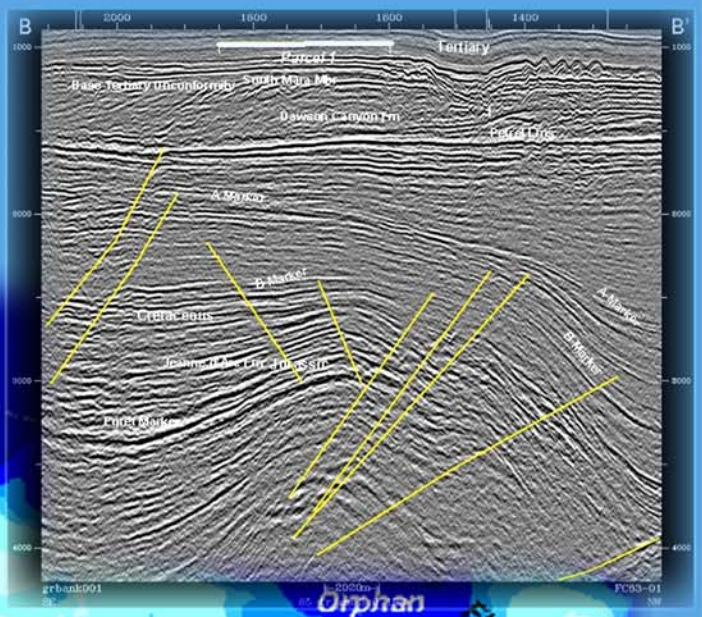
GOVERNMENT OF
NEWFOUNDLAND
AND LABRADOR

Department of
Natural Resources



Newfoundland and Labrador
Call for Bids NL05-01

August 2005

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 & Labrador Offshore Petroleum Board's (C-NLOPB) Call for Bids NL05-01 which closes on December 1, 2005 at 4:00 PM. The Call for Bids includes seven parcels of which three are located in the Jeanne d'Arc Basin on the Grand Banks of Newfoundland, and four are located in the Gulf of St. Lawrence along the west coast of the island of Newfoundland. This report is specifically focussed on the three parcels located in the Jeanne d'Arc Basin. A separate report available at www.nr.gov.nl.ca/mines&en/call_for_bids/NL05western.pdf provides information on the other four parcels. This report should be referenced as Enachescu, M.E. and P. Fagan, 2005, Call for Bids NL05-01, 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 16, 2005 news release.

Acronyms used in this report:

NL = Newfoundland and Labrador
C-NLOPB = Canada-Newfoundland & Labrador Offshore Petroleum Board
NL05-01 = the unique identifier for the 2005 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
Bopd = barrels of oil per day
Mmcf/d = million cubic feet per day

Report Content

1. Introduction

The 2005 Newfoundland and Labrador Call for Bids NL05-01 includes seven offshore parcels comprising a total of 571,984 hectares (1,413,403.2 acres). Parties interested in bidding on lands must submit sealed bids at the C-NLOPB office in St John's, NL by 4:00 pm on December 1st, 2005. Parcels 1, 2 and 3, which are the focus of this report, are located in approximately 100 metres of water on the eastern Atlantic margin of Newfoundland, adjacent to major oil discoveries within the central Jeanne d'Arc Basin. Parcels 4 to 7 are located off the western coast of the island of Newfoundland in 0 to 200m of water and are discussed in a separate report accessible at www.nr.gov.nl.ca/mines&en/call_for_bids/NL05western.pdf

This report provides general background information on petroleum exploration and development activities in the Province, presents general geological and prospectivity information about the Newfoundland and Labrador offshore area, and discusses the specific geology and petroleum potential of the three Jeanne d'Arc Basin parcels.

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

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 are also provided at the end of this paper.

2. Exploration and Development Background

Highly Productive Fields

With production of more than 310,000 bopd, representing almost 10 million barrels per month, the province of Newfoundland and Labrador is producing at the level of the smaller OPEC members from only two large fields - Hibernia and Terra Nova. A third field, White Rose is expected to begin production in late 2005 and ramp up to about 100,000 bopd. It is also likely that a fourth development (Hebron-Ben Nevis) will proceed in the not too distant future, but at the time of writing (July 2005) the operator was still considering its development options. All these fields are located within the Jeanne d'Arc Basin, which is the only prolific offshore oil basins on the east coast of the North America, but is only one of the many Mesozoic basins located in Atlantic Canada (Figure 1). Figures 1 and 2 shows the distribution and locations of Mesozoic and Paleozoic basins throughout Atlantic Canada.

