, all located in the Jeanne d'Arc Basin within or adjacent to the White Rose SDL, is being implemented by Husky Energy using the Rowan Gorilla VI jack-up. The first location O-28 and sidetracks O-28Z, 28Y drilled in the West White Rose pool is reported to have intersected a 280 m multilayered oil column. This reserve addition of between 40 and 90 million barrels is definitely good news for the field, and supports the concept that there are further finds to be made along the edges of the known fields. It should extend the life of the field by at least 2 years. Husky is also considering drilling an exploration well this year on one of its many blocks that surround the White Rose field and participate in a test in the West Bonne Bay area (EL 1040) together with Norsk Hydro.

2.6. Recent Seismic Exploration

Although only two offshore exploratory wells (Lewis Hill G-85 and Hibernia B16-54) occurred during 2005 within the Province's territorial waters, it was a record year for seismic exploration. Some 13,039 line km of 2D data and 381,227 cmp km of 3D data were acquired offshore NL during 2005. Most of the 3D seismic data (268,545 line km) was located in the East Orphan Basin and was acquired by Chevron Canada and partners in preparation for a multi-well program to take place during late 2006 and 2007. These extensive seismic programs will be used to locate all the 'first term' exploration wells on acreage acquired at the C-NLOPB's record setting 2003 Call for Bids. Gravity data to help identify the nature of basement highs was also collected during seismic acquisition.

A modern 3D "Q" seismic survey was also acquired by WesternGeco for ConocoPhillips (90,319 km) in preparation for drilling in the Laurentian Basin, which at the earliest may begin in 2007. The Laurentian Basin was only opened to exploration in 2004 after the resolution of international and inter-provincial boundary locations. A very large area has been mapped by 2D seismic in addition to the 3D coverage. At least two possible drilling locations were identified by the partners in the Laurentian Basin exploration but more work is needed to firm up these prospects.

After completion of the Laurentian Basin survey the "Q" vessel moved to the northern Jeanne d'Arc Basin/Central Ridge area to acquire 3D data (22,363 cmp km) on lands acquired by Husky

in the 2004 landsale. Husky will continue this survey starting this July, using the MV Western Regent, a seismic ship capable of deploying 10 streamers. During 2005 Geophysical Services Inc. (GSI) continued its speculative 2D survey in the Labrador Sea recording 13,039 km and increasing its regional coverage to over 25,000 km. More 2D acquisition (approximately 15,000 km) is planned by GSI for 2006, to increase the density of lines in the Hopedale Basin, extend the survey to the northerly Saglek Basin and collect some sea-wide lines to tie offshore Labrador to the Greenland margin. This extensive speculative program by GSI has been ongoing since 2002 and is laying the groundwork for future land licensing and drilling in the area.

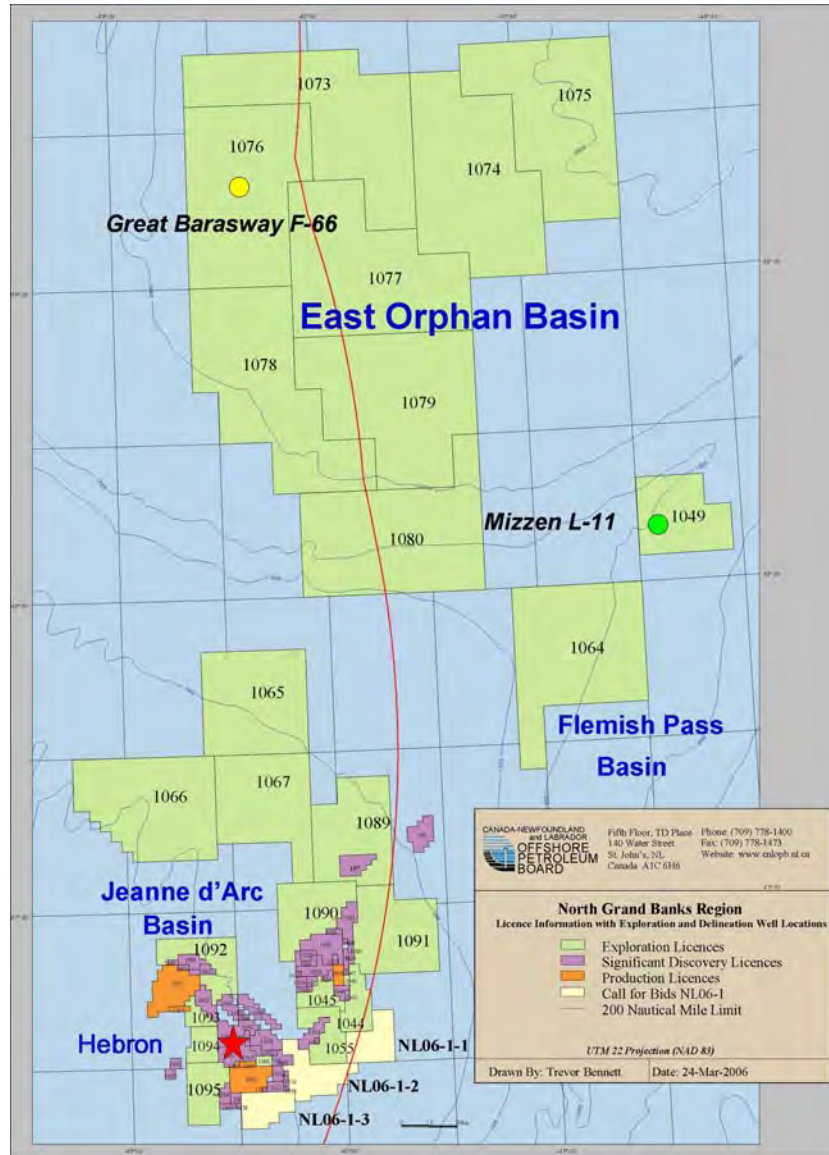


Figure 5. Land tenure on the north-eastern Grand Banks and environs including the Exploration Licences awarded at the 2003 - 2005 landsales and 2006 Call for Bids NL06-1 Parcels 1, 2 and 3 (summer 2006, modified after C-NLOPB). Dashed red line indicate 200 Mi limit.

2.7. Recent Offshore Landsale Results

Offshore Newfoundland and Labrador exploration areas are licensed by the C-NLOPB to the party submitting the highest bid in the form of work commitments, which are secured by a

refundable deposit equal to 25% of bid amount (<http://www.cnlopb.nl.ca/>). The minimum bid for parcels in the Call for Bids NL06-1 is \$1 million (US \$0.9 Million).

For example, during the 2004 landsale several companies (Petro-Canada, Husky Energy, Norsk Hydro and HMDC) bid C\$71 million (US\$57 million) for 5 parcels located within the shallow waters of the Jeanne d'Arc Basin and environs, and in the vicinity of known reserves (Exploration Licences 1089 to 1093 in Figure 5). During the 2005 landsale, three other Jeanne d'Arc parcels were awarded (ELs 1094-1096) all surrounding the Terra Nova and Hebron - Ben Nevis oil fields (Figure 5). Other areas where lands have been licensed in the past five years include the North Jeanne d'Arc Basin (ELs 1065 to 1067) Laurentian Basin (ELs 1081 to 1088) and East Orphan Basin (ELs 1073 to 1080). Each EL requires a well during the initial five year term to extend the licence for an additional four years (Period II). In addition the interest owner may extend Period I from five (5) years to six (6) years by posting a Drilling Deposit with the Board (\$1 million for a Jeanne d'Arc parcel) prior to the end of the fifth year of Period I.

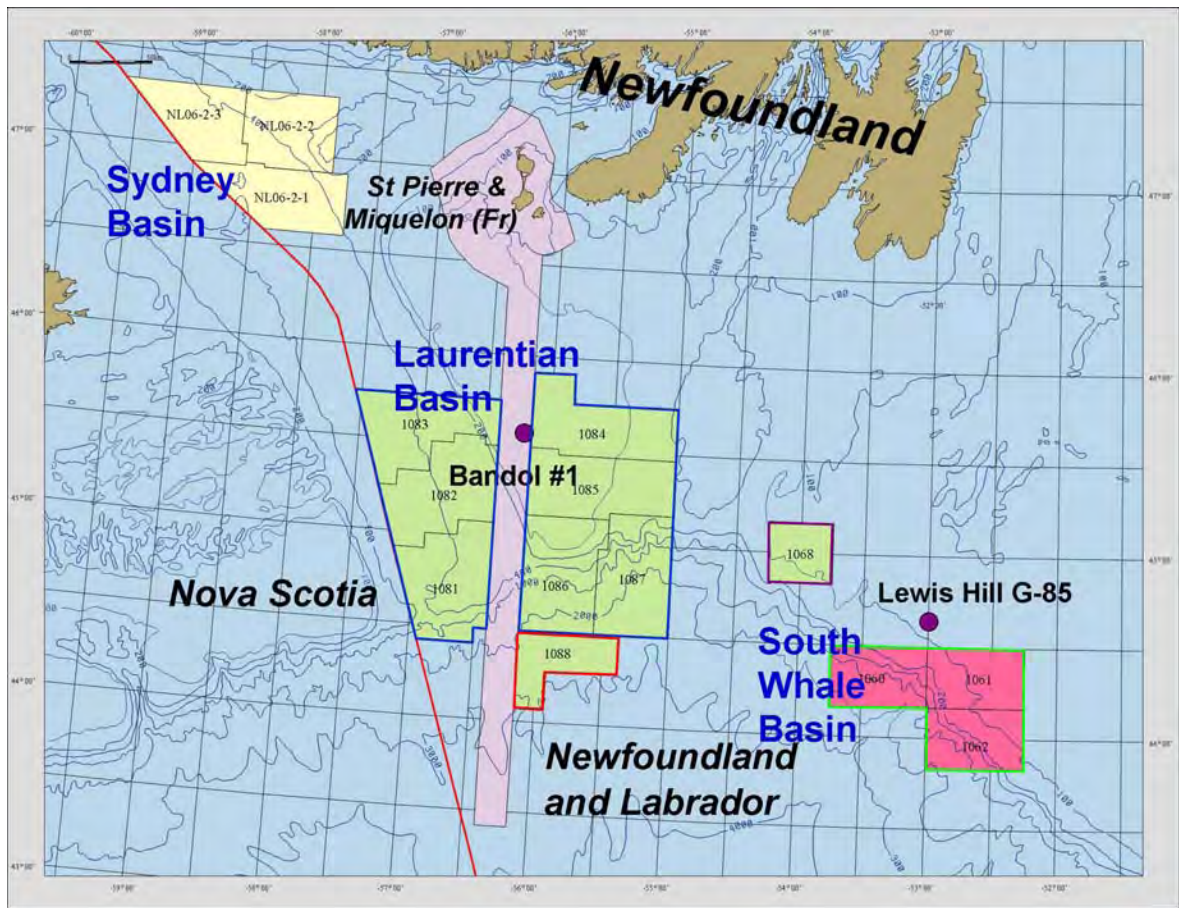


Figure 6. Current Exploration Licences in the Southern Grand Banks (modified after C-NLOPB) including the locations of Bandol #1 and Lewis Hill G-85. The ELs 1081-1087 are licensed to ConocoPhillips (operator), BHP and Murphy; EL 1088 is licensed to Imperial Oil; EL 1068 is licensed to EnCana and ELs 1061-1063 are licensed to Paramount Resources and Polaris.

Several licenses in the Jeanne d'Arc (ELs 1044, 1045 and 1055) and Flemish Pass (ELs 1049 and 1064) basins were validated by exploration wells and the licencees (Husky and Petro-Canada, respectively) are in the process of determining whether additional drilling is warranted in Period

II. Exploration commitments are currently spread over 37 licenses which have varying expiry dates spanning the next five to six years. Just under \$800 million (US \$720 million) in work commitments remain for the current licences, which could translate into ten or more exploration wells over the next five years. Some of these wells will be located on shelf and several in deep water. A major discovery by any of these wells would doubtless lead to considerably more drilling.

Six West Newfoundland offshore ELs are active (1069 to 1072, 1097 and 1098) and operated by St John's, NL based exploration companies (Ptarmigan, Vulcan, CIVC). All these licenses are located near shore, along the West Newfoundland coast (Figure 2).

2.9. Current Production and Development Activity

With production levels set to attain 400,000 bopd during 2006 from three producing fields, the Canadian Province of Newfoundland and Labrador is establishing itself as a major oil province on the international oil and gas stage (Enachescu, 2004a; Enachescu and Fagan, 2004 and 2005; Enachescu, 2005a; Enachescu and Hogg, 2005a; Enachescu, 2006a).

The White Rose oil field commenced production in November 2005 and brought just a minor contribution to the average annual daily production (Table 1). A better number to consider is the daily average for the spring of 2006 when all fields combined to produce 338,000 bopd. Production of up to the milestone 400,000 bopd is expected sometime during this year when the Terra Nova FPSO returns from a major turnaround and the sixth oil producer comes on stream at White Rose. Development (production and injectors) wells at Hibernia, Terra Nova and White Rose oil fields have, to a great extent, proven the large size and high productivity of the respective reservoirs.

Almost 73 million barrels were produced during 2005 from the Hibernia field with an average daily production of 198,871 bopd. The C-NLOPB has increased its recoverable reserve estimate for the Hibernia field to 1.244 Billion barrels, a 66% increase over Mobil's 1997 published estimate of 750 million barrels recoverable. In 2004, Hibernia interest holders acquired two licences north and south of the Hibernia PL, suggesting that the group has either identified possible extensions to the field or has mapped potential satellite prospects. One extended-reach well (B16-54 and sidetracks) drilled from the central platform have been directed to EL 1093, to test for hydrocarbons in this region of the field.

Jeanne d'Arc Basin	Total Production Oil (bopd)	Daily Average Production Oil (bopd)	Total Production Gas (bcf)	Daily Average Production Gas (mmcf/day)
Hibernia	72,587,803	198,871	98,5	265
Terra Nova	36,215,787	99,221	39.0	120.
White Rose	2,465,781*	60,000 *		
Total	111,690,412	306,001	140,5*	385

Table 1. Jeanne d'Arc Basin oil and gas daily average and total annual production during 2005. Produced gas was used for re-injection and managing offshore facilities. *Observation: White Rose field production only during November-December 2005.

Although affected by operational problems during September-October 2005, Terra Nova production, has maintained an average for the year of approximately 99,221 bopd. Terra Nova development drilling is proceeding according to the DPA and evaluation of resources within the undeveloped Far East Block and other adjacent fault blocks is ongoing. A well is planned for this year in a satellite structural high within the Far East Block.

In the fall of 2005, Husky Energy started production from its operated (72% interest) White Rose field located on the eastern side of the Jeanne d'Arc Basin. Also that year, one delineation well White Rose B-19 and a sidetrack B-19Z were drilled in the north-western part of the producing pool. Over 100,000 bopd were produced during a short test during June 2006, and this will be the production level to operate the field this summer with a possible increase to 125,000 bopd by the end of 2006. During spring 2006 a delineation well and a sidetrack (O-28Y and O-28Z) were drilled in the west White Rose pool (Enachescu, 2006b) proving a western extension of the Ben Nevis oil and gas reservoir. This western pool may contain 40-90 million barrels in the Ben Nevis Avalon reservoir. More delineation wells outside of the prime oil pool (South Ben Nevis/Avalon Pool) are planned for 2006. Production is stored and offloaded from the Sea Rose FPSO and oil is transported to the markets by two dedicated oil shuttle tankers.

A Joint Operating Agreement (JOA) has been signed between the shareholders of the Hebron-Ben Nevis field, and Chevron Canada has been selected as operator for this possible development. A development solution was selected, some front-end engineering was done in St. John's, Houston and Calgary, preparing for regulatory approvals, all positive steps towards the advancement of the development of the Hebron-Ben Nevis asset (Power, 2005). Discovered in the early 80's to the north of the Terra Nova field, with an estimated three billion barrels in place, this field would represent the fourth major development in the Jeanne d'Arc Basin. Despite the large reserves, development has been constrained by the fact that most of the oil is of a heavier grade (21° API).

The successful development of similar fields (e.g. Captain, Alba and Grane) in the North Sea and higher oil prices suggest that the economics of such a large field in a maturing basin should be robust. "The North Sea's Captain and Alba fields are two of the world's premier offshore heavy oil producing projects, producing more than 130,000 barrels per day of medium-heavy crude oil. When these fields were developed in the 1970s and 1980s, they presented considerable challenges, but today the development of these fields is considered relatively routine. There are currently as many as 19 heavy-oil fields in the UK sector of the North Sea, ranging in size up to a billion barrels of oil-in-place, and Norway's Grane Project is a heavy oil development success" (Power, Ocean Resources, 2005).

Critical fiscal negotiation between the Government of Newfoundland and Labrador and Chevron Canada and partners took place during this winter-spring and for now discussions are interrupted without a resolution (Enachescu 2006a and b). While a resolution for a development of the Hebron-Ben Nevis is still elusive, we believe that high oil prices and renewed determination of all involved in the negotiations of the fiscal terms will be conducive to field development in the near future. This large accumulation of medium and heavier oil (731 million barrels proven and probable) is the last of discovered fields (1980) in the NL offshore area with sufficient reserves to justify stand alone development (Enachescu, 2004; Enachescu and Hogg, 2005; Enachescu and Fagan, 2005b). If development is approved during 2006 the field will start producing in 2011.

Based on latest geologic, petrophysical and reservoir simulation studies and drilling results, the C-NLOPB has revised upward its estimates of Recoverable Reserves/Resources for the Hibernia Field Oil Reserves to 1.244 billion barrels, an increase of 379 million barrels and for the Hebron complex to 731 million barrels of Proven and Probable Oil Resources, an increase of 317 million barrels. These amounts bring the total of Oil Reserves/Resources in the Newfoundland and Labrador offshore area to 2.75 billion barrels, an increase of 696 million barrels over previous estimates. This combined reserve boost generously counterbalances the oil already produced from Hibernia and Terra Nova since their start of production and brings the total of Oil Reserves/Resources in the Grand Banks area to 2.751 billion barrels. More upside for the Hibernia field exists in satellite fault blocks located outside of the PL 1001 (Figure 5).

3. Exploration Potential of the Newfoundland and Labrador Mesozoic Basins

For the past twenty five years the main focus of exploration has been the syn-rift sequence within the Jeanne d'Arc. More recently the same play was pursued in two wells in the Flemish Pass Basin (Figures 2, 3 and 5) and one well in the South Whale Basin. Only 10 exploratory wells were drilled in the entire offshore NL East Coast area since 1995 (Enachescu, 2006b). Some of the deep water wells in the Flemish Pass Basin were costly disappointments, but they were testing completely new play concepts for the area with very little information on the nature and distribution of reservoir rocks. The seismic and drilling focus has now shifted toward two practically unexplored basins - the Laurentian and East Orphan basins. Nevertheless, exploration blocks within the Jeanne d'Arc Basin continue to attract attention as evidenced by the 2004 and 2005 landsales and the fact that lands were posted by industry for the current 2006 landsale. The following section will provide a short discussion on key exploration areas within the Mesozoic basin chain where exploration activity is taking place (Figures 1 and 2).

3.1. Southern Grand Banks.

The basins of the southern Grand Banks (Laurentian Basin and South Whale Basin) have had a common structural evolution with the Scotian Shelf and Slope during most of the Mesozoic era. These two rift basins are interconnected and show a strong imprint of salt tectonics, similar to the Sable Sub-basin on the Scotian Shelf (from which oil, gas and condensate have been produced) and to other basins along the southern margin of the Grand Banks/Scotian Shelf (Figures 2 and 3). These basins are located approximately 200 km south of Newfoundland (Figures 2, 3 and 6), in shallow to intermediate water depths and are free of the sporadic and seasonal iceberg traffic that is a factor on the Northern Grand Banks, Orphan Basin and Labrador Shelf.

Laurentian Basin. This basin covers an area of 60,000 km² and is the south western most Grand Banks basin. Early seismic mapping and reports by the Geological Survey of Canada (GSC) have indicated a recoverable resource potential for the basin at 600 to 700 million barrels of oil and 8-9 tcf of natural gas. A single well Bandol #1 was drilled during 2001 in the French territorial waters by ExxonMobil, Gulf et al. This well has been reported by press release to be a dry hole and was abandoned, but due to French exploration regulations, detailed results won't be released until 2011 (Figures 6 and 7). From inspection of available seismic data and from older mapping (Wade and Mc Lean, 1990), it is clear that Laurentian Basin is a typical Atlantic margin deep basin influenced by salt and extensional tectonics. The possible hydrocarbon plays are similar to those encountered on the Scotian shelf and slope, and include: listric fault blocks, rollover anticlines or salt anticlines with Jurassic/Early Cretaceous sandstone reservoirs; and possible development of the Jurassic Abenaki limestone porosity or slope sandstone fans. Major

Late Cretaceous-Tertiary mass transport deposits are also evident—on seismic data. The water bottom is strongly canyonized and submarine slides triggered on the Laurentian slope were recorded in the past (e.g. Piper et al., 1985). Present Exploration Licence holders are ConocoPhillips, (the principal operator), BHP Billiton, Murphy Oil and Imperial Resources. The ConocoPhillips operating group has explorations rights to almost the entire basin and partners have access to the Bandol #1 well results (Jenson and Hooper, 2006).