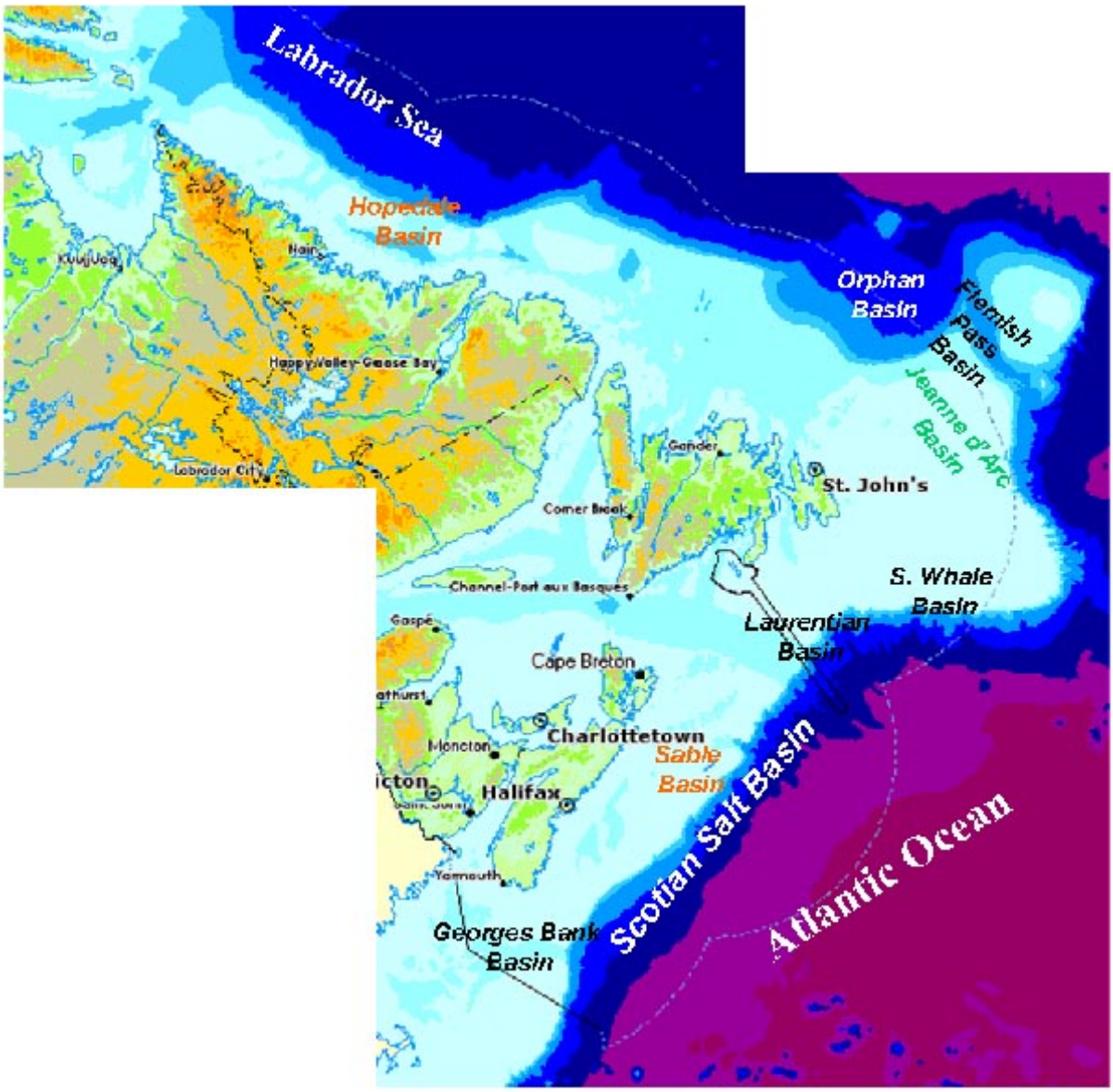


Figure 1. Atlantic Canada offshore petroleum basins (bathymetry map from NRCan).

Large Under Explored Area

Newfoundland and Labrador's area of petroleum potential extends far beyond of the boundaries of the Jeanne d'Arc Basin. The continental margin of Atlantic Canada stretches on for more than three thousand kilometres from Georges Bank, at the Canada/United States border to the northern tip of Labrador (Figures 1 and 2). Mesozoic sedimentary basins are found all along this trend running (with NL jurisdiction) from of the Laurentian Basin, across the Grand Banks basins, through the deeper waters of the Flemish Pass and Orphan Basins and northward to include several basins along the Labrador shelf and slope (Figures 1 and 2) The NL offshore jurisdictional area includes about 1.6 million km^2 of which about half is considered to have petroleum potential with a total of only 131 exploration wells. The well density is very low even by frontier standards. Under-explored areas of potential are also found in the Paleozoic basins of the Gulf of St. Lawrence on the west side of the island of Newfoundland which also extend eastward into the Province's onshore area and to the northeast beneath the Mesozoic sediments of the Labrador Sea.

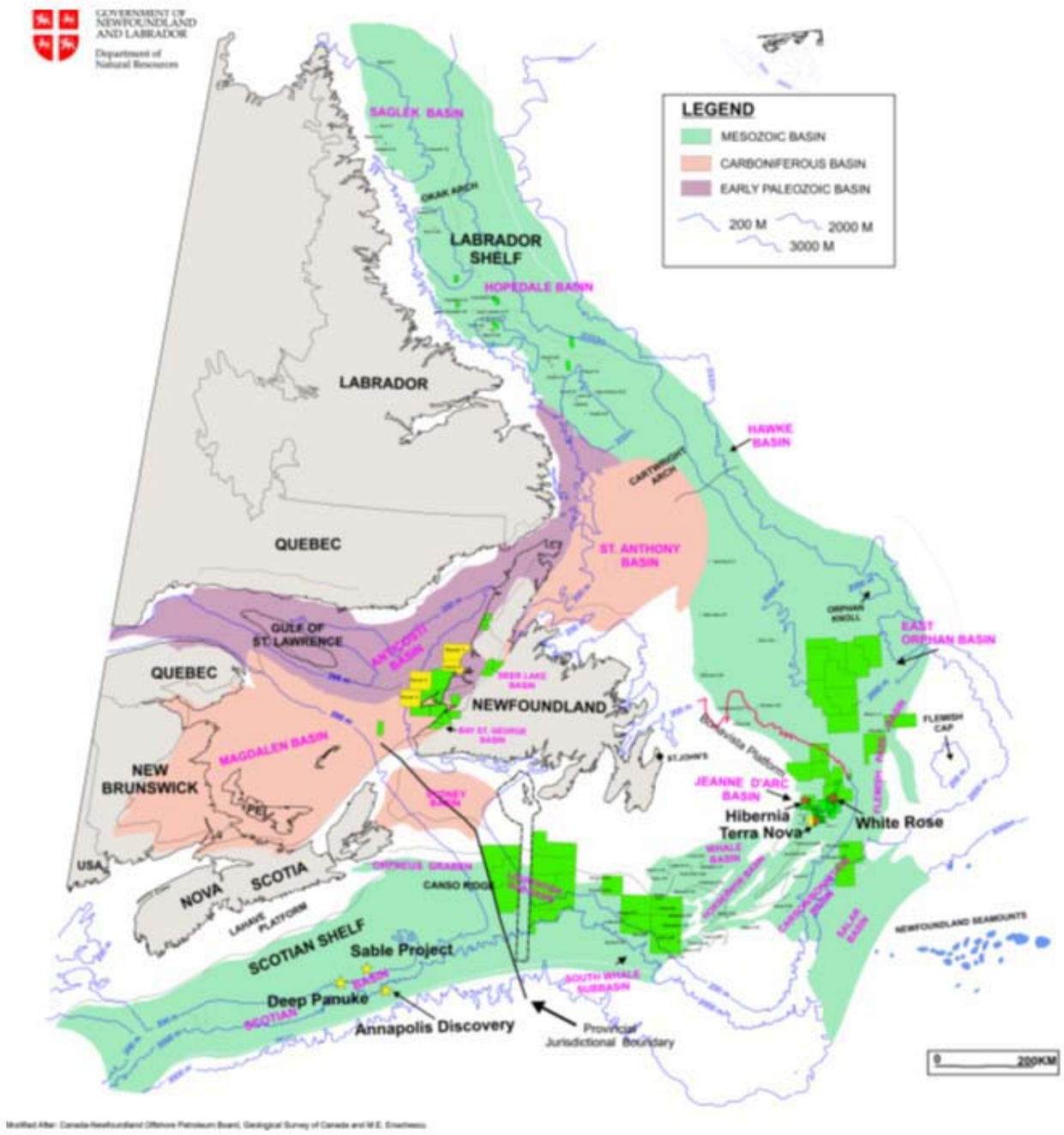


Figure 2. Regional Map of the Mesozoic and Paleozoic basins of Atlantic Canada including NL land tenure as of summer 2005 (modified after the GSC, C-NLOPB and Enachescu, 2005)

Natural Gas Has Not Been an Exploration Target

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 almost 10 tcf of recoverable gas that has been discovered is a by-product of oil exploration - which has discovered approximately 2.1 billion barrels of recoverable oil and 436 million barrels of Natural Gas Liquids. With the recent increases in North American natural gas prices and the clear need to develop new supply areas, serious discussions have begun on ways and means to bring the Newfoundland and Labrador natural gas to market. Possible modes of transportation under consideration include both pipeline and Compressed Natural Gas tankers. Oil is currently being transported from the fields by shuttle tanker.

Exploration History

Exploratory drilling on the Atlantic Canada margin began in mid 1960's, and to date a total of about three hundred fifty exploration wells have been drilled in Nova Scotia and NL waters, almost equally divided between the two provinces. From a frontier exploration point of view, all the basins along the margin can be considered to have hydrocarbon potential. Most of the basins are sparsely drilled, and some have been explored by reflection seismic and are yet to be drilled (Fagan and Atkinson, 2000; Hogg and Enachescu, 2001 and 2003; Enachescu, 2004a and b; Enachescu and Fagan, 2004).

Up to now, large discoveries have been made in three areas - the Hopedale Basin (Labrador Shelf), Jeanne d'Arc Basin (Grand Banks) and the Sable Basin (Scotian Shelf) (Hogg and Enachescu, 2003; Enachescu, 2004a and b; Enachescu and Fagan, 2004 and 2005; Figures 2 and 3). A detailed discussion of the Jeanne d'Arc Basin fields is included in the report that was published by the Department of Natural Resources to provide information on the 2004 landsale parcels (Enachescu and Fagan, 2004) – the weblink is given in the Foreword to this report.

The prime 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 Basin, Flemish Pass, Carson-Salar and deep water South Whale, or in long dormant areas such as the on-shelf South Whale 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 area identifying the sandstone reservoirs and source rock intervals is shown in Figure 4.

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 Transfer fault Zone, COB=Continent-Ocean Boundary.

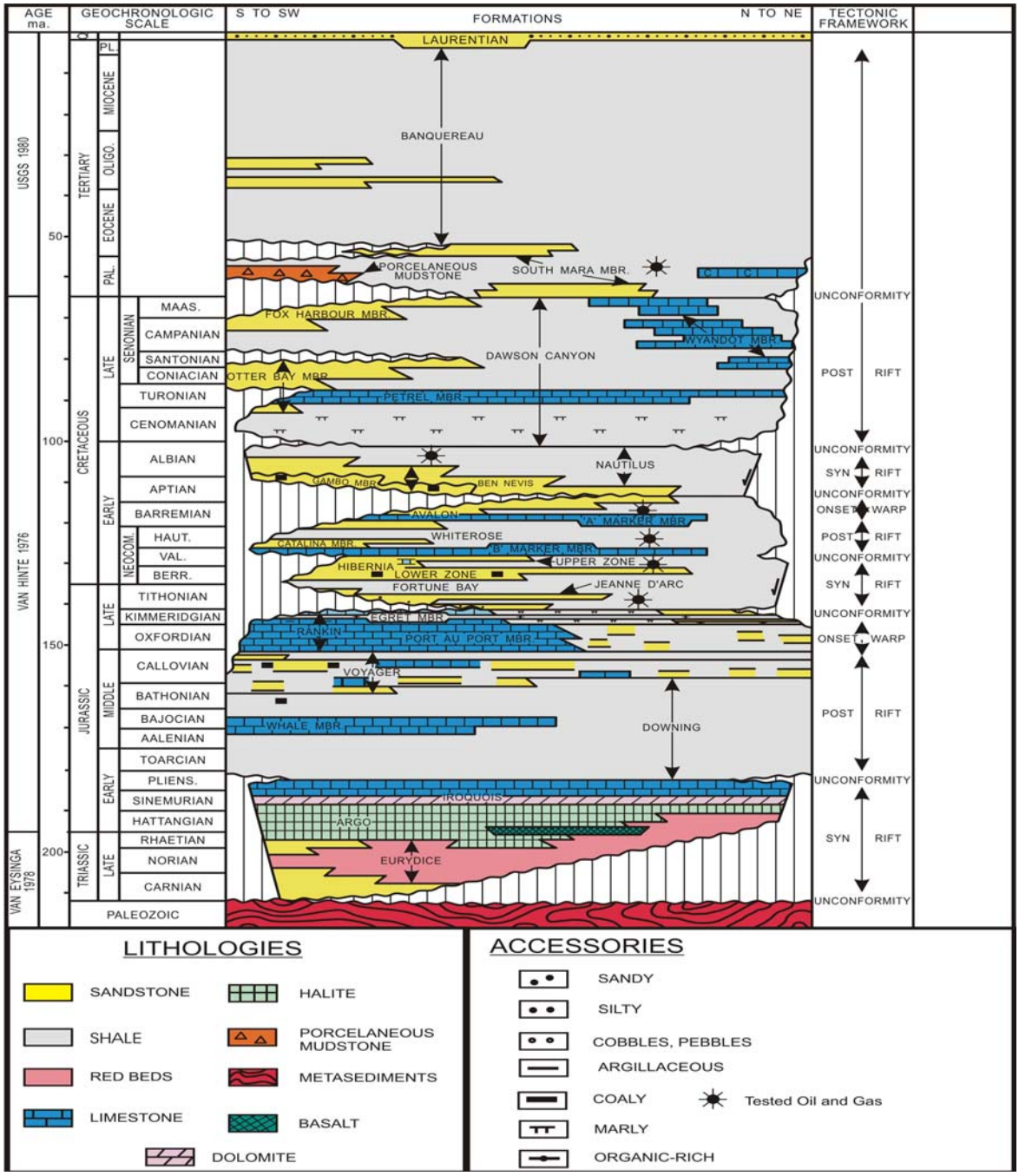


Figure 4. Generalized stratigraphy of the Jeanne d'Arc basin and environs (modified after Sinclair 1994 and C-NLOPB)

Strat Plays Almost Untouched

Most exploration to date has focussed on large 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 (Cretaceous-Early Tertiary basin margin and floor fans) have been mapped within the Jeanne d'Arc Basin. Considering that the basin has a proven petroleum system and extensive infrastructure in the existing developments, these strat plays represent an exceptional exploration opportunity for current and new players to the area.