The basin is now in its first exploration round, as a result of a moratorium that stemmed from an international boundary dispute (the French islands of St. Pierre and Miquelon lie directly north of the basin) and the subsequent need to define the inter-provincial boundary between Nova Scotia and Newfoundland and Labrador. During the summer of 2004, existing federal permits which had been frozen under the moratorium since the late 1960s were renegotiated into Exploration Licences under the current legislation. Under the new arrangement the ConocoPhillips-Murphy Oil consortium has agreed to an expenditure commitment of C\$18 million (US \$ 16.2 million) across their seven licences, in addition to the C\$23 million already spent on seismic data on the licences since 1997. Imperial Resources has committed to \$1.5 million work expenditure for its licence (EL 1088 in Figure 6). Significant 2D coverage and a large 3D “Q” seismic survey operated by ConocoPhillips during summer 2005 are presently being used to interpret potentially large prospects in preparation for a drilling program expected to begin in 2007. At least two large plays were identified and site surveys have been carried out over potential locations, but lack of available drilling units may push back the drilling date for this basin.

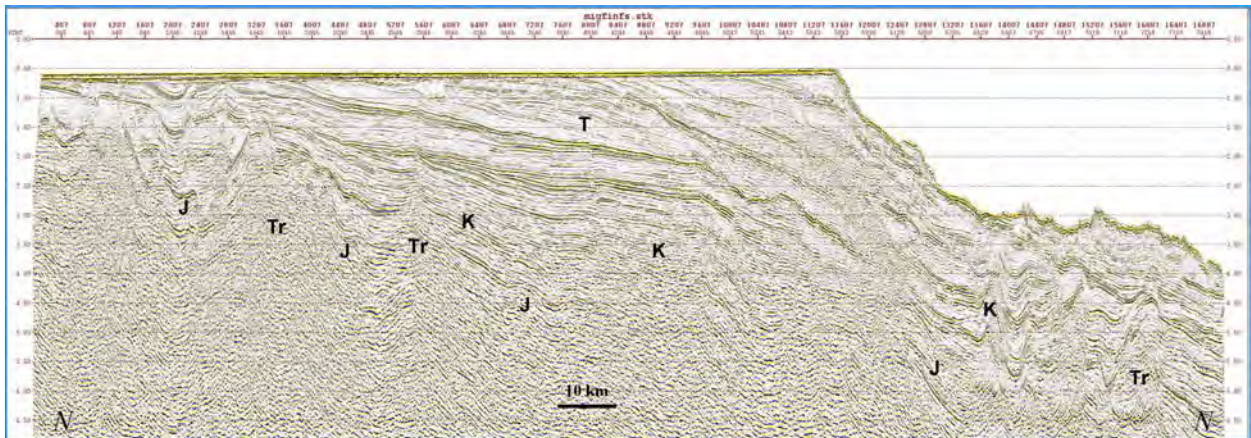


Figure 7. Seismic line (courtesy of GSC) showing structural and tectonic style of the Laurentian Basin. Annotations are Tr = Triassic, J = Jurassic, K = Cretaceous and T = Tertiary sequences. Structural plays, including Argo salt induced features on both shelf and slope are the targets of the present exploration in the basin.

South Whale Basin. The South Whale Basin is a Mesozoic sedimentary depocentre situated mostly in shallow and intermediate waters of the southern Grand Banks, close to the Newfoundland Transfer Zone (NTZ), (Figures 6). Due to its shallow water and ice free location the basin was the first to be drilled in the NL offshore, and was tested by 14 wells without success during the sixties (2 wells), seventies (11 wells) and eighties (1 well) (Balkwill and Legall, 1989; Wade and MacLean, 1990; Enachescu et al., 2001; Enachescu and Fagan, 2005). The 5 to 8 km deep basin contains syn-rift Late Triassic - Mid-Cretaceous sediments, probably of Scotian Shelf affiliation. The favoured oil play of the early exploration efforts in the basin was the salt anticline which was drilled generally crestal and at shallow depths, but all wells were

abandoned with only minor shows (e.g. Figure 12). Repeated dry wells brought an early condemnation of the basin for lack of a proven source rock and breaching of the traps at the Avalon (Base Aptian) Unconformity. Re-mapping of the basin with modern seismic data and re-evaluation of potential plays with focus on the inter-salt domains or on the slope, has revitalized exploration hopes and brought several operators back to the area (Figures 6).

The petroleum system of the South Whale Basin should include localized Kimmeridgian source rock (Verrill Canyon or Egret shales) in the several mapped sink-synclines or mini-basins and probably Mid-Late Cretaceous source rocks on the slope. Late Jurassic (Mic Mac sandstone and Abenaki carbonate) and Early Cretaceous (Logan Canyon sandstone) reservoirs will be targeted in large fault bounded roll-over anticlines and rotated fault blocks within deeper synclines (Hogg and Enachescu, 2001; Enachescu and Fagan, 2005 a and b). Possibly sand-rich fans may develop on the southern slope of the basin.

During the summer of 2005 an intermediate depth exploration well was drilled by Husky Energy on the large Lewis Hill prospect. The Lewis Hill G-85 well, spudded in 100 m water depth tested several Cretaceous sandstone targets. The well was abandoned without testing and Husky has elected not to move to Period II with the two ELs it owned in the basin. Under the confidentiality periods afforded under the regulations, certain well results will become publicly available in 2007 and they may influence the future activity in this basin. EnCana (EL 1068) and a partnership consisting of Paramount Resources and Polaris Resources (ELs 1060-1062), still have land interests in the area but no firm drilling plans have been announced. Period I expiry for EL's 1060-1062 are currently under court review and EL 1068 has a Period I expiry of January 15, 2007.

3.2. Carson Salar Basins

This is a complex basinal area located on the Grand Banks eastern divergent margin and extends from continental shelf to upper rise water depth (200-4000 m) (Enachescu, 1988). Four exploration wells were drilled in the seventies and eighties in the shallower part of the basin with no success. Good reservoirs have been drilled but no source rock was intersected. The two exploration blocks leased by Petro-Canada, Norsk Hydro and EnCana on the slope were recently dropped and the lands are free for posting (Figure 5 and 8).

A dense 2D grid and a 3D seismic survey cover this basin. There is significant hydrocarbon potential in the deeper part of this complex basin described recently by Solvason et al., (2005) and Solvason (2006). An Egret equivalent source rock should be present only beyond the basement ridge that separates the shelf and slope basins (Solvason et al., 2005; Enachescu and Fagan, 2005a). Cretaceous (Albian, Cenomanian) source rock (Albian, Cenomanian-Touronia) was drilled during the ODP Leg 210 (Enachescu et al., 2005; Hardy and Enachescu, 2005). Late Cretaceous and Early Tertiary slope fans and several anticlines in deep water identified on the seismic data, constitute viable plays.

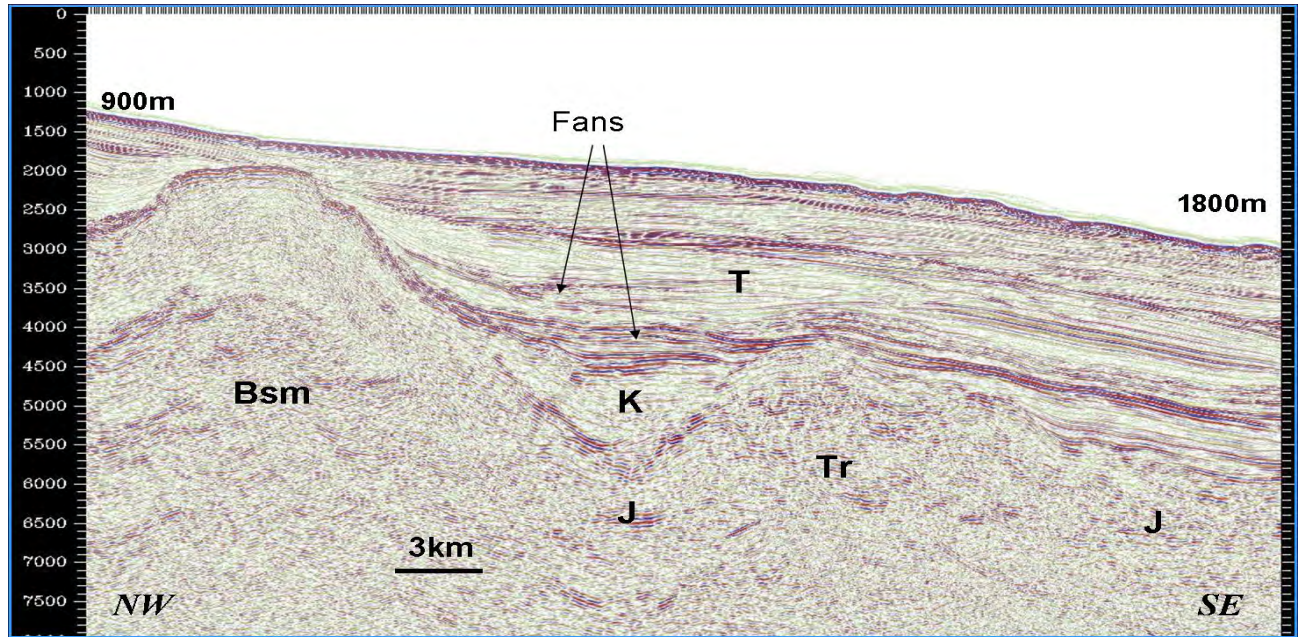


Figure 8. Seismic line (courtesy of GSI) showing structural and tectonic style of the Carson Salar Basin, showing possible hydrocarbon plays on the upper slope. Annotations are Bsm = Pre-rift basement, Tr = Triassic, J = Jurassic, K = Cretaceous and T = Tertiary sequences.

3.3. Flemish Pass Basin

This is a Mesozoic basin partially located in a bathymetric low (roughly 1100 m of water) northeast of the Jeanne d'Arc Basin and west of the Flemish Cap bathymetric high (Figures 1 to 3 and 5). Four older and two recently drilled wells have proven that the basin has excellent Egret equivalent source rock and good, thick sandstone reservoirs (Foster and Robinson, 1993; McCracken et al., 2000; Hogg and Enachescu, 2001; Enachescu et al., 2005). Several 3D seismic data surveys cover almost the entire basin and show large and very large anticlines. These are complexly faulted extensional anticlines, subsequently modified by several trans-tensional episodes (Thompson, 2003; Enachescu and Hogg, 2005 and 2006).

The basin is subdivided by transfer faults into several sub-basins that had relatively different depositional and structural histories. Two recent wells, Mizzen L-11 and Tuckamore B-27, drilled in the northern Flemish Pass Basin were abandoned. Non-commercial oil pay in Early Cretaceous sandstone was seen on logs at the Mizzen location and a Late Jurassic sandstone had good reservoir properties but was wet (Enachescu and Hogg, 2005). The above mentioned oil pay is present in a Hibernia equivalent sandstone and the thick Late Jurassic source rock interval identified at Mizzen L-11, bodes well for future exploration of this basin and its larger neighbour to the northwest - the East Orphan Basin (Figure 9). Petro-Canada, ExxonMobil, ChevronTexaco, EnCana and Norsk Hydro are the companies most recently involved in the Flemish Pass Basin drilling.

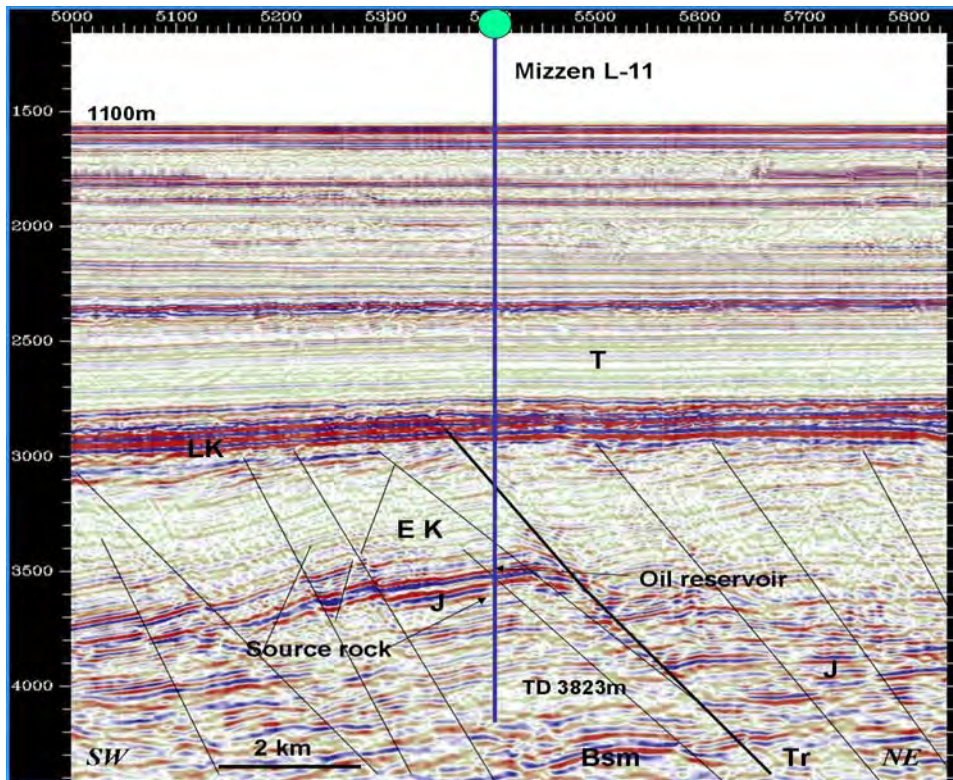


Figure 9. Seismic line (courtesy of GSI) showing structural and tectonic style of the Flemish Pass Basin, and location of the Mizzen well. Annotations are Bsm = Pre-rift basement, Tr = Triassic, J = Jurassic, LK = Late Cretaceous, EK = Early Cretaceous and T = Tertiary sequences.

In May 2004 the Canada-Newfoundland and Labrador Offshore Petroleum Board and the Geological Survey of Canada published a report that estimated the undiscovered recoverable petroleum resources in the Flemish Pass Basin at 273 million m³ (1.7 billion barrels) at a 50 percent probability - with expected field sizes ranging from 528 to 44 million barrels. Only two ELs operated by Petro-Canada are now active (Period II) in the Flemish Basin as a result of validation by drilling. There is a large area available for future posting and sufficient modern seismic coverage to evaluate its remaining petroleum potential.

3.4. East Orphan Basin

The present major focus of exploration in Atlantic Canada is in the East Orphan Basin, a highly extended Mesozoic-Tertiary sedimentary area situated north and northeast of the Grand Banks of Newfoundland in water depths ranging between 1500 and 3500 m (Figures 1 to 5 and 10). Connected to the proven petroleum systems of the Jeanne d'Arc and Flemish Pass Basins, the East Orphan Basin has the potential for several giant discoveries (Smee, 2003; Enachescu et al., 2004a and b; Enachescu and Fagan, 2005; Kearsley and Enachescu, 2005; Enachescu et al., 2005). Large and complex anticlines, rotated fault blocks and submarine fans can be mapped in the basin using the present 2D and 3D coverage.

The petroleum system of the East Orphan Basin should also include:

- a) Kimmeridgian and probably Albian to Late Cretaceous source rocks;
- b) Late Jurassic, Early and Late Cretaceous and Tertiary reservoirs;
- c) Source maturation, generation and short distance migration of oil and gas from large sub-basins into existing antiforms and submarine fans (Enachescu et al., 2004a and b, 2005a, Enachescu and Fagan, 2005b; Enachescu and Hogg, 2006).

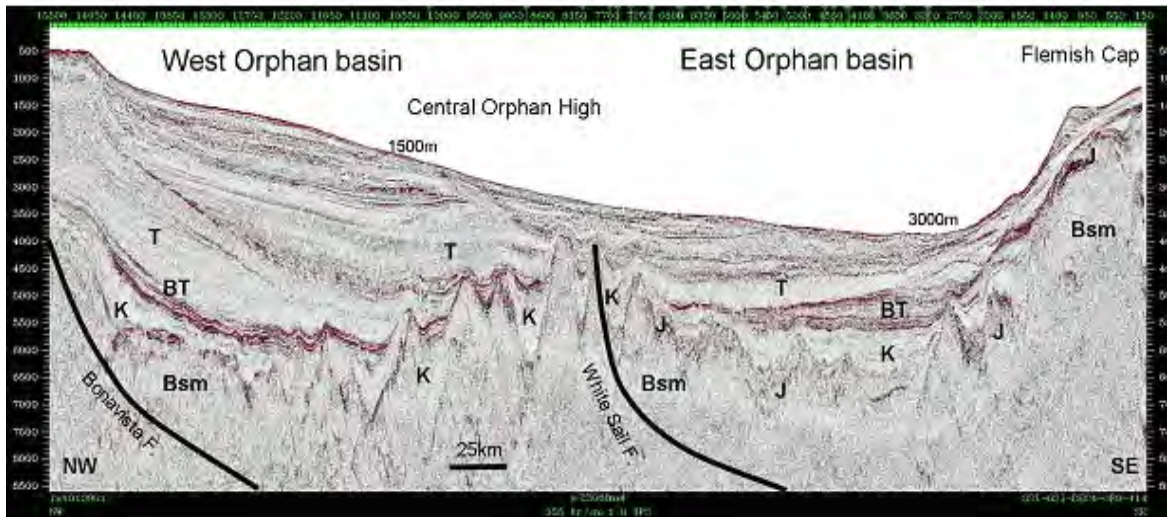


Figure 10. NW-SE Seismic section (courtesy of GSI) across the Orphan Basin showing the West and East Orphan basins and illustrating structural and stratigraphic hydrocarbon plays (reproduced from Enachescu et al., 2005).

All eight ELs active in the basin (Figure 5) are owned by the same partnership led by Chevron. Three large 3D seismic surveys were acquired in the past years covering several exploration licenses operated by Chevron on behalf of ExxonMobil, Imperial and Shell. The surveys have provided detailed mapping on several large antiforms (200-400 km²) resulting from extensional roll-over anticlines being modified by transtension and inversion. One location in 2,350 m of water, Great Barasway F-66, has an interpreted site survey and will become the first structure to be tested in this basin using the Eirik Raude semi-submersible during the summer of 2006. The seismic section in Figure 11 shows the approximate location of the Great Barasway structure.

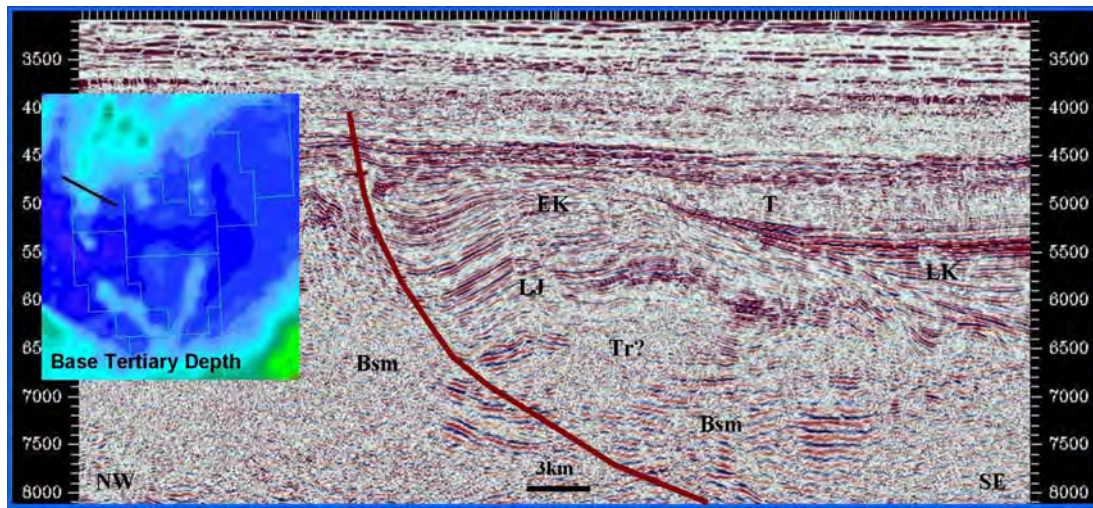


Figure 11. Seismic section (courtesy of GSI) across fault bounded large structural closure within the East Orphan Basin. Annotations are: Bsm = Petroleum Basement; Tr = Triassic sequence; LJ = Late Jurassic sequence that include source rock; EK = Early Cretaceous and LK = Late Cretaceous sequences that may include reservoir beds and T = Tertiary sequence. Line shows approximate location of Great Barasway F-66 exploration well. Insert shows location of section on Base Tertiary Depth map (reproduced from Enachescu et al., 2005).