Recent Offshore Drilling

The most recent drilling programs offshore NL were concentrated in the Jeanne d'Arc Basin and the deep water (1100 m) 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). One well in the basin (Mizzen L-11) has intersected Early Cretaceous oil pay and also has re-confirmed the presence of Jurassic source rocks, with important consequences for elucidating the petroleum system in the Flemish Pass and the neighbouring Orphan Basin (Enachescu and Hogg, 2005, Enachescu et al, 2005). The Mizzen well information was made public on April 26, 2005 and is available at the C-NLOPB office.

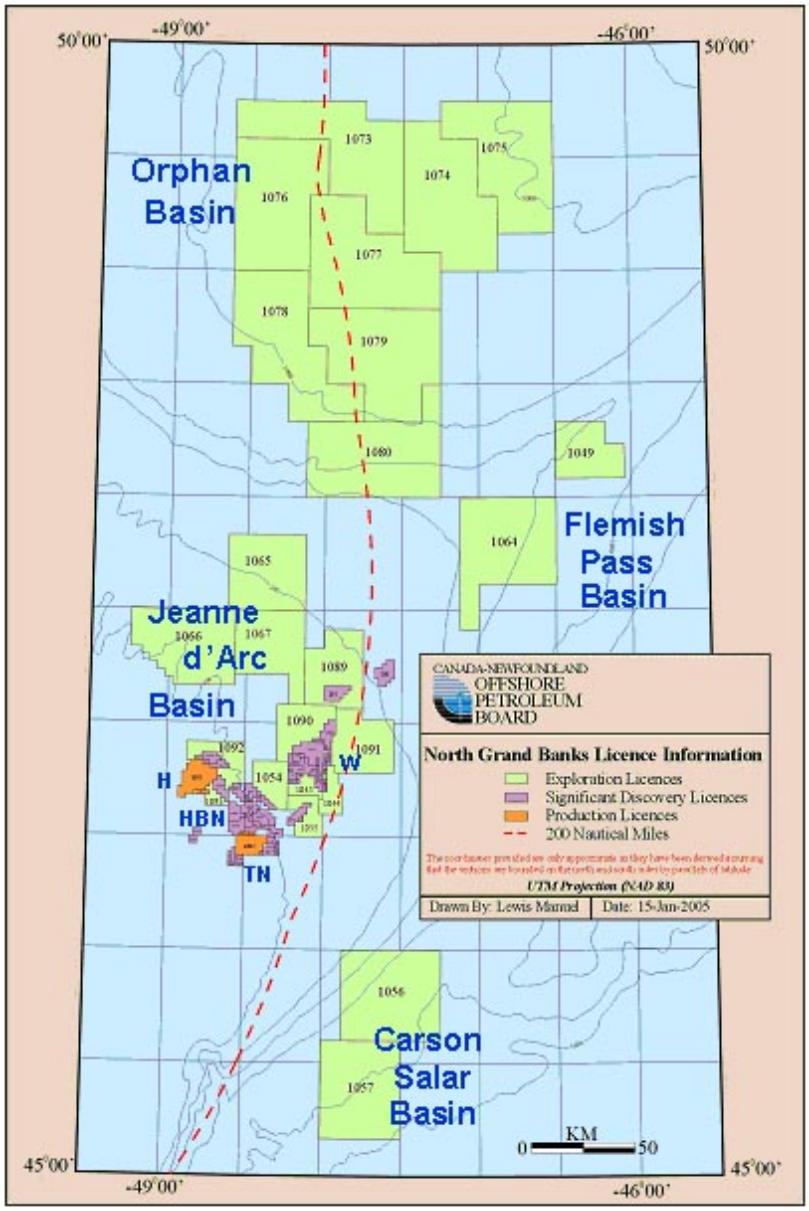


Figure 5. Land tenure on the north-eastern Grand Banks and environs including the Exploration Licences awarded at the 2003 and 2004 landsales (spring 2005, modified after C-NLOPB). Annotations are: H = Hibernia, TN = Terra Nova; W = White Rose, HBN = Hebron Ben Nevis fields. Dashed red line indicate 200 Mi limit

The latest offshore exploration well, Lewis Hill G-85, was spudded on July 11, 2005, and test a large structural prospect in the South Whale Basin. This is a basin that has seen no drilling since 1987 - and the well previous to that was in 1974. If Lewis Hill proves to be a discovery or delivers other promising results it could lead to a land-rush for large tracts of open ground along the southern margin of the Newfoundland Grand Banks. Also of note, is the fact that Lewis Hill is being drilled by the jack-up Rowan Gorilla VI, marking the first time a jack-up has been used on the Grand Banks. The Gorilla VI will also be used to drill two delineation wells in the White Rose area this summer. Successful utilization of jack-up rigs on the Grand Banks introduces new potential for lower drilling costs in the area.

Recent Seismic Exploration

Although no offshore exploratory drilling occurred within the Province during 2004, over 10,000 km of 2D and 1,900 km^2 of 3D seismic data were acquired during the summer season. The 3D data was acquired in the East Orphan Basin and will help locate one of the first exploration wells on acreage acquired in the C-NLOPB's record setting 2003 Call for Bids, and operated by Chevron Canada. Two other large 3D seismic surveys will be executed in the East Orphan Basin during the summer of 2005 in preparation for a multi-well program that is expected to begin in late 2006 or early 2007. Meanwhile modern 3D "Q" seismic survey is being acquired by WesternGeco for Conoco-Phillips in preparation for drilling to begin in the Laurentian Basin in 2007. The Laurentian Basin was recently opened to exploration after the resolution of international and inter-provincial boundary locations. After completion of the Laurentian Basin survey the Q vessel will move to the Jeanne d'Arc Basin/Central Ridge area to acquire 3D data on lands acquired by Husky in the 2004 landsale. In addition to these programs, Geophysical Services Inc recently began a large (14,000 km) speculative 2D survey, in the Labrador Sea and the adjacent deep off-shelf waters to the east. This is clear evidence that industry is ready to revisit offshore Labrador, which has not seen a landsale or a well in over 25 years.

Onshore Activity

An oil and gas discovery made on Newfoundland's Port au Port Peninsula in the mid-nineties tested at initial rates of approximately 1500 bopd and 2.3 mmcf/d from what appears to be a hydrothermal dolomite zone within Ordovician sediments. However, flow rates were not sustained in extended tests, and further work is required to determine the economic feasibility of the discovery. Interest in the trend has been given a boost by success in similar rocks in New York State (Eaton; AAPG Explorer) and exploration of the trend continues in western Newfoundland, on the Gaspe Peninsula (Quebec) and on Anticosti Island.

Significant oil and gas shows have also been encountered in Carboniferous rocks in the Deer Lake Basin and Bay St. George Sub-basin onshore western Newfoundland. Vulcan Minerals of St. John's spudded the first of several planned wells in the Bay St. George Basin on July 20, 2005 to test large structural features mapped on seismic data. Carboniferous exploration in the Province is also being encouraged by the success of Corridor Resources who made a significant gas discovery in a Carboniferous sub-basin in the province of New Brunswick. This field is currently producing approximately 2 mmcf/d which is being consumed in the local market.

Recent Offshore Landsale Results

The oil industry's increased interest in the NL offshore area is exemplified by the fall 2003 landsale in the Orphan Basin in which a consortium that includes ExxonMobil, Chevron Canada

and Imperial Oil bid C$672.7 million[1] in work commitments[2] for eight large parcels lying in water depths ranging from 2000 to 3000m (Figure 5). This was by far the most successful offshore landsale in Canada's exploration history, and included a record bid of C$251.6 million for a single parcel (EL 1079).

The subsequent landsale in 2004 was also successful as several companies (Petro-Canada, Husky Energy, Norsk Hydro and HMDC) bid C$71 million (US$57 million) for 5 smaller size parcels located within the shallow water of the Jeanne d'Arc Basin and environs, and in the vicinity of known reserves (Exploration Licences 1089 to 1093 in Figure 5).

Other areas where lands have been licenced in the past five years include the southern Grand Banks, Carson-Salar Basin, Jeanne d'Arc Basin, Flemish Pass and offshore western Newfoundland. The three Jeanne d'Arc Basin parcels being offered in the current landsale present the opportunity to explore sparsely drilled lands adjacent to major oil discoveries that are very well covered by 2D seismic-and modern 3D data. The entire seismic data base is available for purchase from seismic contractors or brokers and some of the 2D is also available in hard copy from the C-NLOPB for the cost of reproduction.

The most active explorers of the past couple of decades were Mobil (now ExxonMobil), Chevron Canada, Petro-Canada, Husky Energy, Norsk Hydro, Gulf (now ConocoPhillips), BP, Shell, Murphy Oil and EnCana. Many other companies involved have been re-structured through mergers and acquisitions. Exploration commitments are currently spread over 43 licenses which have varying expiry dates spanning the next five to six years (Figures 9 and 11). As a result, the province could see as many as 10 shallow, intermediate and deep water exploration wells drilled over the next 5 years.

Production and Development Activity

With production levels at approximately 313,000 bopd from two producing fields, Hibernia and Terra Nova, and a third field White Rose approaching first oil at a 100,000 bopd, the Canadian Province of Newfoundland and Labrador is establishing itself as a major oil player on the international oil and gas stage (Enachescu, 2004a; Enachescu and Fagan, 2004; Enachescu, 2005a; Enachescu and Hogg, 2005). Development wells at Hibernia and Terra Nova have to a great extent proven the large size and high productivity of the respective reservoirs.

Almost 75 million barrels were produced during 2004 from the Hibernia field with an average daily production of 203,706 bopd. Petro-Canada has recently increased its recoverable reserve estimate for the Hibernia field to 940 million barrels, a 25% increase over Mobil's 1997 published estimate of 750 million barrels recoverable. In 2004, HMDC 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.

Although affected by some operational problems during the 2004, Terra Nova production, has maintained an average for the year of approximately 110,000 bopd. Terra Nova development

[1] One Canadian dollar is worth approximately US$.80

[2] Lands are licenced 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.

drilling is proceeding according to the DPA and evaluation of resources within the undeveloped Far East Block and other adjacent fault blocks is ongoing.

Jeanne d'Arc Basin	Total Production Oil **(bopd)**	Daily Average Production oil **(bopd)**	Total Production Gas **(MMcf)**	Daily Average Production Gas **(MMcf /day)**
Hibernia	74,556,445	203,706.2	97,336	289.7
Terra Nova	40,224,000	109,901.6	44, 086	131.2.
Total	**114,780,455**	**313,607.8**	**141,423**	**420.9**

Table 1. Jeanne d'Arc Basin oil and gas daily average and total annual production during 2004.

Husky Energy is very close to first oil from its operated (72% interest) White Rose field located on the eastern side of the Jeanne d'Arc basin. In the past couple of years, two successive White Rose delineation wells tested oil and extended the boundaries of the field approximately 5 km to the south. More delineation wells outside of the primary oil pool (South Avalon Pool) are planned for 2005, and first oil is expected in November/December 2005. After the installation of the topsides in Marystown, NL, and sailaway in this August, the Sea Rose FPSO will undergo tests and will then move on location at the White Rose field for offshore installation and production commissioning. The two oil shuttle tankers dedicated to White Rose production transport are already launched and operational. The entire White Rose development is proceeding within the budget and on time.

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. Selecting a development solution, preparing for regulatory approvals and front-end engineering are reported to be ongoing in St John's, Houston and Calgary. These are positive steps towards the advancing development of Hebron-Ben Nevis asset. 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 (21º 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).