With a long intra-continental rift evolution, shallow marine interludes of possible source rock deposition and numerous syn-rift structural and stratigraphic trapping possibilities, the East Orphan Basin has the potential to become the first deep water producing area in Atlantic Canada.

According to recent published regional seismic studies (Smee, 2003; Enachescu et al., 2004b; Enachescu and Fagan, 2004 and 2005; Kearsey and Enachescu, 2005; Enachescu et al., 2005), there are half dozen large structures in the basin, each with the potential to hold several billion barrels of oil-in-place (e.g. Figure 11). Situated on trend with other oil prolific basins on both sides of the Atlantic, the East Orphan Basin's petroleum potential remains to be validated by the Great Barasway F-66 and future deepwater drilling, probably during 2006-2008. Although a large area has been awarded in 2003, a significant area with petroleum potential remains to be licensed within the basin (Enachescu et al., 2004c, 2005; Enachescu and Fagan, 2005).

3.5. West Orphan Basin

The West Orphan basin is an area of approximately 60,000 sq km lying between the White Sail and Bonavista faults and located directly west from the current exploration in the East Orphan Basin (Enachescu et al., 2004 a and b and 2005; Figures 3 and 10). This area is a younger rift basin than the East Orphan or the Jeanne d'Arc basins, that was formed mainly during Cretaceous extensional stages (North Atlantic and Labrador rift stages) of intra-continental rifting and inter-continental drifting (Smee, 2003; Smee et al., 2003; Enachescu et al., 2004 a and b; Enachescu and Hogg, 2005, Enachescu and Fagan, 2005; Hardy and Enachescu, 2005; Enachescu et al., 2005). Landward rift migration formed a large area filled with predominantly Cretaceous sequences lying above and between large northeast-southwest trending rotated basement blocks. The West Orphan Basin contains seven dry holes drilled between 1974 and 1985 (Smee et al., 2003; Enachescu et al., 2004b). While good reservoirs and very large structural traps were tested, no significant hydrocarbon flows were obtained and no Kimmeridgian source rocks were encountered.

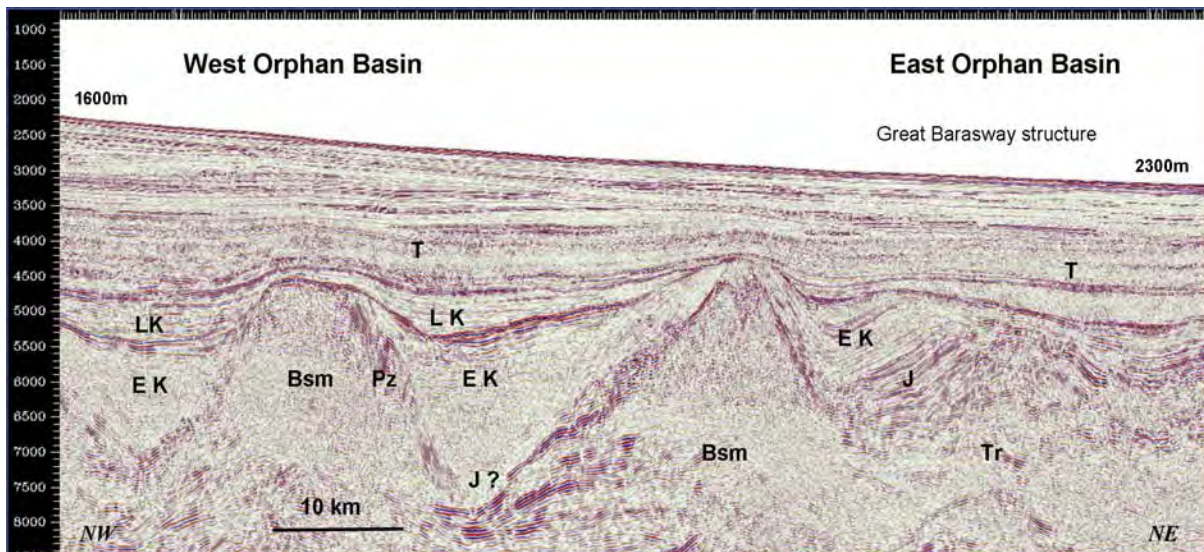


Figure 12. Seismic section (courtesy of GSI) across large half graben within the West Orphan Basin that may contain Late Jurassic rocks and show possible structural and stratigraphic traps. Annotations are: Bsm = Petroleum Basement; Pz = Paleozoic; Tr = Triassic sequence; J? = Possible Late Jurassic sequence that may include source rock; EK = Early Cretaceous and LK = Late Cretaceous sequences that may include reservoir beds and T = Tertiary sequence.

The Tertiary section is significantly thicker in the West Orphan than in the East Orphan Basin, ranging from 3000 m to 5000 m in thickness (Burton-Fergusson et al., 2006; Figures 10 and 12). Below the Base of the Tertiary seismic marker, a thick Mesozoic section can be seen in the downthrown block of the basin-bounding Bonavista Fault. Some sedimentary troughs may contain in excess of 7 km of Cretaceous sedimentary rocks. It is also possible that Jurassic sediments may be present to some degree in several deep troughs in the West Orphan Basin, but current seismic imaging does not allow a definitive conclusion to this effect (Figure 12).

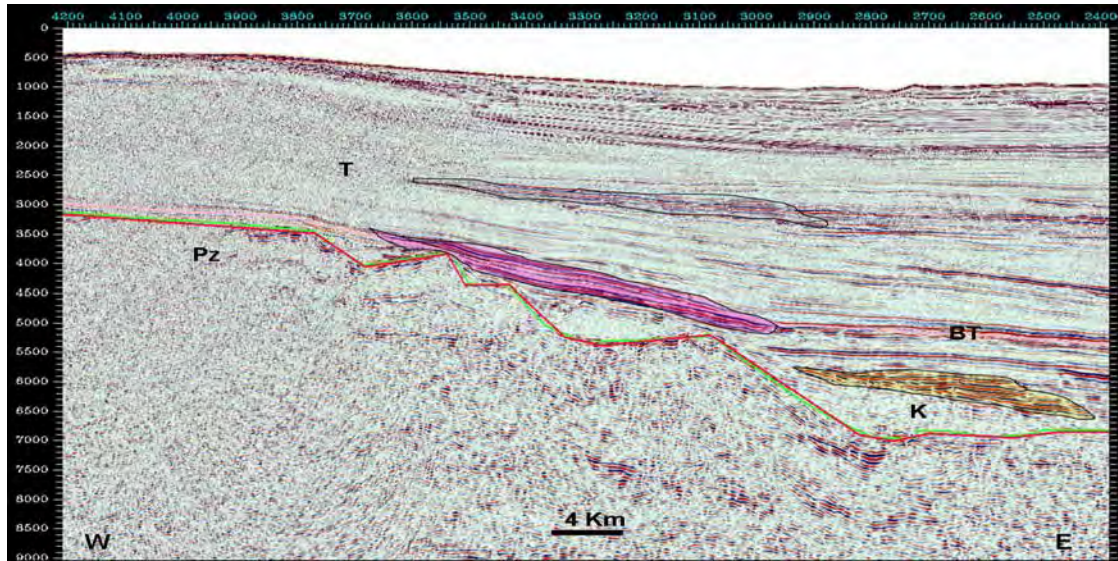


Figure 13. 2D Seismic line (courtesy of GSI) located in the West Orphan Basin shows stratigraphic plays in Late Cretaceous and Early Tertiary sequences interpreted as sedimentary fans (reproduced from Enachescu et al., 2005). Annotations are: Pz = Paleozoic; K = Late Cretaceous; T = Tertiary sequence; BT = Base Tertiary.

The existing 2D seismic data in the area show a significant number of potential hydrocarbon traps within Cretaceous sediments, including tilted fault blocks, drape closures over basement highs and stratigraphic traps on the flanks of basement highs. Sand fans of Late Cretaceous and Tertiary age derived from platform and ridges and sourced from a postulated Albian or Late Cretaceous source rock are the most obvious undrilled play-types in the West Orphan Basin (Hardy and Enachescu, 2005). Several Late Cretaceous and Early Tertiary seismic sequences have the characteristic aspect of marginal fans, but 3D mapping is necessary to verify their areal extent, shape and trapping potential (Figure 13). Some of these features are associated with amplitude anomalies at various levels in the Cretaceous and Tertiary. The area was actively explored in the late seventies and early eighties. No land is licensed in this basin at this time. Given the large size of the basin, and the fact that most of the Mesozoic sequence has never been tested by the drillbit, the West Orphan Basin deserves a second round of exploration using modern seismic including 3D data, thermal modeling of possible Cretaceous source rocks and drilling for Early and Late Cretaceous sandstone reservoirs.

Labrador Sea. This is an area that has seen an early oil exploration phase during the seventies and early eighties that resulted in significant gas finds. The area of hydrocarbon potential is vast, encompassing 50 million acres from 52 to 60 degrees north. Recent regional seismic data was acquired, mostly by GSI of Calgary that ties some of the earlier 28 wells and the gas discoveries, and extends off-shelf into the deeper water. Increased exploration activity is also taking place

across the sea on Greenland's continental margin where indications of older sequences, including Late Jurassic source rocks, have been observed in outcrop and on seismic data. The Labrador Sea has two main basins: Hopedale in the south and Saglek in the north (Figures 1 and 2).

3.6. Hopedale Basin

The Labrador Sea contains a series of Late Cretaceous to Tertiary extensional and trans-tensional basins that were drilled during the seventies and early eighties, and resulted in five significant gas discoveries (McWhea et al., 1980; Balkwill, 1987; Maneley, 2003; Enachescu, 2005b; Enachescu and al., 2006; Enachescu, 2005b and c, 2006d and e). According to the C-NLOPB, a total of 4.24 tcf of gas resource and 123 million barrels of NGL's were found in the Hopedale Basin, between 80 and 150 kilometres off the coast of Labrador in fields such as North Bjarni (2.2 tcf) (Figure 14), Bjarni (0.9 tcf), Hopedale (.105 tcf), Gudrid (0.9 tcf), and Snorri (.105 tcf), but no drilling has occurred in the basin since 1983. The excellent quality reservoirs encountered are Late Cretaceous sandstones of the syn-rift sequence and Paleozoic pre-rift carbonates located at 2.5 to 3.5 km depth. Large structures such as horst and fault blocks are the usual exploration targets (Figures 14 and 15 and McWhea et al., 1980; Meneley, 2003; Enachescu, 2005b; Enachescu et al., 2006; Enachescu, 2006). Conceptual plays include the drape and onlap of the Bjarni sandstone on basement highs, roll-over anticlines, fault blocks and Tertiary turbidite sands. Several stratigraphic traps (pinch outs) were also drilled.

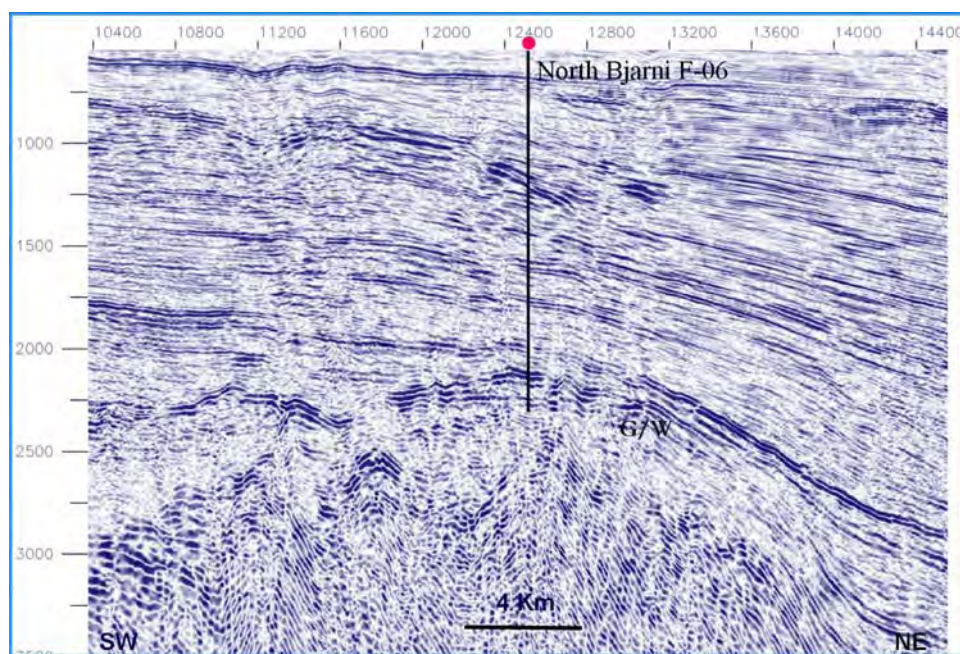


Figure 14. 2D Seismic line (courtesy of GSI) located over the North Bjarni gas field in the Hopedale Basin, Labrador. The Early Cretaceous reservoir is draped over basement high and shows an Amplitude Anomaly and Flat Spot (reproduced from Enachescu et al., 2006).

Significant Discovery Licences (SDLs) in the Hopedale Basin are held by several companies including Petro-Canada, Husky, Suncor, AGIP, ConocoPhillips and ChevronTexaco. These discoveries are currently at the edge of the technical and economical frontier, but new technologies and increasing demand may accelerate their development. Given the large number of undrilled features and proven prospectivity, it is very likely that more reserves will be found in this large unlicensed area (e.g. Figure 15 and Enachescu et al., 2006). Work continues on

studying the impact of ice on offshore pipeline infrastructure. Work is planned in the region, relating to Strategic Environmental Assessments as well as studies on development concepts for monetizing the stranded gas reserves.

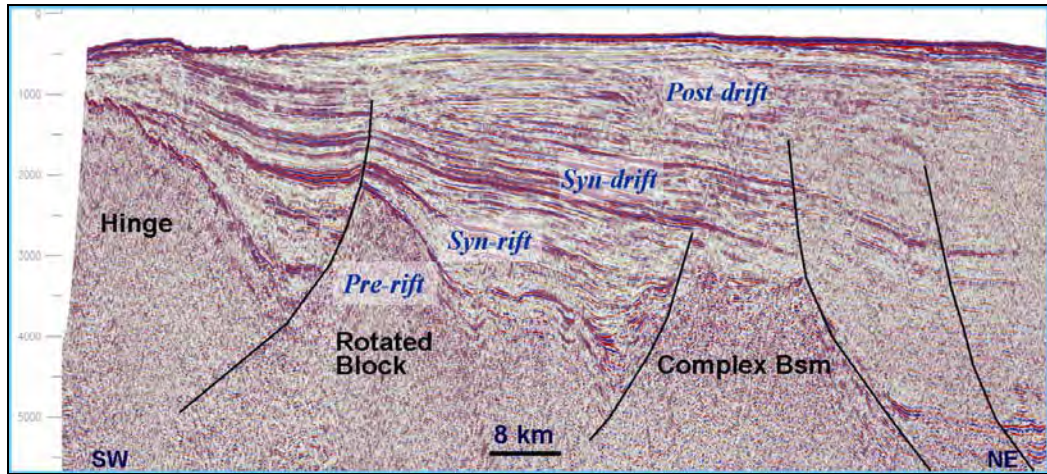


Figure 15. Regional 2D seismic section (courtesy of GSI) across the on shelf part of the Hopedale Basin, Offshore Labrador showing large basement horsts and drape anticlines in the overlying Cretaceous and Tertiary sediments. Three large grabens that may hold mature source rocks are also visible on the shelfal part of the Hopedale Basin. Large listric faults are seen in the eastern part.

3.7. Saglek Basin

The most northerly Labrador Sea Basin is the Saglek Basin which covers an area of 80,000 km². Although the five wells drilled in the basin during the seventies - early eighties exploration cycle were dry, they did prove the presence of both source and reservoir rock within the Bjarni Formation (Mc Whea et al., 1980; Fowler et al., 2005; Balkwill, 1987; Balkwill et al., 1990; Enachescu et al., 2006; Enachescu, 2006).

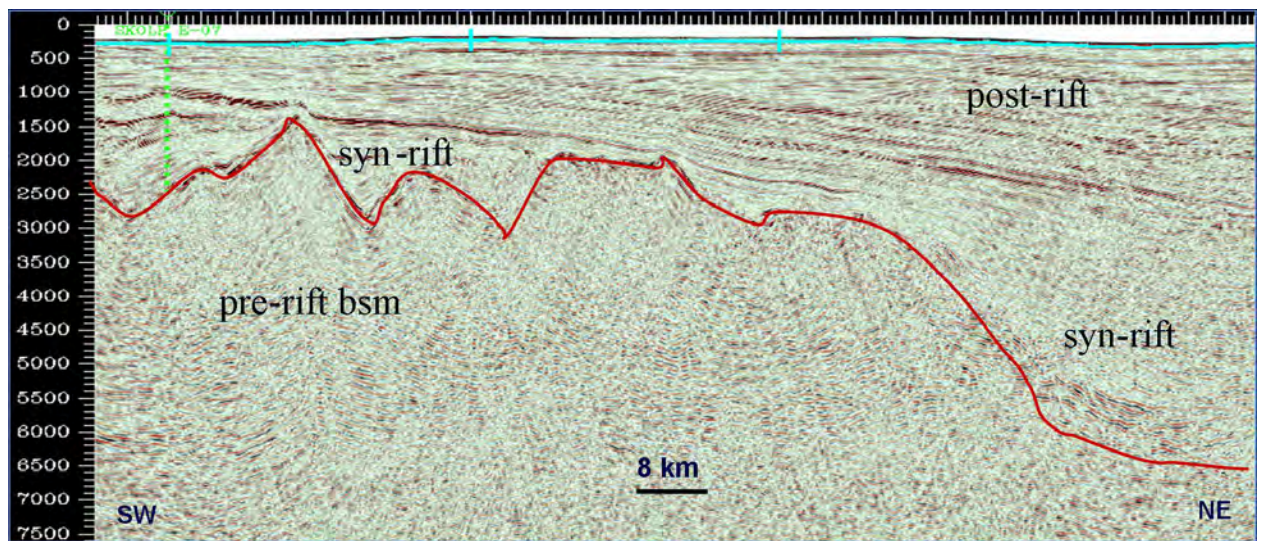


Figure 16. Regional 2D seismic section (courtesy of GSI) across the on shelf part of the Saglek Basin, Offshore Labrador showing large basement horsts, half-grabens and drape anticlines in the overlying syn-rift and post-rift sequences (Cretaceous and Tertiary sediments). A large sub-basin that may hold mature source rocks is visible on the north-eastern shelfal part of the Saglek Basin.

Recent reprocessing of older seismic data and the acquisition of some regional data during 2005 has facilitated additional research into the basin's geology. Large structural leads have been identified on the new data (Figure 16) and more seismic acquisition is planned for the summer of 2006 in the Saglek Basin.



4. Jeanne d'Arc Basin Geological Setting

The Jeanne d'Arc Basin is a fault-bounded Late Jurassic-Early Cretaceous reactivated sector of the larger Late Triassic-Early Jurassic rifted area on the Grand Banks (Enachescu 1987, 1988; Tankard and Welsink, 1987 and 1989; Sinclair, 1988; Grant and McAlpine, 1990; McAlpine, 1990; Hogg and Enachescu, 2001 and Figures 2, 3, 4 and 17 to 20). The basin was primarily shaped by repeated extensional episodes and exhibits only minor inversion due to trans-tensional forces and salt diapirism. A proven rich petroleum system is present including:

- a) Kimmeridgian source rock (Egret Member of the Rankin Formation);
- b) excellent reservoirs in Late Jurassic Jeanne d'Arc, Early Cretaceous Hibernia and Catalina, and Mid-Cretaceous Avalon and Ben Nevis formations (Enachescu, 1987; Tankard and Welsink, 1987; Sinclair, 1988; McAlpine, 1990; Enachescu and Dunning, 1994; Hogg and Enachescu, 2003; Enachescu, 2004; Enachescu and Fagan, 2005).

According to the C-NLOPB, the discovered recoverable reserves and resources of the Jeanne d'Arc Basin are estimated to be 2.75 billion barrels oil and 6 tcf gas with 355 million barrels of associated liquids. Total potential recoverable reserves for this basin are estimated at over 5.3 billion barrels oil and 20 tcf gas. To date 56 exploration wells have been drilled in the Jeanne d'Arc basin, representing an exploratory well density of one well per 250 km² within the basin. All past exploration has been focused on the oil play, but this may change as investigations are currently underway toward bringing Grand Banks gas to market. The White Rose field alone contains almost 2.7 tcf of recoverable gas, and the operator, Husky Energy, has sought and received proposals on ways and means to monetize the gas. Marine transportation of compressed

natural gas (CNG) by ship is one of the promising initiatives being investigated by private firms and by the Centre for Marine CNG Inc. Sub-sea pipeline, LNG, Gas to Liquid (GTL) processing and tanker transportation and Gas to Wire (GTW) are other solutions that have been investigated by engineering firms.