As an example of how important the Newfoundland generated production became for companies involved in NL, Petro-Canada received over 35% of its net earnings in 2003 from its Grand Banks producing properties and just recently increased the recoverable oil reserve for Hibernia to 940 Million barrels (the previous published estimated by partner Mobil, in 1997 was 750 million barrels. The current C-NLOPB estimate is 865 million barrels recoverable.) Petro-Canada has a 20% or greater share in all four of the province's major oil projects, and is involved in 22 out of

the 23 significant discovery areas within Newfoundland and Labrador waters. During 2003, ExxonMobil lifted an average 193,000 bopd from the Jeanne d'Arc Basin, the largest production share among the Hibernia and Terra Nova partners.

Hebron-Ben Nevis is the last of discovered fields in the NL offshore area with sufficient reserves to justify stand alone development. Therefore a renewed exploration approach to the Jeanne d'Arc basin is of crucial importance to the Province and to the existing players who would seek to maximize the economic benefits from existing infrastructure. Several smaller fields are also expected to be developed in the future by subsea tiebacks to existing infrastructure in the basin.

3. Exploration Potential of the Newfoundland and Labrador Basins

For the past twenty five years the main focus of exploration has been the syn-rift sequence within the Jeanne d'Arc Basin and more recently the same play was pursued in two wells in the Flemish Pass Basin. (Figures 2, 3 and 5). Only 16 exploratory wells were drilled in the entire offshore NL area since 1995. 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 Orphan basins. Nevertheless, exploration blocks within the Jeanne d'Arc basin continue to attract attention as evidenced by the 2004 landsale and the fact that lands were posted by industry for the 2005 landsale. This section will provide a short discussion on each of the key exploration areas.

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 therefore 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 (Figure 2). 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.

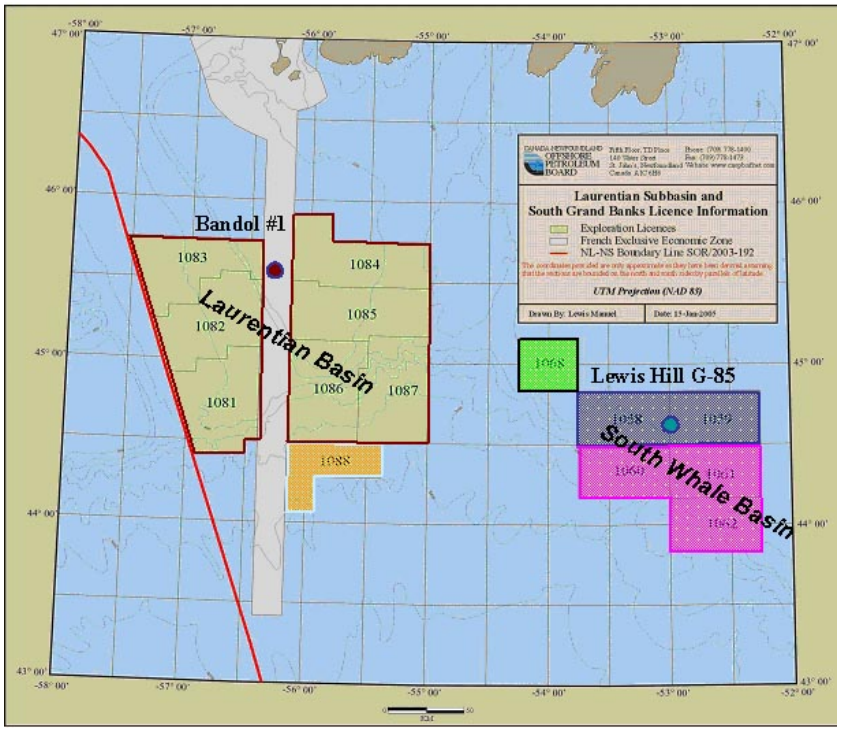


Figure 6. Current Exploration Licences in the Southern Grand Banks (modified after C-NLOPB) including the approximate locations of Bandol #1 and Lewis Hill G-85.

Laurentian Basin

This basin covers an area of 60,000 km^2 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 no detailed results have yet been released (Figure 6). The possible hydrocarbon plays, similar to those encountered on the Scotian shelf and slope, include: listric fault blocks, rollover anticlines or salt anticlines with Jurassic/Early Cretaceous sandstone reservoirs; and possible development of Jurassic Abenaki limestone porosity or slope sandstone fans. Present Exploration Licence holders are ConocoPhillips, (the principal operator), BHP Billiton, Murphy Oil and Imperial Resources.

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. 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 across their seven licences, in addition to the C$23 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). A large 3D “Q” seismic survey operated by ConocoPhilips is ongoing in the basin this summer in preparation for a drilling program expected to begin in 2007.

South Whale Basin

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 and 7). 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 synrift 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 level. 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 (Figure 6 and 7).

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). Possibly sand-rich fans may develop on the southern slope of the basin. The immediate future of exploration in the basin is to be decided this summer (2005) by an exploration well being drilled by Husky Energy over the large Lewis Hill prospect. Besides Husky who operates two large blocks (100% interest) EnCana and two smaller companies, Paramount Resources and Polaris Resources, have land interests in the area.