Within the Jeanne d'Arc Basin (which has been re-targeted by industry in the past two landsales and the present Call for Bids) the potential for oil discoveries is recognized in deeper structural plays, stratigraphic traps in the southern part, and combination traps in the eastern side of the basin - while gas plays are yet to be explored. Smaller satellite fields and extension blocks of the producing fields are also likely to be pursued in the future exploration efforts in this basin.

A more complete description of the Jeanne d'Arc Basin and its exploration history, main fields, structure, stratigraphy and petroleum systems was given by Enachescu and Fagan (2004) (available at http://www.nr.gov.nl.ca/mines&en/oil/call_for_bids_nf04_01.stm). Regional illustrations of the structure, stratigraphy and petroleum potential used in the 2004 report are reproduced with modifications and adaptations in Figures 4, 17 to 21 of this report.

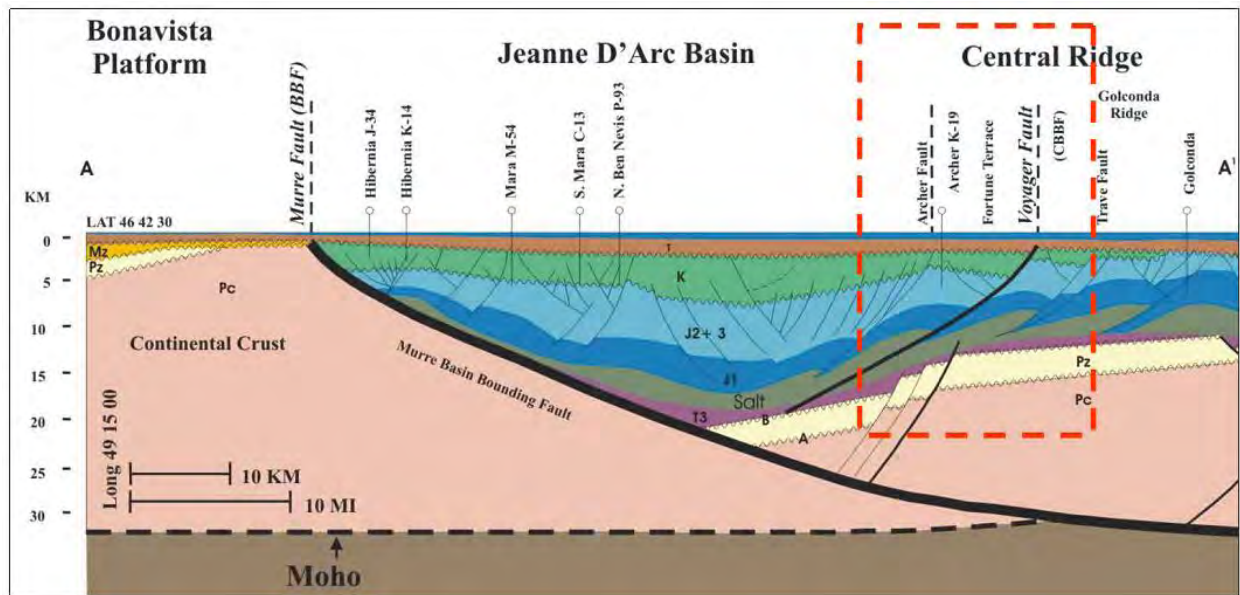


Figure 17. Regional geological cross-section A-A' across the Jeanne d'Arc Basin at the latitude of Hibernia oil field and Trans-Basin Fault Zone (modified after Enachescu, 1987). In the red dashed box is the approximate structural location of the Call for Bids NL 06-1 Parcels 1, 2 and 3. The location of cross-section A-A' is given in Figure 18.

The main Grand Banks structural units considered in this report when discussing the potential of the landsale parcels are the Jeanne d'Arc Basin, Central Ridge and Morgiana Anticlinorium, and Voyager Fault (Figures 17 and 18; Enachescu, 1987 and 1988; Enachescu and Dunning, 1994; Enachescu and Fagan, 2004 and 2005b; Grant and Mc Alpine, 1990; McAlpine, 1990; Tankard and Welsink, 1987 and 1989).

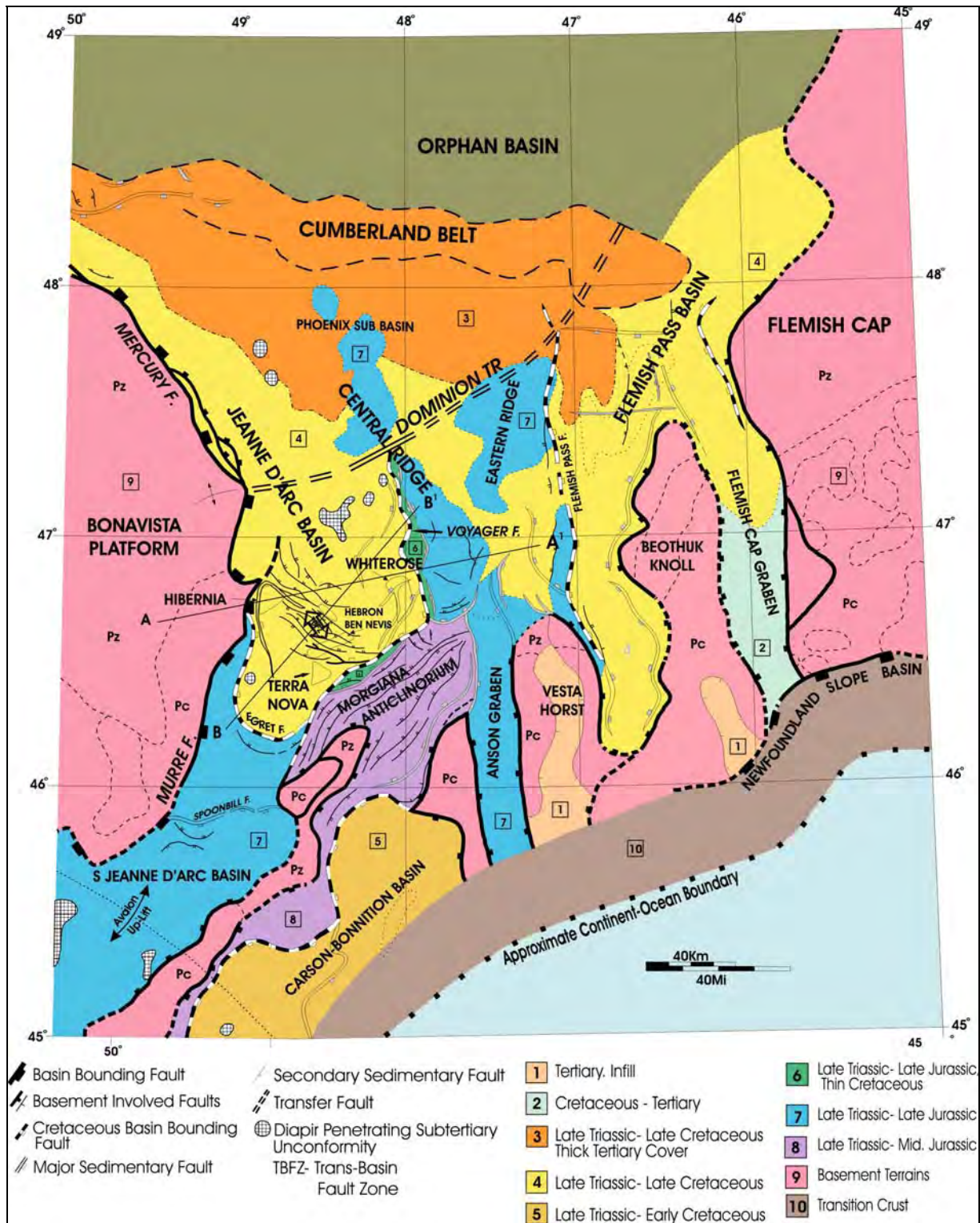


Figure 18: Tectonic and structural framework of North-eastern Grand Banks and environs (modified after Enachescu 1987 and 1994). A-A' is the geological cross-section noted in Figure 17 and B-B' is the geological cross-section shown in Figure 19.

A short description of the Jeanne d'Arc Basin petroleum system, which can arguably be applied to the entire Grand Banks and surrounding basins, is also given below.

Source Rock and Maturation. The Kimmeridgian aged Egret Member of the Rankin Formation is the proven oil source rock for all of the significant oil and gas discoveries on the Grand Banks (Figures 4, 19 and 20). This is a marine organic-rich shale (TOC 2-12%) that began generating hydrocarbons in Late Cretaceous, reached peak oil generation in the Eocene, and in places continues to generate oil and gas. It averages 200 m thickness throughout the Jeanne d'Arc Basin and has also been encountered by drilling on the Central Ridge and in the Flemish Pass Basin. Seismic character strongly suggests that this source rock will be present in the northern Jeanne d'Arc Basin and the East Orphan Basin to the north, and it is also expected to be preserved in some parts of the southern Grand Banks basins. The potential for other source rocks is recognized within the Oxfordian, Early Cretaceous and Early Tertiary.

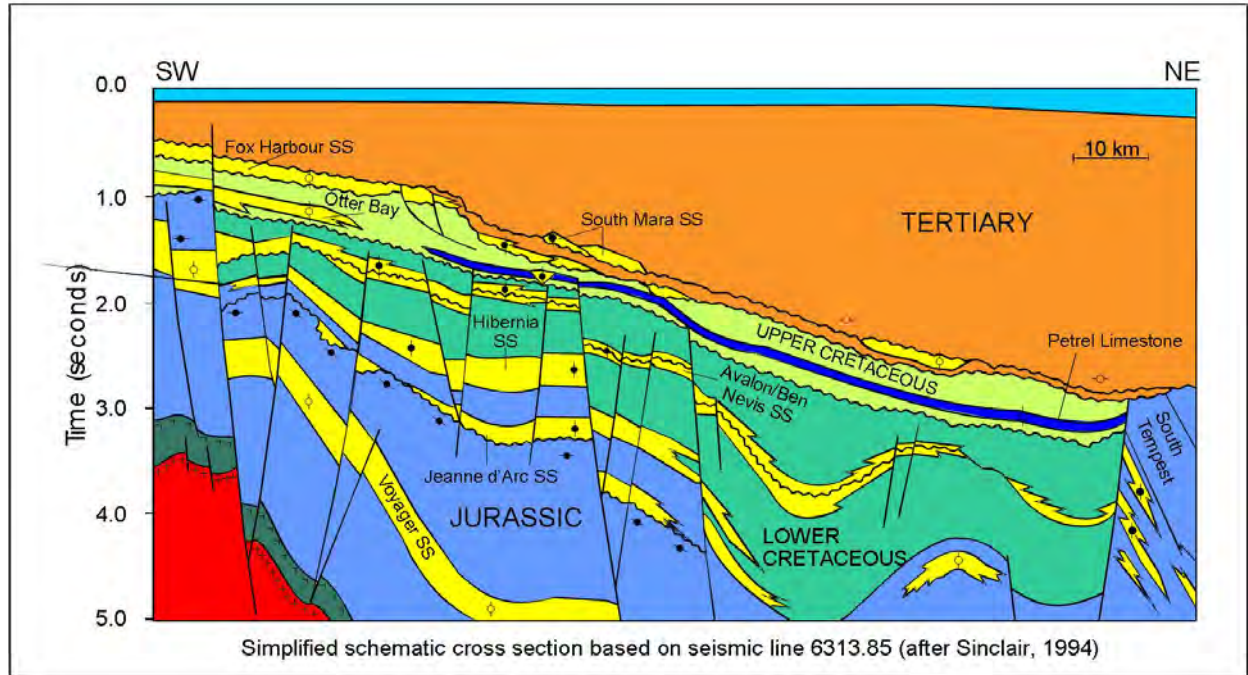


Figure 19. SW-NE regional geological cross-section across the Jeanne d'Arc Basin marked B-B' on the map in Figure 18. Main reservoirs and source rock intervals are indicated (section is modified from Sinclair 1994).

Hydrocarbon Reservoirs. Stacked sandstones intervals within the Jeanne d'Arc, Hibernia, Catalina and Avalon formations are proven quality reservoirs (Figures 4 and 19). 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. Fair to good quality reservoirs are also found in the Voyager and Ben Nevis formations. Excellent reservoirs are found in Late Cretaceous Dawson Canyon (Otter Bay and Fox Harbour Members) and the Paleocene Avondale (Deptuck et al., 2003) and South Mara Members of the Banquereau Formation, but to date only a couple of smaller pools have been encountered at these levels. Exploratory drilling has focused primarily on the proven reservoirs of the Late Jurassic to Early Cretaceous. However, given the large size of some of the stratigraphic prospects mapped within the Late Cretaceous and Early Tertiary sequences there is a real and effectively untested potential for large oil and gas pools at these shallower levels.

Hydrocarbon Traps. The main structural traps are extensional anticlines, roll-overs, faulted anticlines, faulted and tilted blocks and elongated horsts (Figures 17 and 19). 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. All major traps were found to have a stratigraphic component as the accumulations are contained in continental, deltaic and shallow marine sandstones onlapping or wrapped over the main structural traps. 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. However, basin margin plays were found to be most successful.

Seals. Oil and gas accumulations are sealed by thick overlying shales abundant during the Late Jurassic to Late Cretaceous (e.g. Fortune Bay, White Rose and Nautilus shales). Also intra-formational seals are widespread within the rift stage clastic sequences. Excellent regional seals are provided by fine grained Late Cretaceous Dawson Canyon and the Tertiary Banquereau formations (Figure 4).

Migration. Expulsed hydrocarbons have migrated mainly vertically, predominantly along the numerous extensional faults (Figures 12 and 13). Some lateral migration occurred locally along basin flanks. Late migration of hydrocarbons occurred within the basin marginal fans and sand filled canyons.

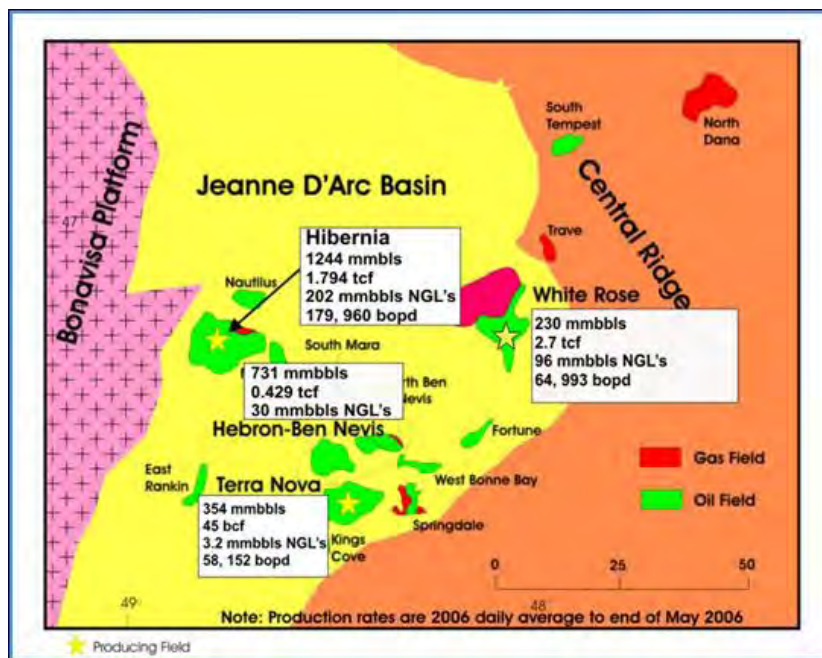


Figure 20. Jeanne d'Arc Basin and environs, producing oil fields and other discoveries (modified after C-NLOPB).

Exploration in the basin has been focused mainly on the proven reservoirs of the Late Jurassic and Early Cretaceous age, located in the down-throw of the Murre and Voyager faults and along the Trans-Basin Fault Zone where most of the large oil discoveries are found (Figures 17 to 19 and 21, and McAlpine, 1990; Enachescu and Dunning, 1994; Enachescu and Fagan, 2004;

Enachescu, 2005a; Enachescu and Hogg, 2005; Enachescu and Fagan, 2005). Significant for this landsale, is that several discoveries were made in the upthrown block of the Voyager Fault.

The recent 2004 and 2005 landsale in the basin included parcels surrounding the Hibernia, Terra Nova, Hebron Ben Nevis and White Rose fields that may provide for extensions of existing fields, additional smaller satellites or new discoveries (Enachescu and Fagan, 2004 and 2005). Future exploration opportunities in the basin include:

- a) deeper fault blocks in the central Trans-Basin Fault Zone and around existing fields (Figure 11 to 13);
- b) complexly faulted structures along the basin margins and on parts of the Central Ridge where Late Jurassic has not been eroded;
- c) Early Cretaceous deeper rollovers in the northern portion of the basin and Central Ridge;
- d) Late Cretaceous and Early Tertiary basin margin and floor fans (Deptuck et al., 2003 and Figure 19);
- e) Paleocene and younger sandstones resulting from the erosion of older sandstones and draped over ridges, faulted blocks and salt diapirs, and
- f) coarse clastics on the flanks of rotated blocks or in minibasins related to salt structures.

The present Call for Bids NL06-01 parcels, are located on both flanks of the Voyager fault system (Enachescu, 1987), north of Terra Nova and south of the White Rose fields. The Voyager Fault and its imbricates form a complex fault zone that is probably made of various linked antithetic faults of the Murre basin bounding fault. The South Tempest oil field and the Trave and Springdale gas fields are located in the imbricate zone or on the footwall of the Voyager Fault.

5. Petroleum Potential of 2006 Call for Bids Parcels 1, 2 and 3

The three parcels cover a total area of 76,419 hectares (188,835 acres) and are located on the eastern side of the Jeanne d'Arc Basin, along the Voyager Fault and its imbricates and on the high basinal trend formed by the Morgiana Anticlinorium and the Central Ridge (Figure 20) (Enachescu, 1987 and 1988). These parcels are also situated in an area with high petroleum potential stretching between the Terra Nova, Hebron Ben Nevis and White Rose oil fields. Several exploration rounds in the past resulted in the drilling of 1 exploration well within the parcels and 12 wells in the immediate vicinity. Five of these wells resulted in hydrocarbon discoveries, all of which are too small for stand alone development. However, these three parcels are located in shallow water (90-120 m water depth), and are also close to the "golden" triangle formed by the Hibernia - Terra Nova - White Rose oil fields and are very close to the Hebron-Ben Nevis multi-zone oil and gas field (Figures 3, 21 and 22). They are also located in the vicinity of several smaller fields, single well discoveries and oil shows drilled during the past 25 years (e.g. Springdale, Fortune, West Bonne Bay, and Beothuk).

A land map of the basin showing the parcels (in red lines), existing Production Licences (PL) and Significant Discovery Licenses (SDL) within the framework of the central-southern Jeanne d'Arc Basin is shown in Figure 22. For reference, the approximate location of the parcels is also shown on the regional geological cross-sections through the central part of the basin given in Figure 17 and on the geological map of the basin (Figure 21).