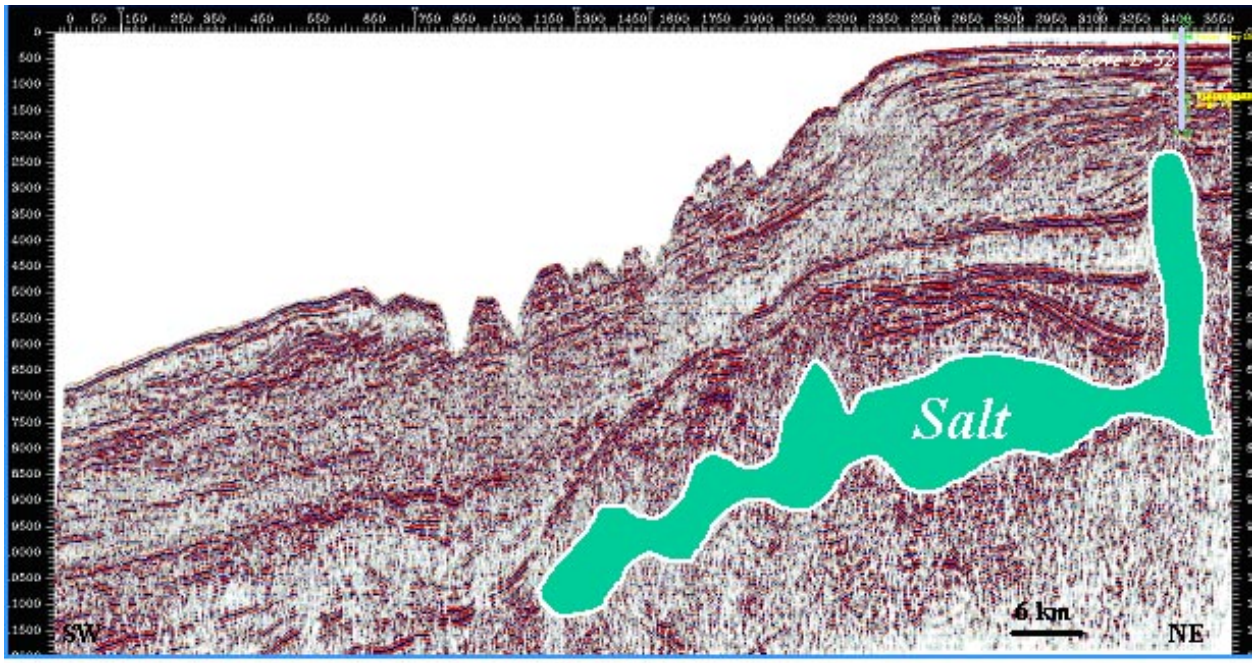


Figure 7. Seismic line (courtesy of GSI) showing Tors Cove D-52 well that drilled a shallow salt cored anticline. Deeper exploration plays on the shelf and slope of the South Whale Basin are the target of the present exploration in the basin.

Carson Salar Basin

This is a complex basinal area located on the Grand Banks eastern divergent margin and extend from continental shelf to upper rise water depth (200-4000m) (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. Two exploration blocks are licensed by Petro-Canada, Norsk Hydro and EnCana on the slope (Figure 5) where Late Cretaceous and Early Tertiary slope fans identified on the modern seismic data, may constitute viable plays. A drilling location is to be decided using a 3D data set covering several prospects on the slope.

Flemish Pass Basin

This is a Mesozoic basin partially located in a bathymetric low (roughly 1100m of water) northeast of Jeanne d'Arc Basin and west of Flemish Cap bathymetric high. 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; 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. 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 but non-commercial oil pay in Early Cretaceous sandstone was seen on logs at the Mizzen location (Enachescu and Hogg, 2005). Petro-Canada, ExxonMobil, ChevronTexaco, EnCana and Norsk Hydro are the companies involved in the most recent Flemish Pass Basin drilling.

In May 2004 the Canada-Newfoundland and Labrador Offshore Petroleum Board and Geological Survey of Canada published a report that estimated the undiscovered recoverable petroleum resources in the Flemish Pass Basin at 273 million m^3 (1.7 billion barrels) at a 50 percent probability - with expected field sizes ranging from 528 to 44 million barrels. The oil pay and the 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. Only two ELs are active in the Flemish basin (Figure 5).

East Orphan Basin

The present major focus of the Atlantic Canada exploration 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 8). 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; Kearsey and Enachescu, 2005). The petroleum system of the East Orphan Basin should include:

a) Kimmeridgian and probably Albian source rocks;
b) Late Jurassic, Early and Late Cretaceous and Tertiary reservoirs;
c) large anticlines, rotated fault blocks and submarine fans; and
d) 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, 2005)

3D seismic acquisition is ongoing on several exploration blocks to provide detailed mapping on several large antiforms (200-400 km^2) resulting from extensional roll-over anticlines being modified by transtension and inversion.

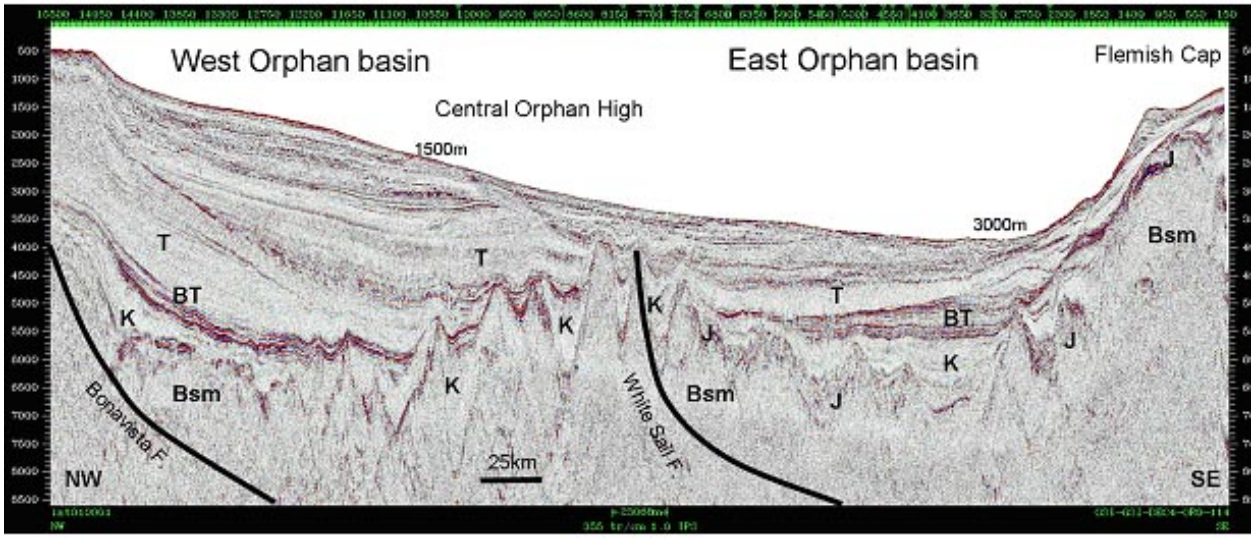


Figure 8. NW-SE Seismic section (courtesy of GSI) across the Orphan Basin showing the West and East Orphan basins and illustrating structural and stratigraphic hydrocarbon plays (reproduced from Enachescu et al, 2005).

With a long intra-continental rift evolution, shallow marine interludes of possible source rock deposition and numerous synrift structural and stratigraphic trapping possibilities, the East Orphan Basin has recently attracted (2003) the highest land bid and the highest singular block bid (EL 1079 operated by ExxonMobil) in the Canadian offshore oil exploration history, from an exploration consortium led by Chevron Canada, that includes ExxonMobil and Imperial Oil (Figure 5). The 8 parcels awarded cover an area of more than 5 million acres. This spring, Shell Canada took a 20% interest in the blocks through a farm-in from ExxonMobil and Imperial Oil.