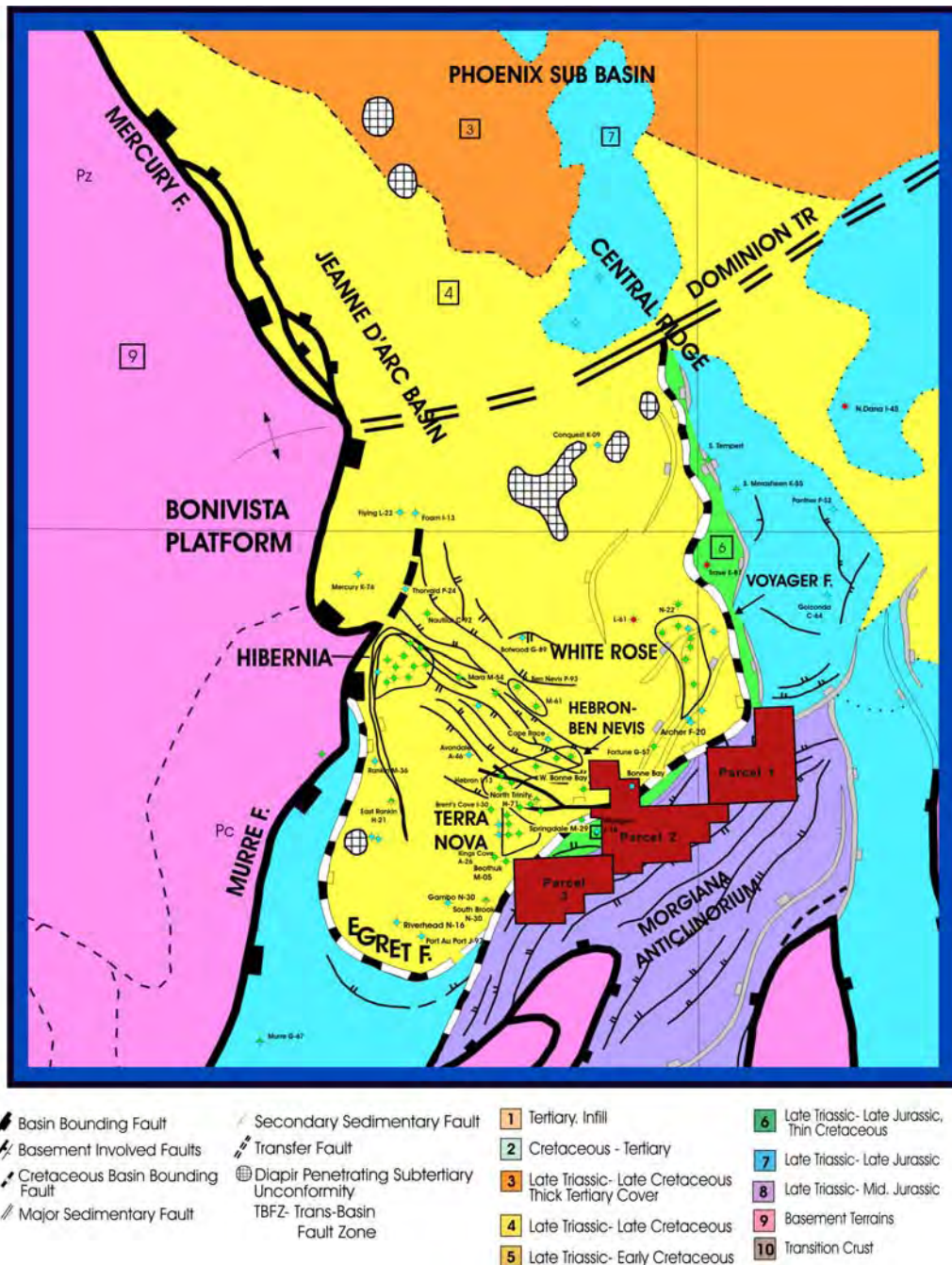


Figure 21. Structural and stratigraphic map of the Jeanne d’Arc Basin with oil fields, main exploration wells, and approximate location of NF06-01 parcels, (modified from Enachescu, 1987 and 2005).

Structurally, Parcels 1, 2 and 3 are located partially within the Jeanne d’Arc Basin and partially on the Morgiana Anticlinorium and the Central Ridge (Figures 21 and 22). The Jeanne d’Arc Basin is a Cretaceous reactivated part of a larger Jurassic basin that included the Morgiana Anticlinorium and the Central Ridge (Enachescu, 1987 and 1988). The anticlinorium and the ridge are intra-basinal highs that separate the Jeanne d’Arc Basin from Carson Basin and Flemish Pass Basin, respectively (Figures 3, 17, 18, 21 and 22; Enachescu, 1987; Enachescu and Fagan, 2004). They are complexly bounded by the Voyager Fault and its imbricates and are cored by elevated pre-rift basement blocks. In places, the basement highs on the Central Ridge and

Morgiana Anticlinorium sustain salt diapirs, a thick Jurassic succession and local Cretaceous cuvettes (e.g. Figure 23). The Egret source rock is mature throughout the Jeanne d'Arc area as proven by the large oil fields and several other smaller discoveries located in the immediate vicinity of the parcels (Figures 21, 22 and McAlpine, 1990; Hogg and Enachescu, 2001; Enachescu and Fagan, 2005).

A total of 13 wells are either situated within or near the landsale parcels. More information on the wells situated within or near the parcels can be obtained from C-NLOPB Schedule of Wells (C-NLOPB, 2005 and http://www.cnolpb.nfnet.com/publicat/other/sch_well/northind.htm), GSC Atlantic East Coast Basin Atlas (<http://cgca.rncan.gc.ca/BASIN/DEMO/basin-f-swf.cgi>) or from the White Rose and Terra Nova Development Plan Applications (DPA). Complete well history reports are available from the C-NLOPB. All parcels are located on the shelf in water depth varying from 90 to 120 m.

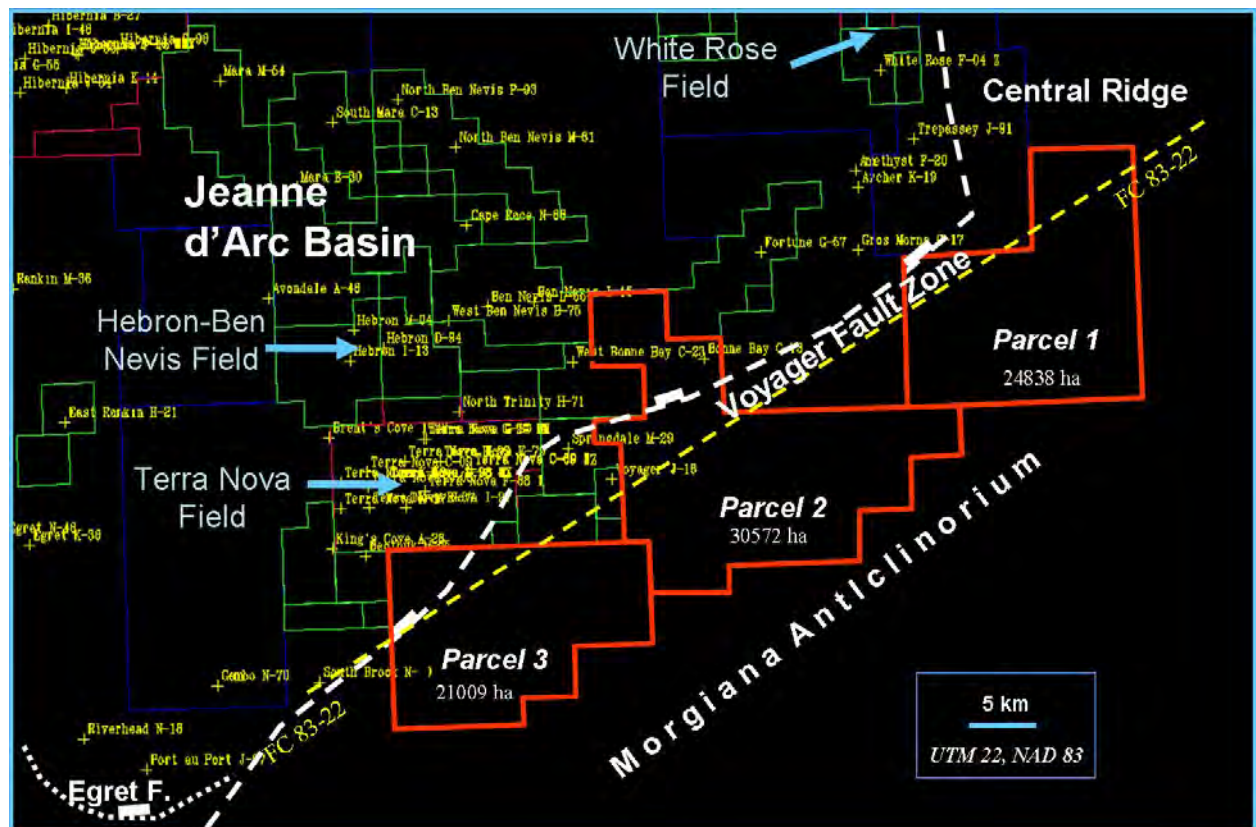


Figure 22. Call for Bids NL 06-01 land situation map. Parcels 1, 2 and 3 structurally located within the Jeanne d'Arc Basin, Morgiana Anticlinorium and Central Ridge are shown in red line. Main tectonic elements bordering the Jurassic+Cretaceous basin modified after Enachescu (1987). Exploration Licences (ELs) are shown in thin dark blue line, Production Licences (PLs) in thin red line and Significant Discovery Licences (SDLs) are shown in green line. Location of regional seismic strike line FC 83-22 is shown in dashed yellow line.

The parcels and the rest of the basin have a dense 2D coverage (Figure 23 and 24). The structural dip direction changes from east-west in Parcel 1 to northwest-southeast in the south. The strike lines are oriented approximately northeast – southwest. Several grids contain east-west and north-south oriented lines. All these lines are available in paper copies from the C-NLOPB for the cost of reproduction or for purchase in digital form from the data collectors which are seismic

contractors such as GSI, WesternGeco, Veritas, etc., or oil companies such as Petro-Canada, Husky, ExxonMobil, etc.

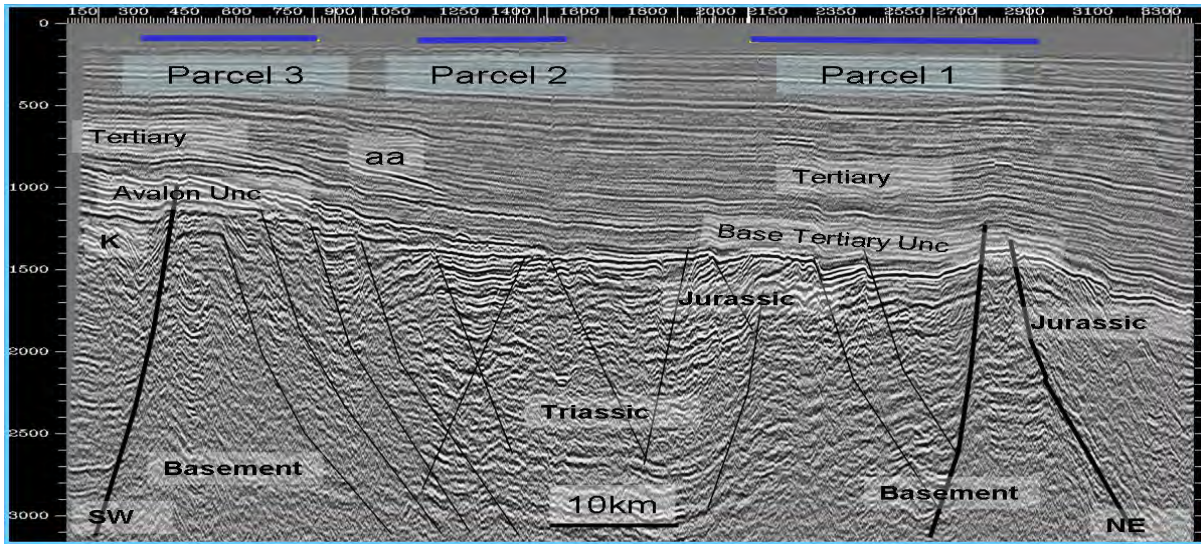


Figure 23. Regional SW-NE 2D seismic line FC 83-22 (courtesy of GSI) through Parcels 1, 2, 3 and environs showing complex faulting, main unconformities and various rotated blocks. This strike line shows the pre-rift basement, the syn-rift basin fill (Triassic to Mid-Cretaceous) and the post-rift sediments (Late Cretaceous to Tertiary) present in the parcels. The Jurassic and in places Cretaceous sequences are eroded at the Base Tertiary Unconformity and Avalon Unconformity. Location of the line is given in Figure 22.

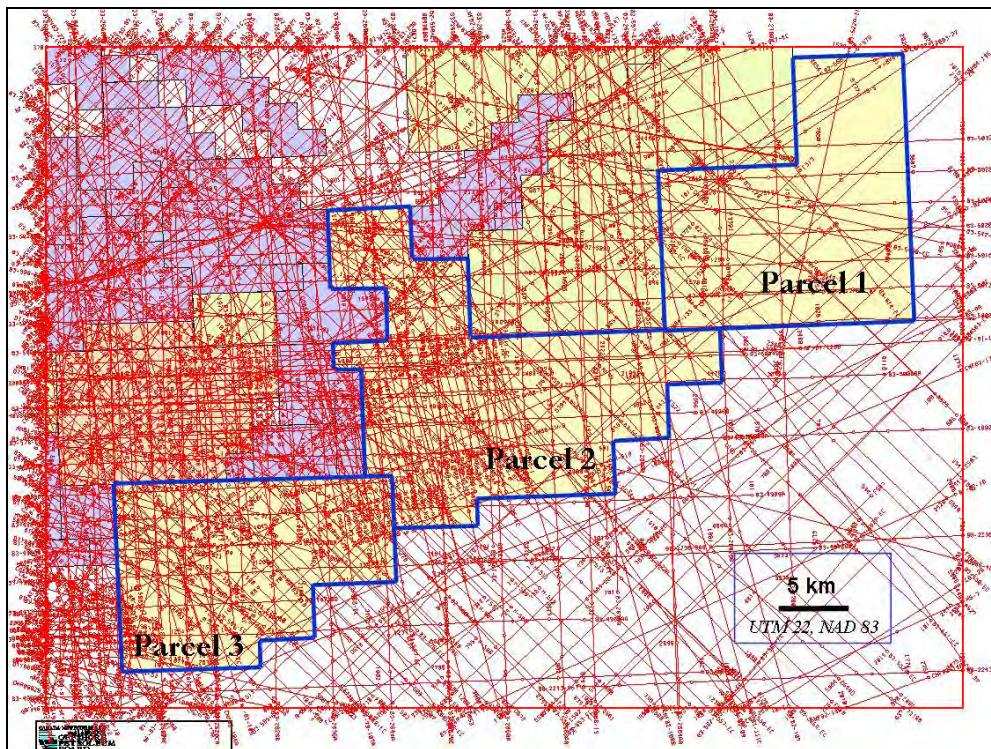


Figure 24. Existing seismic coverage within Parcels 1, 2 and 3 and adjacent areas in the Jeanne d'Arc Basin and environs. Data is available in paper copy from C-NLOPB or in digital form from the geophysical contractors or from oil companies. Landsale parcels are shown in thick blue line.

5.1. Parcel 1

This shallow water parcel (average water depth 120 m) is located just south of White Rose PL 1006 and several SDLs associated with this field. Parcel 1 covers an area of 24,838 hectares (61,376 acres) and is surrounded by active Exploration Licenses 1044, 1055 and 1091. The parcel is situated in an area of complex geology at the intersection of the NW-SE and N-S fault systems that affect this rifted area. These faults and many splays form the complicated Voyager Fault zone (Enachescu, 1987). Within this parcel, the Jeanne d'Arc Basin undergoes an abrupt change of the direction of its axis, from a NE-SW to a NNW-SSE direction. Within the parcel the Morgiana Anticlinorium oriented NE-SW continues in a northerly direction with the Central Ridge. Both these structural units of the Mesozoic rift system have a folded and faulted sedimentary sequence above a relatively shallow pre-rift basement covered by red beds and salt structures (Figure 25 to 28). There are no wells within the parcels, but several exploration holes are situated along its western border (Figure 25).

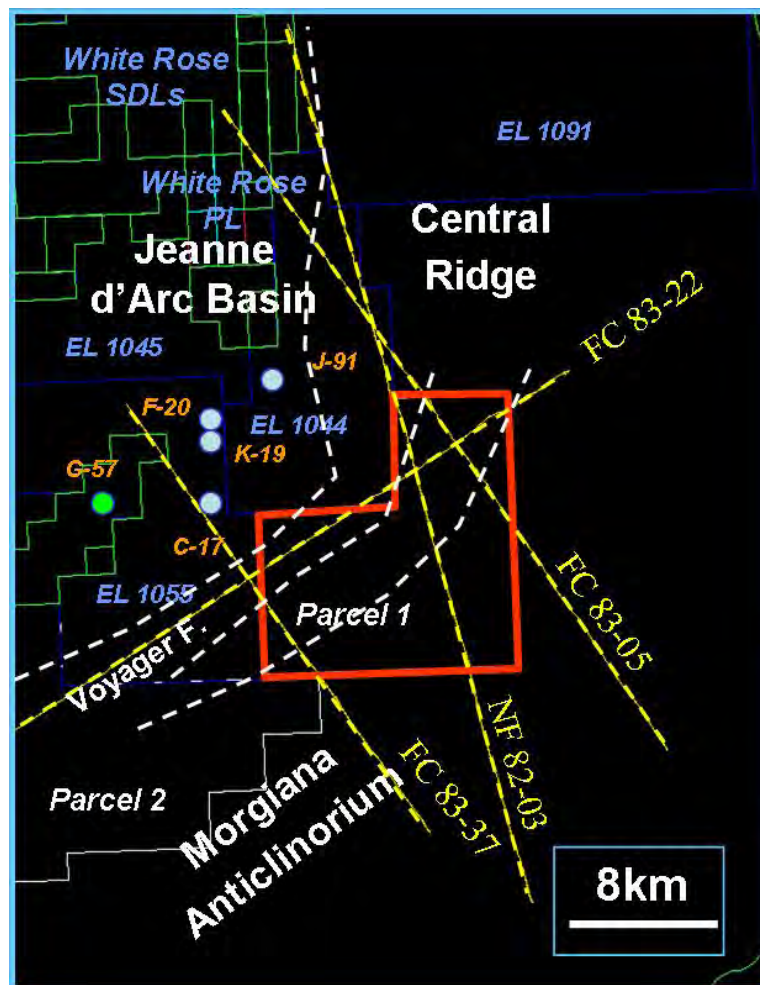


Figure 25. Location of Parcel 1 within the eastern Jeanne d'Arc Basin is shown in red line. Four seismic lines represented in dashed yellow line (courtesy of GSI) are used to illustrate the petroleum geology of this parcel. The parcel is surrounded by several active SDLs shown in thin blue line.

The parcel is located near the smaller Fortune G-57 oil discovery that tested 6,978 bopd light oil and 8.5 mmcf/d gas and has excellent reservoirs in Tertiary South Mara Member and Early Cretaceous Hibernia Lower zone (location in Figure 25). Several reservoir cores are available for

viewing at the C-NLOPB core storage facility in St. John's. The Fortune G-57 discovery has an estimated 6 million barrels of recoverable oil within a narrow fault block. The SDL for the discovery is shown in Figure 25, to lie immediately west of Parcel 1. The Fortune well had a TD at 4995 m and also encountered the Late Jurassic Egret source rock and sandstone reservoirs (Tempest sandstones). They all encountered good quality reservoirs and several oil and gas shows. The most significant wells are Amethyst F-20, (TD 3305 m; encountered reservoir sandstone in South Mara Mbr., Ben Nevis and Hibernia Formations and Egret source rock of the Rankin Formations); Archer K-19 (TD 4299 m; encountered reservoir sandstone in South Mara Mbr., Ben Nevis, Hibernia and Rankin Formations and Egret source rock); Gros Morne C-17 (TD 2280 m; encountered reservoir sandstone in Avondale Mbr., Ben Nevis/Avalon and Hibernia Formations) and Trepassey J-91 (TD 2995 m; encountered reservoir sandstone in Avondale Mbr. and Ben Nevis/Avalon Formations). The main risk of these wells was seal across the fault or unconformity.

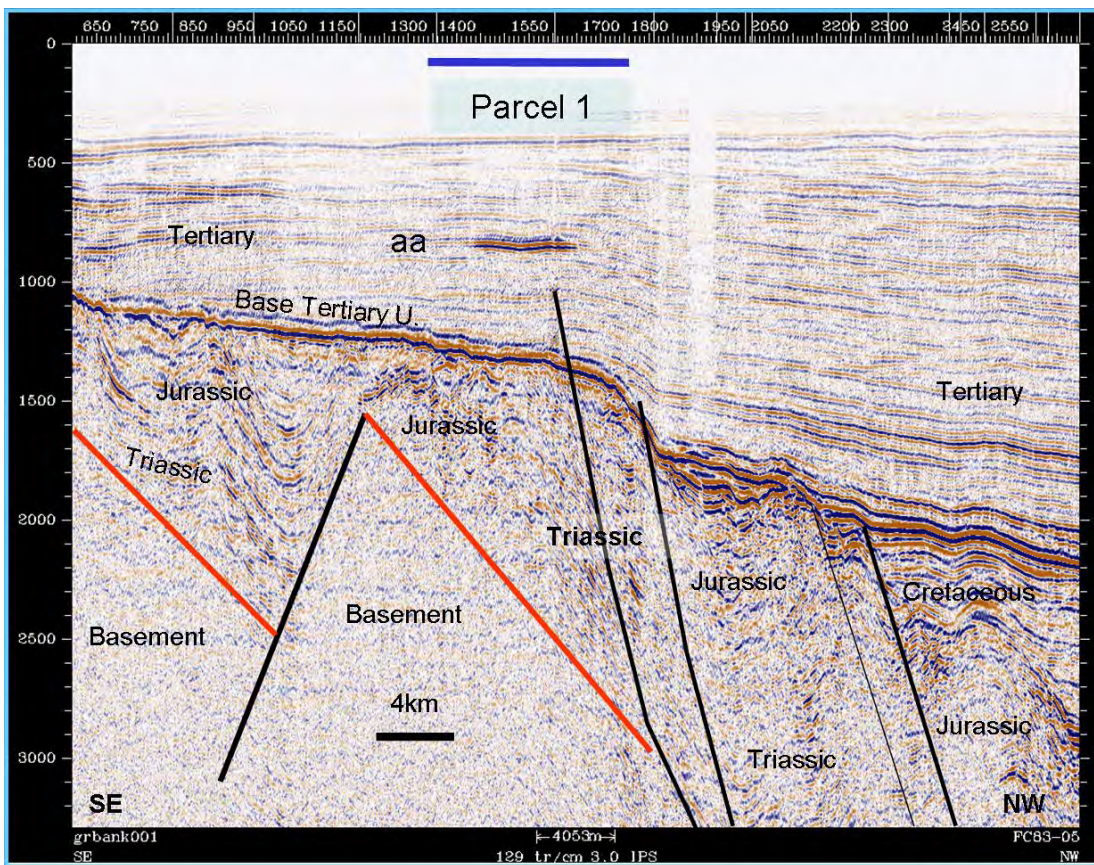


Figure 26. 2D seismic line FC 83-05 oriented SE-NW (courtesy of GSI) through Parcel 1 and environs showing the structure, stratigraphy and play types present in the area. The Parcel is located on and off the Central Ridge and Morgiana Anticlinorium. Here and in following interpreted seismic section major faults are illustrated with thick black lines, top basement is in red and aa = amplitude anomaly.

Four seismic lines are used to illustrate the structural setting of the parcel and its hydrocarbon potential (Figure 25). Seismic line FC 83-05 (Figures 25 and 26) intersects Parcel 1 on the Central Ridge and within a small imbricate block, immediately southeast of the Jeanne d'Arc Basin. The seismic line shows the Triassic and Jurassic sedimentary sequences are densely faulted and faulted above an elevated basement. Jurassic strata subcrop under a strong erosional

surface represented by the coalesced Avalon and Base Tertiary unconformities. Above this major unconformity the Tertiary sediments onlap in a southeasterly direction. The Tertiary succession is relatively thin (under 1.2 km) and contains a strong bright spot (labeled aa on Figure 26) associated with the presence of gas in a sandier mid-Tertiary channel.

Seismic line NF82-03 (Figures 25 and 27) crosses the Parcel 1 in a northwesterly direction and shows the syn-rift and post-rift sedimentary sequences present on the Central Ridge. The Triassic salt forms pillows above the basement and is overlain by a thick faulted and folded Jurassic sequence, severely truncated by the Base Tertiary-Avalon composite Unconformity. Within the parcel Mid- and Late Jurassic layers are truncated by the unconformity that shows a rough topography. As illustrated by this seismic line several cuvettes filled with preserved Cretaceous strata (K on Figure 27) have survived in local synclines the long erosional interlude. A thicker (up to 1.7 km) of Tertiary succession is present above the unconformity.

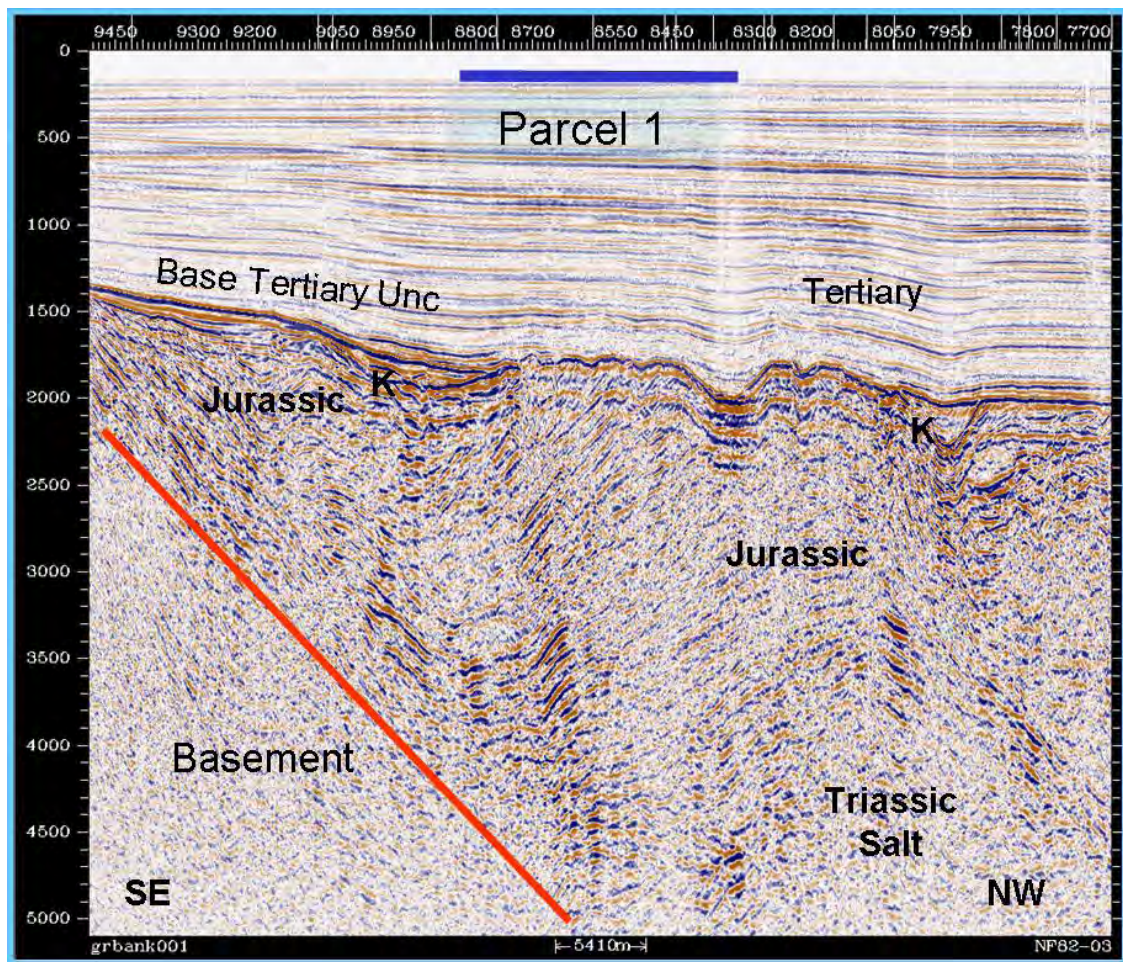


Figure 27. SE-NW 2D seismic line NF82-03 (courtesy of GSI) through Parcel 1 and environs showing the structure, stratigraphy and play types present in the area. K = Undifferentiated Cretaceous rocks found in small preserved sedimentary cuvettes.

Seismic line FC83-37 (Figures 25 and 28) crosses the parcel in a northwesterly direction and is situated in the very southern corner of the parcel. Its southeastern part was acquired over the Morgiana Anticlinorium represented by a high basement block bordered by the Voyager Fault and its imbricates that were active throughout the Tertiary. In the hanging wall of the main fault

are several fault bounded terraces containing thick Jurassic sequence angularly truncated by the Base Tertiary Unconformity. Lower Tertiary beds onlap this unconformity. Several amplitude anomalies (aa) are present at different levels within the Tertiary in the upthrown segment of the upper Voyager Fault imbricate.

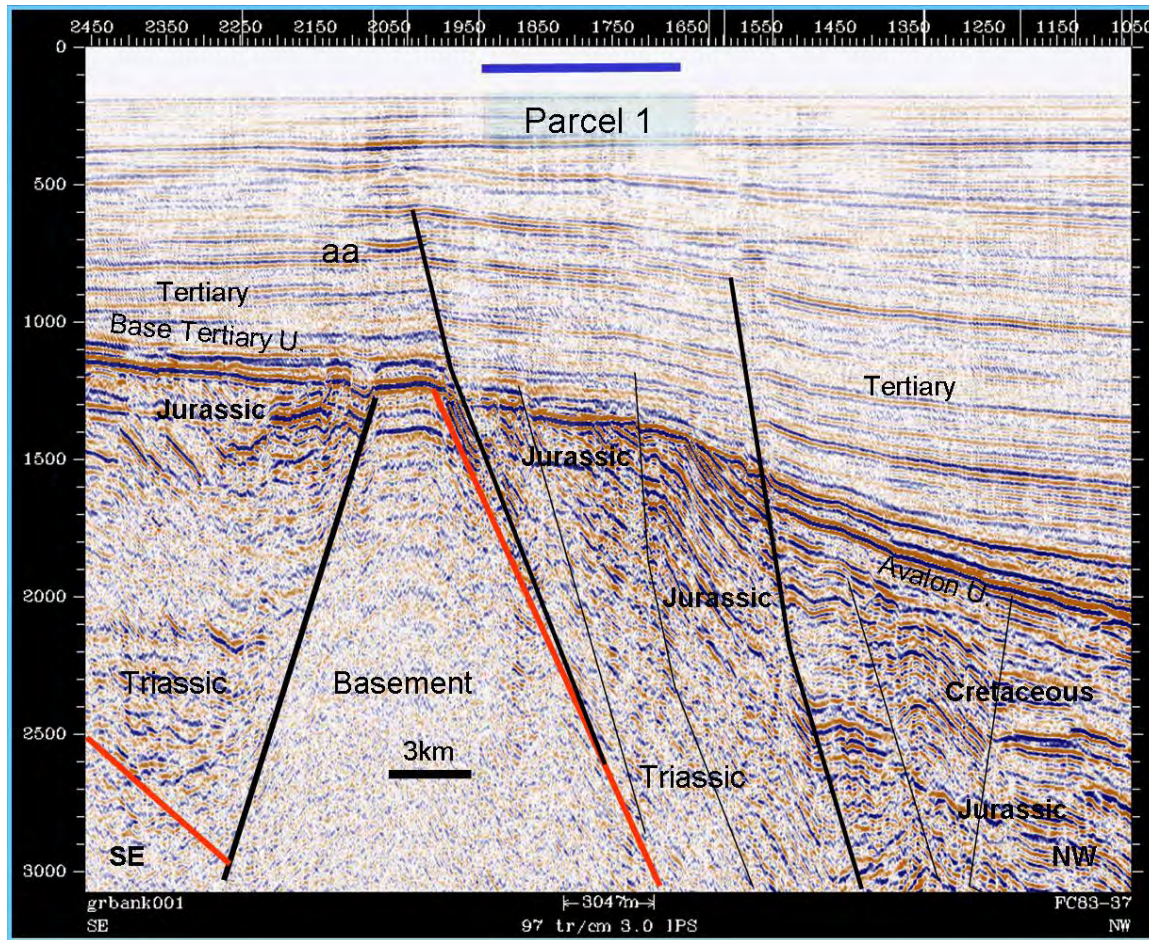


Figure 28. SE-NW 2D seismic line FC83-37 (courtesy of GSI) through Parcel 1 and environs showing the structure, stratigraphy and play types present in the area. The parcel is located between major faults part of the Voyager Fault zone.

Line FC83-22 is a representative line for the subsurface geology on the Morgiana Anticlinorium and Central Ridge. This regional strike line (Figures 22, 23 and 25) illustrates the fault bounded topography of the Base Tertiary Unconformity and the complex syn-rift geology below the unconformity. Several fault bounded blocks with variable thickness of Jurassic and possible preserved Cretaceous layers are interpreted within the parcel. Oblique fault planes of the Voyager Fault and associated synthetic faults are contained within the plane of the section but for simplicity are not shown. 3D seismic data may be needed to correctly map the fault systems in this parcel.

The primary exploration targets in this parcel are the Voyager (Tempest Mbr.) and Hibernia sandstones within complex structural-stratigraphic traps. These Jurassic and Early Cretaceous reservoirs may be trapped in salt induced or extensional anticlines found on the Central Ridge-Morgiana Anticlinorium high trend or in fault blocks bounded by lower imbricate faults. Jurassic

and Cretaceous reservoir beds may also be trapped under the Base Tertiary angular unconformity and sealed by Tertiary shales. Secondary targets are provided by Paleocene sandstones - Avondale and South Mara members (Deptuck et al., 2003) - that may onlap the unconformity and form complex structural stratigraphic traps. Also a secondary target may be Avalon-Ben Nevis sandstones trapped in local cuvettes between Jurassic beds and the Base Tertiary Unconformity.

The source rock is the Egret Member of the Rankin Formation that is mature in the downthrown of the Voyager Fault and probably marginally mature when preserved on the ridge-anticlinorium side. Migration should be short distance along the numerous major and minor faults and the splays of the Voyager Fault. Effective seals are present within the syn-rift succession while the Tertiary Banquereau Formation is an excellent regional seal. The key risks on this parcel are trap integrity, seal across faults and unconformities, preservation of porosity within syn-rift reservoir on the high side of the Voyager Fault, the greater difficulty of having Kimmeridgian sourced oil migrate into the younger Late Cretaceous-Early Tertiary reservoirs, and the possibility of encountering heavy oil due to increased potential for biodegradation of hydrocarbons in shallower reservoirs.

The parcel is covered by modern and older 2D seismic lines that are available for purchase in digital form from GSI, WesternGeco, Veritas and other seismic brokers and contracting companies (Figure 24). A large volume of older reprocessed data is also available from seismic vendors. More information on available data can be obtained from their websites.

5.2. Parcel 2

This is the largest and likely most attractive parcel of the present Call for Bids in the Jeanne d'Arc basin (Figures 21, 22 and 29). Parcel 2 occupies an area of 30,572 hectares (75,545 acres) located just east of the Terra Nova PL, and east of several large discoveries and SDLs (Hebron and Ben Nevis) and also close to several smaller oil and gas discoveries (Springdale, West Bonne Bay and Fortune SDLs) (Figure 29). This is also a shallow water parcel (100-120 m water depth) located partially within the Jeanne d'Arc Basin and partially on the Morgiana Anticlinorium. The parcel was subjected to some exploration activity in the early eighties, when most of the seismic data covering the parcel was acquired, but more recent data also exists.

Only one well, Bonne Bay C-73 (TD at 3719 m), has been drilled in this large parcel and it had minor oil shows from the Hibernia and Jeanne d'Arc sandstones. The well encountered good reservoirs in South Mara Mbr., Ben Nevis, Hibernia and Jeanne d'Arc Formation sandstones. A core from what is labeled as Terra Nova Mbr. of the Jeanne d'Arc Formation (Kimmeridgian) is available from the C-NLOPB. The Voyager J-18 (TD 3743 m) drilled immediately to the west of the parcels has intersected the South Mara Mbr., Ben Nevis, Catalina Mbr., Hibernia and Jeanne d'Arc sandstone reservoirs, as well as Kimmeridgian source rock. There is little doubt that the source rock encountered at Voyager J-18 would extend on to Parcel 2. The Voyager, Bonne Bay as well as Fortune locations were drilled to test structural closures associated with rotated blocks.

The Springdale M-29 well was drilled to 3192 m TD and tested gas from the Paleocene South Mara Member at a rate of 11.6 mmcf/d. It has also flowed 377 bopd of heavy oil from the Ben Nevis sandstone. The well intersected the Hibernia and Jeanne d'Arc formations and 55 m of Kimmeridgian Egret source rock. It is estimated that the Voyager stratigraphic trap at Springdale contains 237 bcf of dry gas and 14 mmbbls heavy oil reserves (14.4-27.5⁰ API). West Bonne Bay C-23 was the latest well drilled in this area (1997). It tested a small horst block that showed fault

bounded closure at all potential reservoir levels. A geological cross section of this well is presented in Figure 30. This oil well TD-ed at 4418 m after encountering reservoir at several levels and reached the Kimmeridgian Rankin Formation. The well tested from the Lower Hibernia Formation zone at a rate of 3245 bopd and 4.4 mmcf/d gas and showed indications of hydrocarbon present on logs and mud readings at other levels. Cores from the tested interval exist at the C-NLOPB Core Repository in St John's. An SDL was awarded in 1998 for this discovery that is estimated to contain about 36 million barrels (P50).

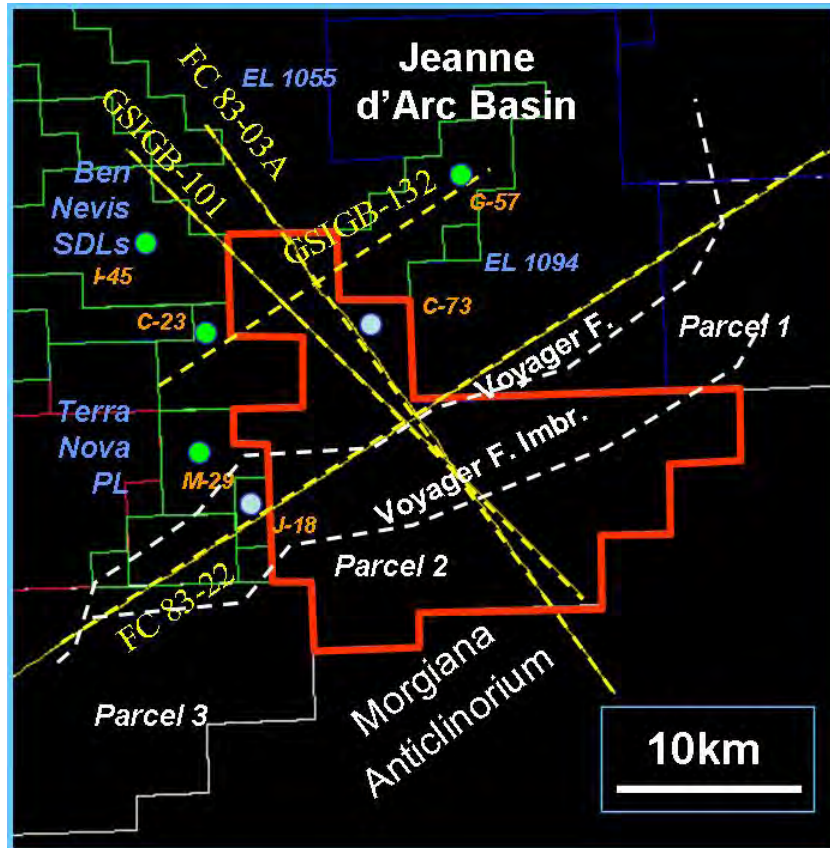


Figure 29. Location of Parcel 2 within the south-central Jeanne d'Arc Basin, Voyager Fault zone and Morgiana Anticlinorium shown in red line. Two SW-NE 2D seismic lines and two SE-NW seismic lines are used to illustrate the petroleum geology of this parcel. The parcel is surrounded by Terra Nova PL and several SDLs shown in green line.

The large Hebron-Ben Nevis oil field and producing Terra Nova oil development located just west of Parcel 2 are discussed in detail by Enachescu and Fagan, 2004 and 2005, described in the Terra Nova DPA and on the C-NLOPB website <http://www.cnlopb.nl.ca/>

Four seismic lines are used to illustrate the structural setting of the parcel and its hydrocarbon potential (Figure 29). Seismic line FC 83-03 A (Figures 29 and 31) intersects Parcel 1 on the Morgiana Anticlinorium, crosses the Voyager Fault and its imbricate, passes in the vicinity of the Bonne Bay C-73 well and terminates within the eastern flank of the Jeanne d'Arc Basin, where the North Ben Nevis SDL is located. The Voyager Fault marks the western flank of the Anticlinorium, severely displaces the syn-rift sedimentary successions and shows activity all the way to the Late Tertiary. Several rotated blocks with Jurassic beds under the Base Tertiary/Avalon combined unconformity are interpreted on the Morgiana Anticlinorium. In the

downthrown of the Voyager Fault lies the Jeanne d'Arc Basin. Several rotated blocks and rollover anticlines bounded by antithetic and synthetic faults to Voyager Fault are visible showing thick syn rift infill.

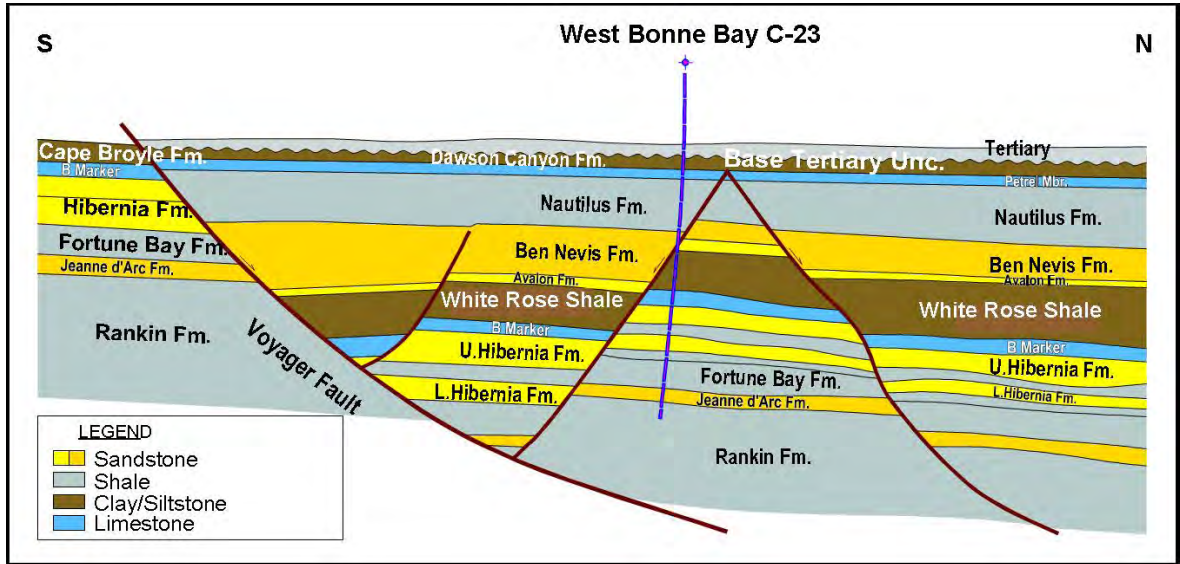


Figure 30. S-N geological cross-section through West Bonne Bay C-23 well showing the horst block that tested oil and gas from the Hibernia Formation.

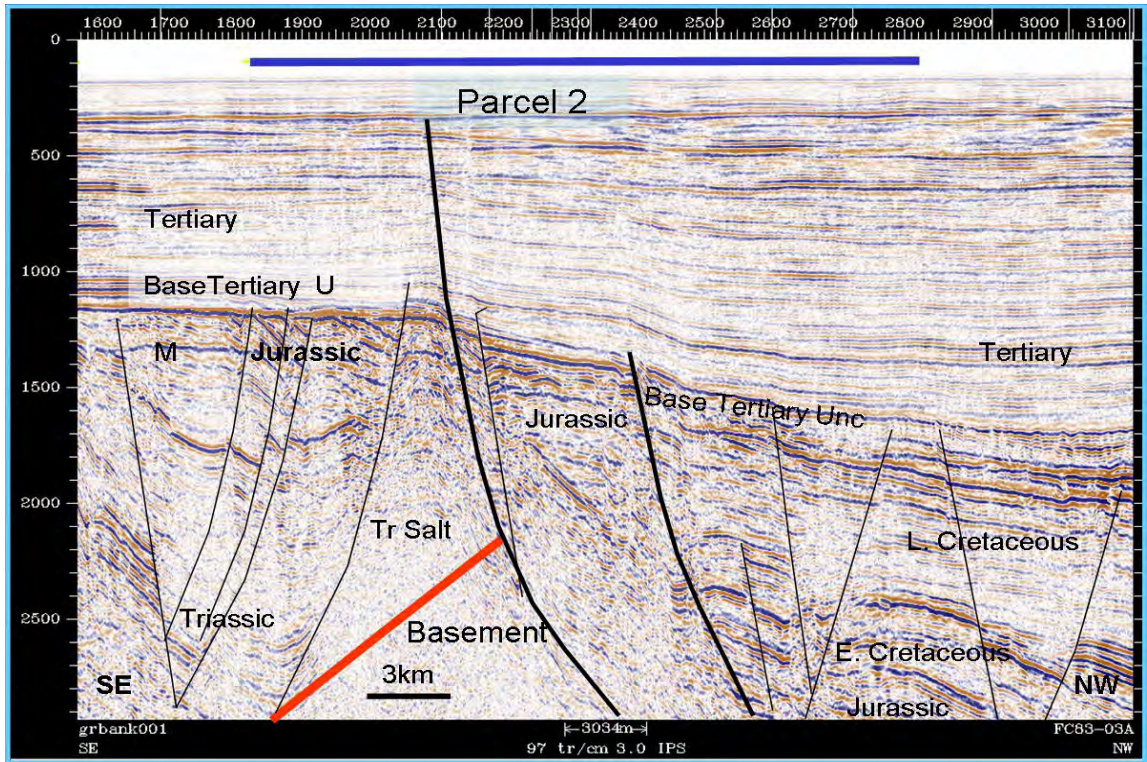


Figure 31. SW-NE 2D seismic line FC83-03A (courtesy of GSI) through Parcel 2 and environs showing the structure, stratigraphy and play types present in the area. The parcel is located in a highly faulted area extending between the Jeanne d'Arc Basin and the Morgiana Anticlinorium and it is surrounded by the Terra Nova, Ben Nevis and Fortune oil fields.

The seismic line GSIGB-101 (Figure 32) shows a similar structural and tectonic configuration. In the SE, the Jurassic sequence is eroded by the combined Avalon/Base Tertiary unconformity. Salt pillows are imaged above the petroleum basement in the upthrown side of the Voyager Fault. The Jurassic strata are faulted, folded and truncated by the unconformity. In the Voyager Fault hanging wall there are several rotated fault blocks bounded by antithetic and synthetic faults and containing a thick sequence of Jurassic and Cretaceous beds. The Avalon and Base Tertiary unconformities coalesce on the terrace in front of the Morgiana Anticlinorium. Both lines FC 83-03A (Figure 31) and GSIGB-101 (Figure 32) illustrate several untested structural traps of significant size within the Jeanne d'Arc Basin.

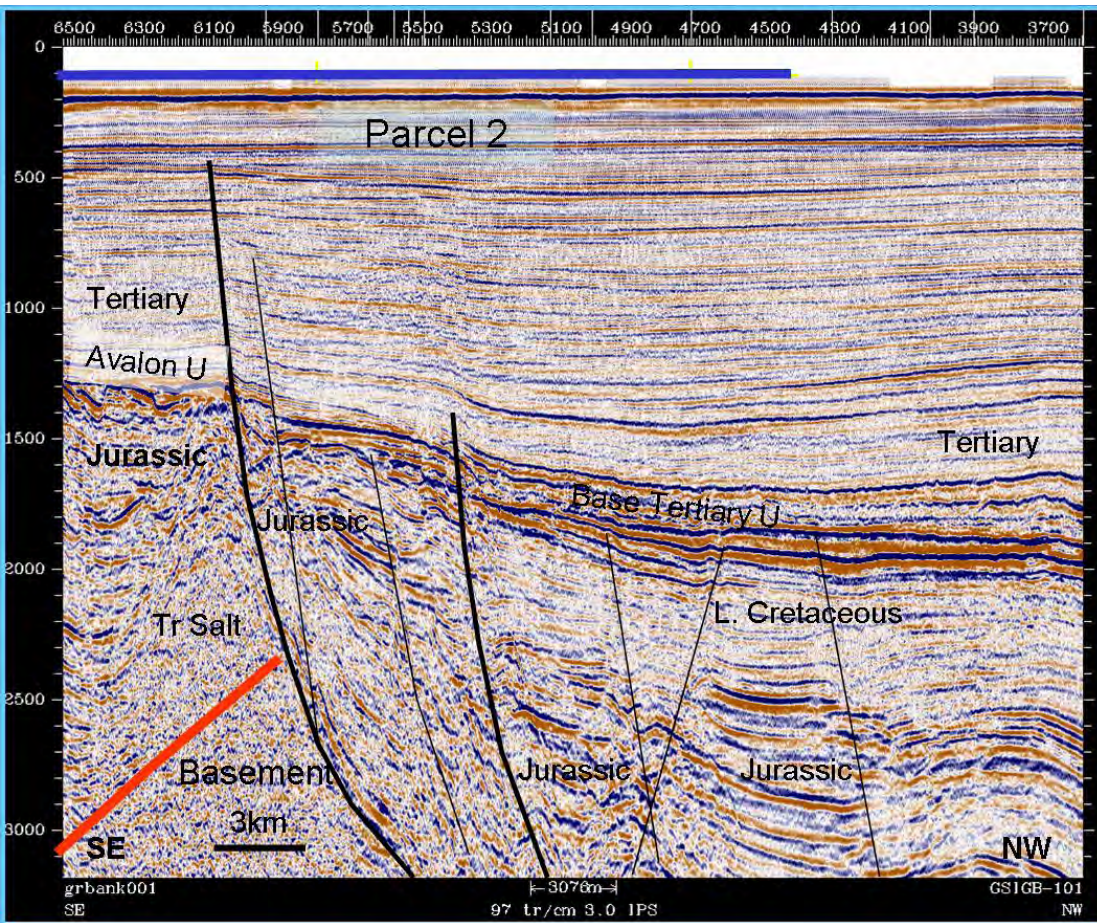


Figure 32. SW-NE 2D seismic line GSIGB 101 (courtesy of GSI) through Parcel 2 and environs illustrating the structure, stratigraphy and play types present in the area. The line shows the Morgiana Anticlinorium in the southeast and several rotated blocks in the downthrown side of the Voyager Fault, within the Jeanne d'Arc Basin, containing Jurassic and probably Cretaceous sequences.

The seismic line GSIGB-132 (Figures 29 and 33) is a strike line located within the Jeanne d'Arc Basin and indicates the structural configuration of the northern part of the parcel. In the NW side the line intersects the Fortune G-77 well that tested 6978 bopd from Early Cretaceous (Hibernia) and Late Jurassic (Jeanne d'Arc and Tempest) reservoirs. A clear Avalon Unconformity is imaged separating Early Cretaceous potential reservoirs from the Late Cretaceous mostly shale sequence. Several rotated blocks, 3 to 4 km wide, located within the parcel contain Late Jurassic and Early Cretaceous sequences within a reasonable drilling depth. The quality of reservoir

should be similar to reservoirs encountered at Hibernia. The Late Cretaceous and the Paleocene sequences separated by the Base Tertiary unconformity show significant reflectivity indicating the possibility of reservoir presence at these levels and of stratigraphic trapping.

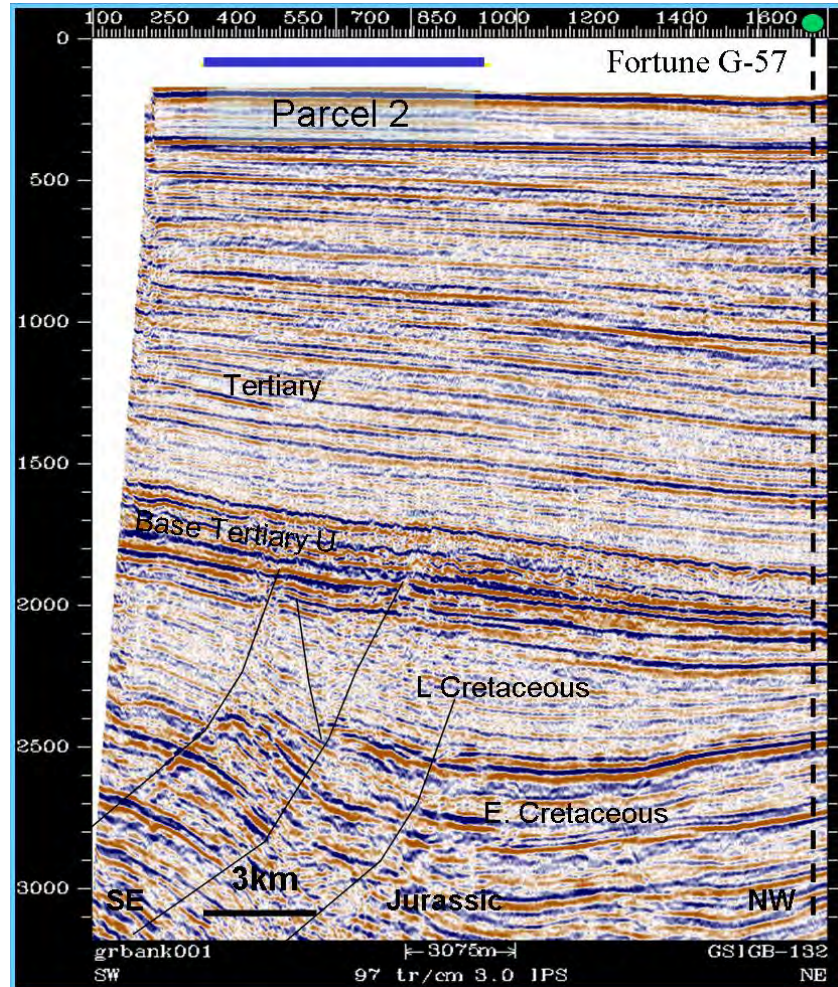


Figure 33. SW-NE 2D strike seismic line GSIGB 132 (courtesy of GSI) through Parcel 2 and environs illustrating the structure, stratigraphy and play types present in the area. The line located within the Jeanne d'Arc Basin shows several rotated blocks containing thick Jurassic and Cretaceous sequences down dip from the oil discovery Fortune G-57 well.

Line FC83-22 is a regional strike line that crosses the Morgiana Anticlinorium (Figures 22 and 23) and illustrates that there is Jurassic and possible Cretaceous potential below the Base Tertiary Unconformity. A complex syn-rift sequence is present below the unconformity and above basement and salt structures. The line also suggests the possibility of stratigraphic traps between the Avalon and Base Tertiary unconformities.

This parcel is situated within an area with proven mature source rock and light oil accumulations, and shows significant potential for both quality reservoir and structural traps. The major plays in Parcel 2 are the Jeanne d'Arc and Hibernia sandstones trapped within relatively narrow but elongated fault blocks parallel to the Voyager Fault. These sandstones have shown excellent reservoir properties in adjacent exploration wells. There is also high potential for stratigraphic trapping of the late Cretaceous and Paleocene sandstone onlapping the terraces and the

anticlinorium. These younger reservoirs are derived from erosion of older sandstone from the south Jeanne d'Arc and Morgiana Anticlinorium. Excellent intra-formational seals and the regional Banquereau Formation seal should insure integrity of the traps. The main geological risks of the Parcel 2 traps are communication across fault planes and unconformities and the possible presence of heavier oils.

5.3. Parcel 3

This southern parcel occupies an area of 21,009 hectares (51,914 acres) located just south of the Terra Nova PL. The parcel is surrounded by several SDLs including Springdale, the Far East Block of the Terra Nova field, King's Cove and Beothuk (Figure 34). There are no exploration wells in this shallow water parcel (100 m water depth) that is located part on the Morgiana Anticlinorium and part within the Jeanne d'Arc Basin proper. However, there are several exploration wells drilled in the vicinity. The Voyager J-18 and Springdale M-29 wells which are located north of the parcel have been discussed in the section describing the potential of Parcel 2. Immediately to the north of the parcel is the Terra Nova PL; this field was described in detail in Enachescu and Fagan (2004 and 2005b) and it is also presented on the C-NOLPB website.

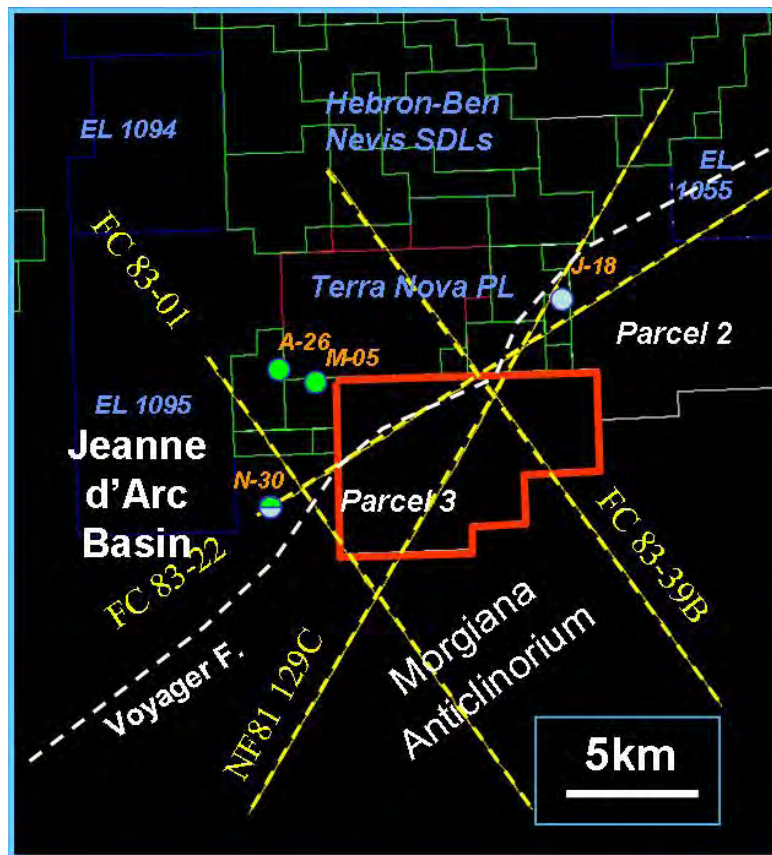


Figure 34. Location of Parcel 3 within the south-central Jeanne d'Arc Basin, Voyager Fault zone and Morgiana Anticlinorium shown in red line. Two SW-NE 2D seismic lines and two SE-NW seismic lines are used to illustrate the petroleum geology of this parcel. The parcel is surrounded toward the north by Terra Nova PL (in thin red) and by several other SDLs (shown in thin green line).

Less than 5 km from the parcel's northwestern corner are King's Cove A-26 and Beothuk M-05 discoveries. Both wells targeted the Jeanne d'Arc and younger sands located in incised paleovalleys updip from the Terra Nova field, but on the same structural nose (Figure 35). The

King's Cove A-26 well (TD 3092 m) was drilled in the West Flank of the Terra Nova structure and encountered reservoir and oil in several horizons (Enachescu, 1993; Enachescu et al., 1994; Enachescu and Fagan, 2005). While logs indicated the presence of hydrocarbons in Late Jurassic sandstones and other younger levels the well was abandoned without a conclusive DST. Several of the usual Jeanne d'Arc reservoirs have been encountered in the well that TD-ed in the late Kimmeridgian source rock. An earlier well, Beothuk M-05 (TD 3779 m) has tested oil from the Beothuk Mbr. of the Jeanne d'Arc Formation and intersected 120 m of the Egret source rock. Other reservoirs were present in this well. The C-NLOPB carries a 10 million barrel reserve for the complex King's Cove and Beothuk discoveries, contained within the Kimmeridgian paleo-valley fill. To the south west, several other wells that TD-ed at depths shallower than 2800 m (South Brook N-30, Gambo N-70, Port au Port J-97 and Riverhead N-18) were drilled to test this system of incised valleys, and encountered excellent reservoirs and source rocks but were dry. The Gambo N-70 (TD 2515 m), intersected sandstones and conglomerates in a Late Jurassic paleo-valley fill, but did not find hydrocarbons. This Late Kimmeridgian paleo-valley system was described by Enachescu et al. (1994) and is partially shown in Figure 35.

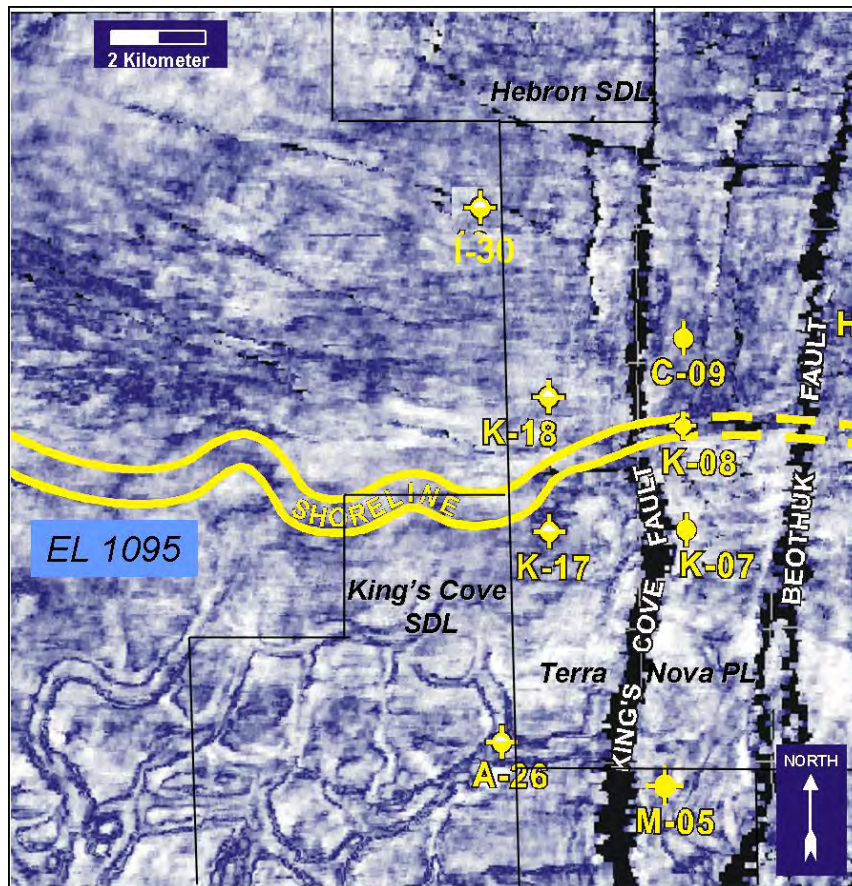


Figure 35. 3D Amplitude map of the Terra Nova oil field and environs including land tenure and interpretation of a paleo-drainage system and shore line. The map shows the locations of the King's Cove A-26 and Beothuk M-05 exploration wells within paleo-valleys (modified after Enachescu, 1993 and Enachescu et al., 1994).

Several lines are used to illustrate the structure, stratigraphy and petroleum potential of this parcel (Figures 34, 36, 37 and 38). Line FC 83-39B (Figure 36) is a dip line crossing the eastern side of the parcel, just south of the Terra Nova field. A high basement block bounded by the

Voyager Fault brings the Jurassic and probably Early Cretaceous strata within shallow drilling depths. These strata are truncated by the Avalon Unconformity. Several rotated blocks dip north-westerly and both the Avalon and Base Tertiary unconformities are well expressed. In between the unconformity there is potential for stratigraphic trapping within Late Jurassic sandstone. Above the Base Tertiary Unconformity an Early Tertiary mounded sequence is trapped against the Voyager Fault that penetrates to the Late Tertiary level. The South Mara sandstone reservoir was encountered in all the wells drilled on this flank of the basin. Similar geological setting and possible traps are shown by the parallel line FC 83-01 that is located in the south-western corner of the parcel (Figures 34 and 37). An amplitude anomaly is seen on the upthrown side of the Voyager Fault and is associated to the Paleocene interval where porous sands were intersected elsewhere.

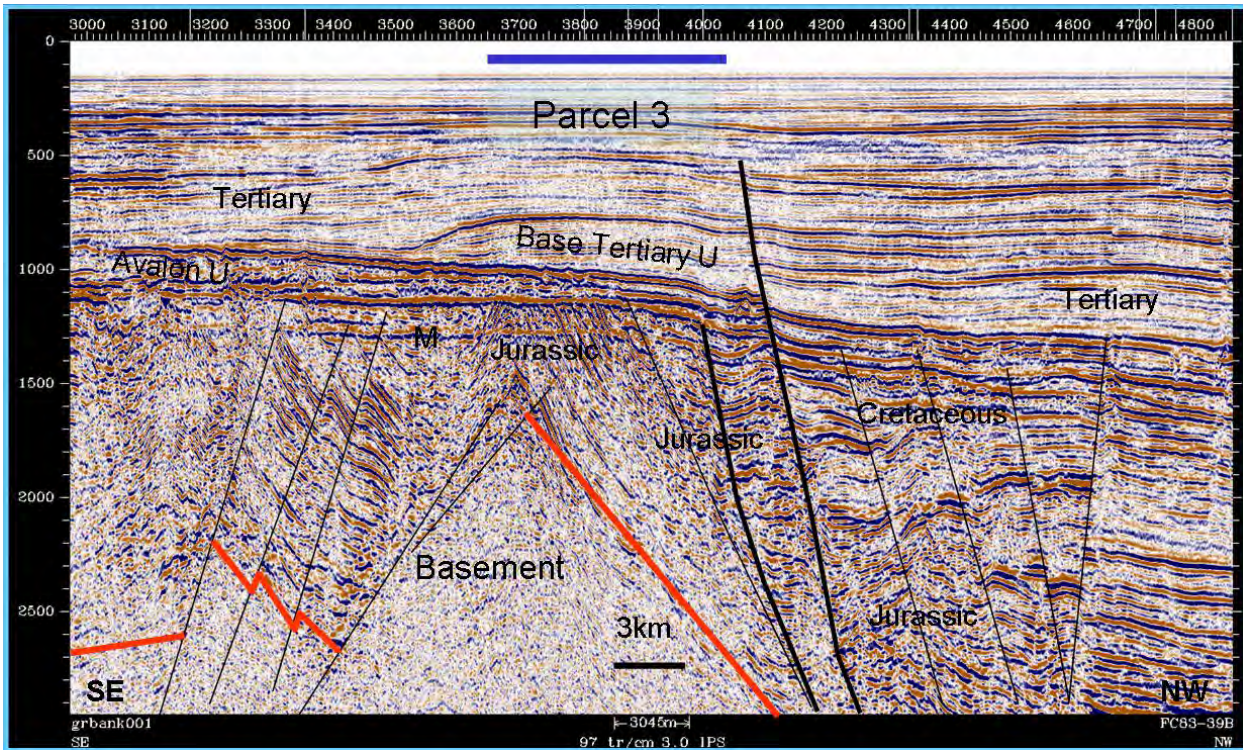


Figure 36. SE-NW 2D seismic line FC83-39B (courtesy of GSI) through Parcel 3 and environs showing the structure, stratigraphy and play types present in the area. The line is located in a complexly faulted area extending between the Jeanne d'Arc Basin and the Morgiana Anticlinorium. The Voyager Fault marks the extent of these structural units. M = water bottom multiple.

Two strike lines are also crossing the parcel: the regional FC83-22 line (Figures 22 and 23) and the NF81 129C (Figures 34 and 38). Both lines show a thick Jurassic sequence and thin Early Cretaceous sequence present under the Avalon Unconformity. Regional line FC83-22 shown in Figure 23 indicates the presence of several rotated blocks with thick Jurassic within the Voyager Fault zone. A Late Cretaceous wedge of sediments building from the south downlap into the Avalon Unconformity and prograde northward. As proven by adjacent drilling, the sandier intervals including the Otter Bay and Fox Harbour members are included in this sedimentary wedge. Above the Base Tertiary Unconformity, the Paleocene Avondale and Tilton members are shown by a high reflectivity seismic sequence. Both major unconformities (Avalon and Base Tertiary) deepen toward the northeast.

The primary targets in this parcel are the Jeanne d'Arc and Hibernia sandstones within structural-stratigraphic traps. The Jeanne d'Arc sandstones, deposited in an alluvial/fluvial to marginal marine setting, have high porosity and permeability in the adjacent Terra Nova field (Enachescu and Fagan, 2004 and 2005; Terra Nova DPA; C-NLOPB website and http://www.cnlopb.nl.ca/publicat/other/d02_01/d02_01e.pdf). The main play in the north-western part of Parcel 3 is the Jeanne d'Arc sandstone deposited during the late Kimmeridgian in several stacked alluvial systems that entered the basin from the south, filled the sculptured mid-Kimmeridgian erosional surface and extended north of the Terra Nova Oil field during a lowstand (Figure 34). This play was discussed by Enachescu et al. (1993 and 1997) and is also described in the Terra Nova DPA. Some of the paleo-valleys are large and deeply incised (more than 200 m) in the Egret Member of the Rankin Formation. This system is informally known as Riverhead paleo-drainage. Shale plugs filling part of the incised valleys were found in several of the wells drilled in the southern Jeanne d'Arc Basin. This observation is important as the play must rely on updip seal from shale plugs to insure larger accumulations. Faulting also occurs on strike and locally dissects the paleo-drainage system, forming complex traps. Several wells, just outside the parcel, have chased the Kimmeridgian valley-fill play. King's Cove A-26 (TD 3092 m) encountered hydrocarbons in sandstones of the Jeanne d'Arc Formation. Two other wells located just outside the parcel, Port au Port J-97 (TD 2700 m) and Riverhead N-18 (TD 2626 m), have tested the same Jeanne d'Arc sand paleo-valley fill play concept without success. Lack of seal may explain the absence of hydrocarbon accumulations.

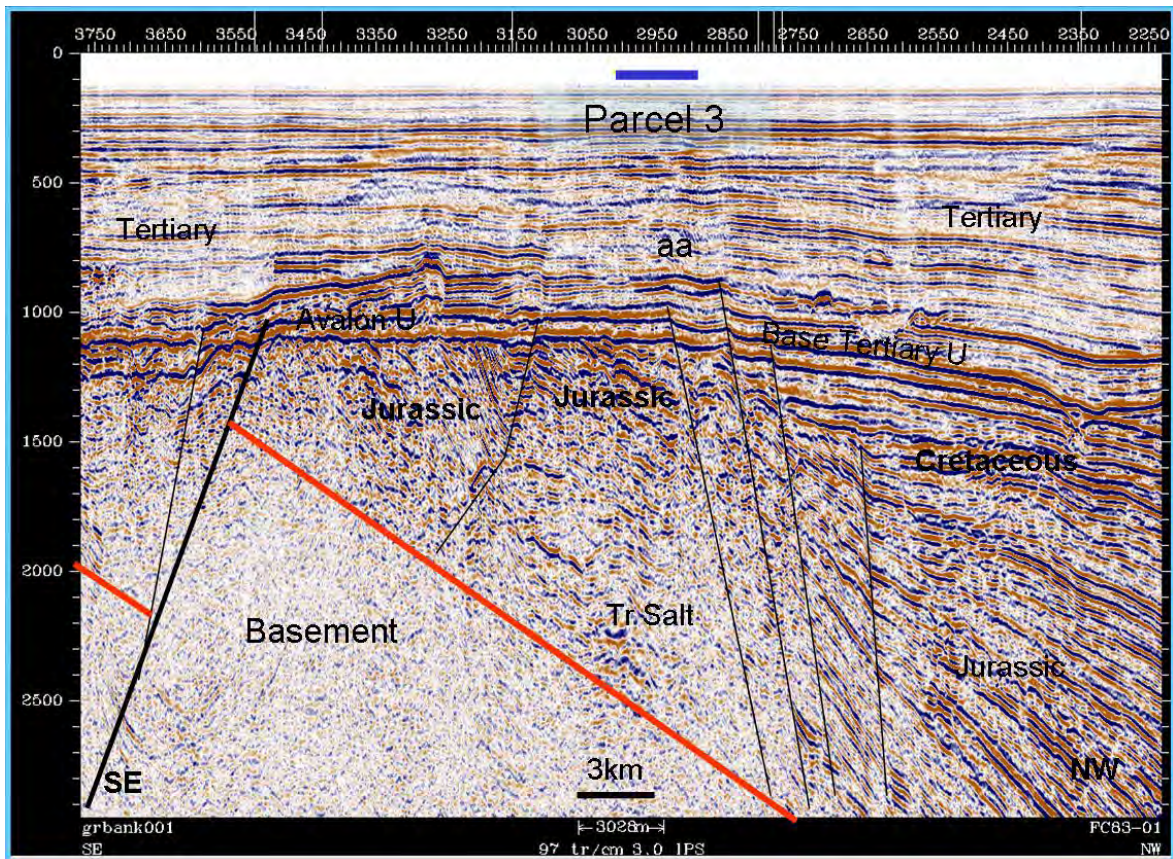


Figure 37. SE-NW 2D seismic line FC83-01 (courtesy of GSI) through Parcel 3 and environs showing the structure, stratigraphy and play types present in the area. The line is located in a complexly faulted area extending between the Jeanne d'Arc Basin and the Morgiana Anticlinorium and shows amplitude anomaly aa within Lower Tertiary and Jurassic subcrop play.

The Riverhead N-18 well has unsuccessfully tested one of the largest incised-valleys in the area. The play is discussed by Enachescu and Fagan (2005b). Seismic data indicates that similar prospects to the one tested by Riverhead N-18 well remain to be tested on the parcel and could be successful if the sand is effectively sealed both laterally and vertically. The play can be tested with relatively shallow wells (approximately 2500 m).

Sub-unconformity traps formed by Jurassic strata truncated by the Base Tertiary Unconformity and covered by Tertiary shale are a target on the Morgiana Anticlinorium. Avalon Ben Nevis sandstones of late Early Cretaceous age and sandstone members of the Dawson Canyon (Late Cretaceous) and Banquereau (Early Tertiary) formation provide secondary targets in the parcel and more likely within stratigraphic than structural traps. The key risks are similar to those outlined for parcel one - namely trap integrity, difficulty of migration into the younger reservoir and the possibility of heavy oil.

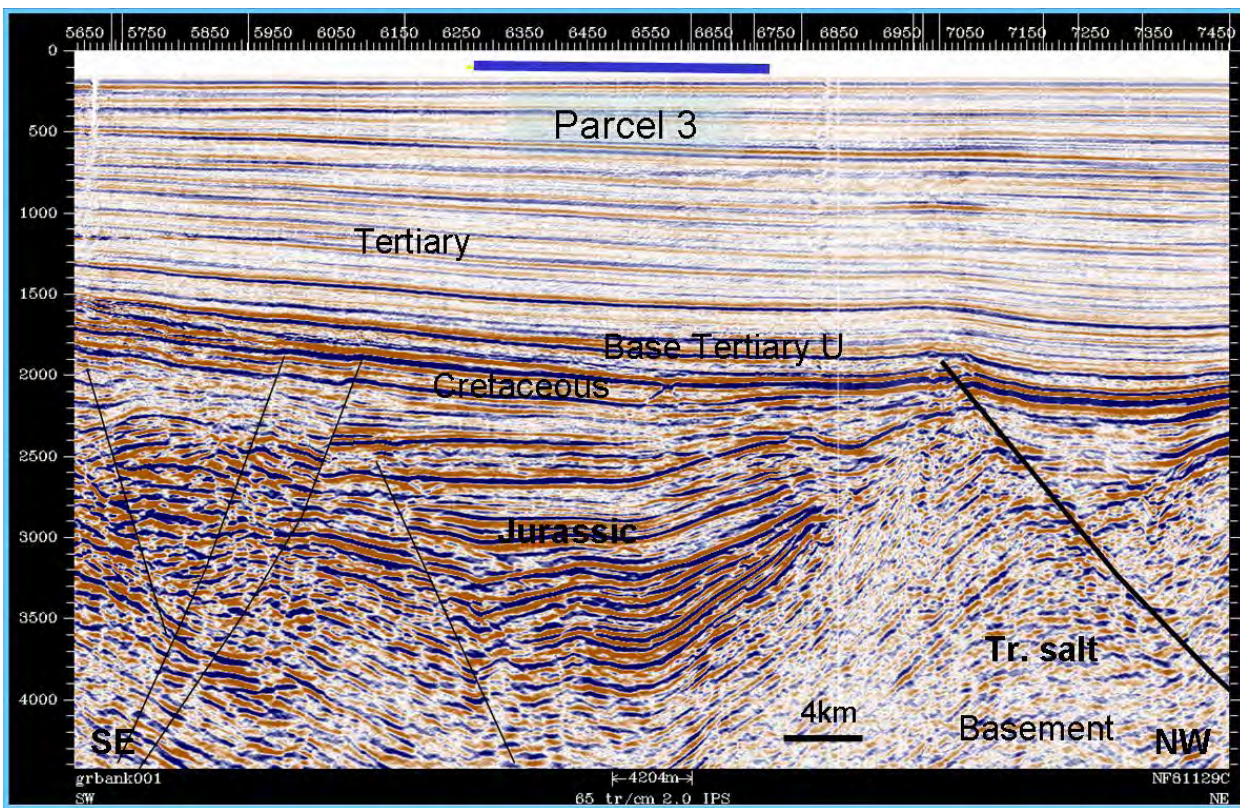


Figure 38. SW-NE 2D seismic line NF81-129C (courtesy of GSI) through Parcel 3 and environs showing the structure, stratigraphy and play types present in the area. The line is located in a complexly disturbed area extending between the Jeanne d’Arc Basin and the Morgiana Anticlinorium and shows thin Cretaceous and thick Jurassic sequences present in the parcel. Tr. = Triassic.

2D seismic and limited 3D data should be available from seismic vendors (GSI, WesternGeco, Veritas, TGS NOPEC etc.) or from oil companies that in the past were active in the area. As in all cases, a certain amount of hard copy data that is past its period of confidentiality can be obtained from the C-NLOPB.

6. Discussion

The Call for Bids NL06-01 parcels are significant size exploration blocks situated part within the prolific Jeanne d'Arc Basin and part bordering on the Morgiana Anticlinorium to the east. All three parcels are located between the producing White Rose field in the north and the Terra Nova field in the south, in areas with excellent reservoirs, mature source rocks and proven migration paths. The presence of nearby infrastructure and the successful operating record in this shallow water area would suggest that there will be competition for these parcels.

Numerous leads and prospects in this Jeanne d'Arc Basin area, including some mapped on the bid parcels, have previously been considered too small to drill, or to have too great a trap/seal risk. New mapping and evaluation of potential using 3D seismic data may lower the geological risk. Additionally, proximity to existing infrastructure in a high oil price environment most certainly lowers the economic risk. This is a scenario in which smaller fields can become attractive and entice companies to include such features in their exploration plans. Many other small fields in the area can be tied into a common development, or brought on stream as satellites to the larger fields.

The three parcels contain multiple reservoir targets within the proven Avalon/Ben Nevis, Hibernia and Jeanne d'Arc sandstones reservoirs. Additionally, secondary quality reservoirs such as the South Mara and Avondale Members have been identified in post-rift successions. Other reservoirs such as the "Tempest sandstone" were identified on the ridges, under the Base Tertiary Unconformity. These multiple target zones can be tested by drilling relatively shallow wells (2000-3000 m). The geological risks associated with the post-rift successions are considered higher with regard to hydrocarbon migration, oil biodegradation, and lateral seal. However they can be minimized by regional evaluation and dynamic modelling of the petroleum system. Light oil has been drilled in the area in the syn-rift sequence (e.g. West Bonne Bay well).

Parcel 1 has significant potential for multiple plays and for finding medium size discoveries close to the White Rose field. Possible structural and stratigraphic trapped reservoirs include Voyager, Jeanne d'Arc, Hibernia, Ben Nevis and Paleocene sandstones. It is expected that Parcel 2, the largest of the three parcels, will attract the greater interest, due to its position in a known oil prone area and proximity to Fortune and West Bonne Bay discoveries. Its northern part is covered by 3D data. It also has greater upside potential because it may contain large structural-stratigraphic prospects within Voyager, Jeanne d'Arc and Hibernia reservoirs. Ben Nevis and Paleocene sandstone reservoirs are also a valid play within this parcel. Part of Parcel 3 has stratigraphic traps within the paleo-drainage system that is known as the Riverhead drainage system, which occupied the southern portion of the Jeanne d'Arc Basin during late Kimmeridgian to Tithonian time. Several stacked paleo-valley systems filled mostly with good quality sandstone reservoirs can be interpreted from the seismic data. Some large and deep valleys in this play have been tested outside the parcel with mixed results. No doubt that the juxtaposition of Egret source rock that forms the floor of the earlier paleo-valleys and the drainage system, will create oil accumulations in some of the situations, when the valleys are plugged (shale out) up-dip and are laterally encased by shales, or onlap impermeable formations. The Terra Nova field to the North is an example of the size of accumulation that can be encountered with an effective up-dip seal in this area. Sub-unconformity (Base Tertiary, Avalon Unconformities) traps with Jeanne d'Arc and Hibernia sandstone plays also remain to be tested

in the parcel. Late Cretaceous and Paleocene sandstone stratigraphic plays are to be targeted on the Morgiana Anticlinorium side of the parcel.

Several seismic amplitude or other attribute anomalies are observed on the parcels, especially in Tertiary beds, and may indicate hydrocarbon reservoirs to be present at depth. Systematic mapping and post-stack analysis of seismic attributes may further reduce the geological risks associated with reservoir and trap integrity.

7. Conclusions

The three Jeanne d'Arc Basin parcels are situated in an area where both large and small discoveries were made in the past exploration rounds. As a point of comparison, the parcels are approximately 10 times larger than typical Gulf of Mexico parcels. The parcels stretch between Terra Nova and White Rose fields, along the Voyager Fault. With infrastructure available in the Terra Nova and White Rose fields and possible in the future at Hebron/Ban Nevis, any discovery in these parcels will have potential for development by subsea tiebacks. The parcels are also surrounded by other smaller discoveries, as well as several shows. Only one exploration well was drilled within these parcels with eleven others located in their vicinity.

The main potential petroleum plays on the parcels are the Jeanne d'Arc, Hibernia and Avalon/Ben Nevis sandstones trapped in fault blocks. The Jeanne d'Arc Formation sandstones were deposited during Late Kimmeridgian-Tithonian in a vertically accreted paleo-valley system and reworked in near-shore environments. This play was successful at the Terra Nova and Hebron fields and it is expected to extend to other areas in the south-eastern Jeanne d'Arc Basin. Oil pay was found in the Hibernia sandstone reservoir in several of the fields surrounding the parcels. Similarly, Avalon and Ben Nevis sandstones contain oil and gas in several of the fields and petroleum potential is also recognized in the Late Cretaceous-Early Tertiary sandstone members.

These parcels present an excellent opportunity either for entering the Jeanne d'Arc Basin exploration scene or for increasing the current portfolio in a proven basin. While no very large structural traps can be identified on the parcels, several medium size fault blocks and large stratigraphic traps are interpreted from the 2D and 3D data grids available in the area. Clearly, the attractiveness of these parcels is considerably enhanced by the potential for development by subsea tie-back to the nearby Terra Nova and White Rose FPSOs – or to whatever system is eventually put in place at the future Hebron-Ben Nevis development.

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