According to recent published regional seismic studies (Smee, 2003; Enachescu et al, 2004b; Enachescu and Fagan, 2004 and 2005; Kearsey and Enachescu, 2005), there are half dozen large structures in the basin, each with the potential to hold several billion barrels of oil-in-place. 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 future deepwater drilling, probably during 2006-2008. Esso Exploration Inc., a subsidiary of ExxonMobil recently signed a letter of intent to use the semi-submersible Eirik Raude to drill the East Orphan Basin. This rig was proven in Canadian waters by drilling several wells in Flemish Pass and Scotian Slope basins. 3D seismic, environmental assessment and sea bottom hazard work are presently ongoing in preparation for a deep water drilling program expected to run from 2006 – 2008. Although a large area has been licensed a significant area with petroleum potential also remains to be licensed within the basin (Enachescu et al, 2004c and 2005; Enachescu and Fagan, 2005).

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 (Figures 3 and 8). This area is a younger rift basin than the East Orphan or the Jeanne d'Arc basins, that has 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). 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.

The Tertiary section is significantly thicker in the West Orphan than in the East Orphan Basin, ranging from 3000m to 5000m in thickness (Figures 8 and 9). Below the Base of 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 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.

Neither major shows, nor source rocks were encountered in the West Orphan Basin wells but good reservoirs were intersected in Upper Cretaceous and Tertiary formations (Koning et al., 1987; Smee, 2003, Enachescu and Hogg, 2005, Enachescu and Fagan, 2005). The seismic data 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 and shape and trapping potential (Figure 9). Some of these features are associated with amplitude anomalies at various levels in the Cretaceous and Tertiary. At this time, no land is licensed in this basin.

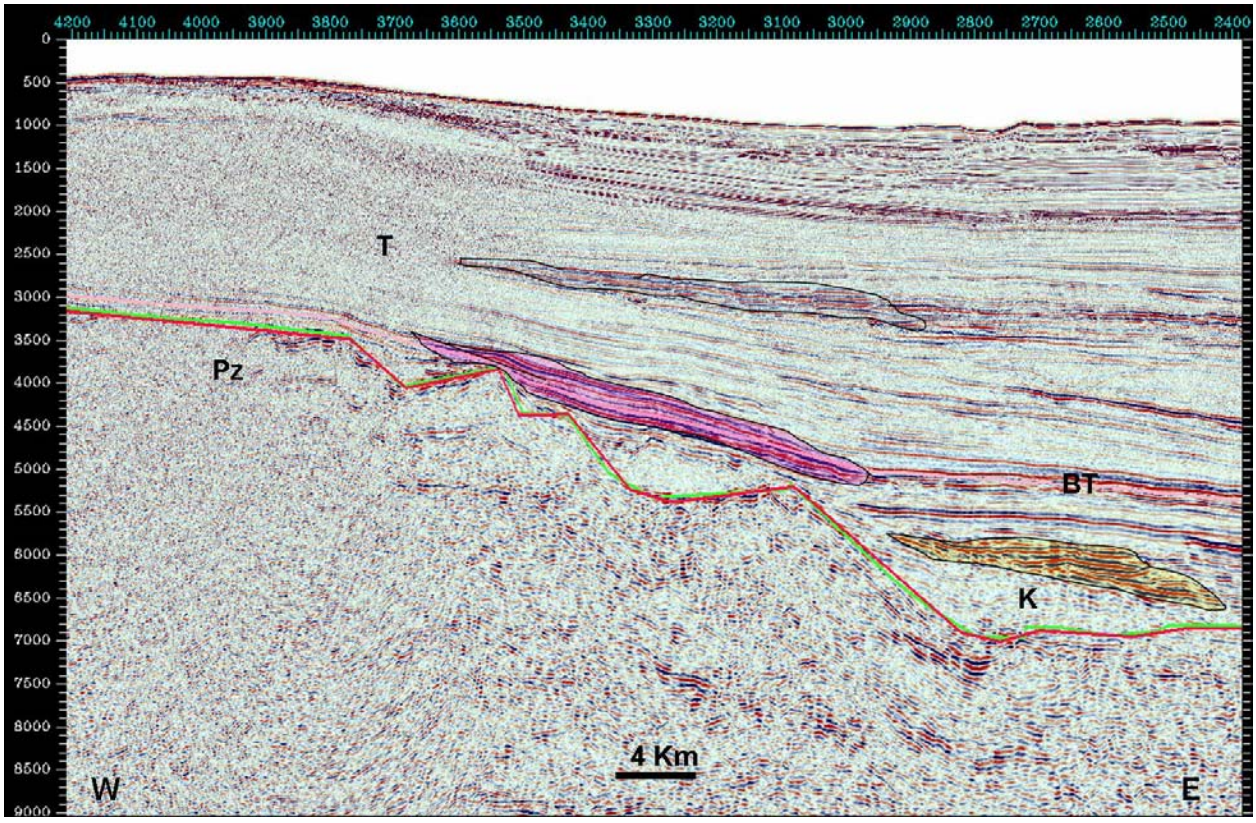


Figure 9. 2D Seismic line (courtesy of GSI) located in the West Orphan Basin showing stratigraphic plays in Late Cretaceous and early Tertiary sequences interpreted as sedimentary fans (reproduced from Enachescu et al, 2005).

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, M., 2005b). A total of 4.2 Tcf were found in the Hopedale Basin, between 80 and 150 kilometres off the coast of Labrador in fields such as North Bjarni (2.2Tcf), Bjarni (0.9 Tcf), Hopedale, Gudrid (0.9 Tcf), and Snorri, but no drilling has occurred in the basin since the early 1980s (Figures 1 and 2). The excellent quality reservoirs encountered are Late Cretaceous sandstones of the synrift 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 (Figure 10 and McWhea et al., 1980; Meneley, 2003; Enachescu, 2005b). Conceptual plays include the drape and onlap of the Bjarni sandstone on basement highs, roll-over anticlines, fault blocks and Tertiary turbidite sands.

The area of 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 (e.g. Figure 10). 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.

Significant Discovery Licences (SDL's)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.

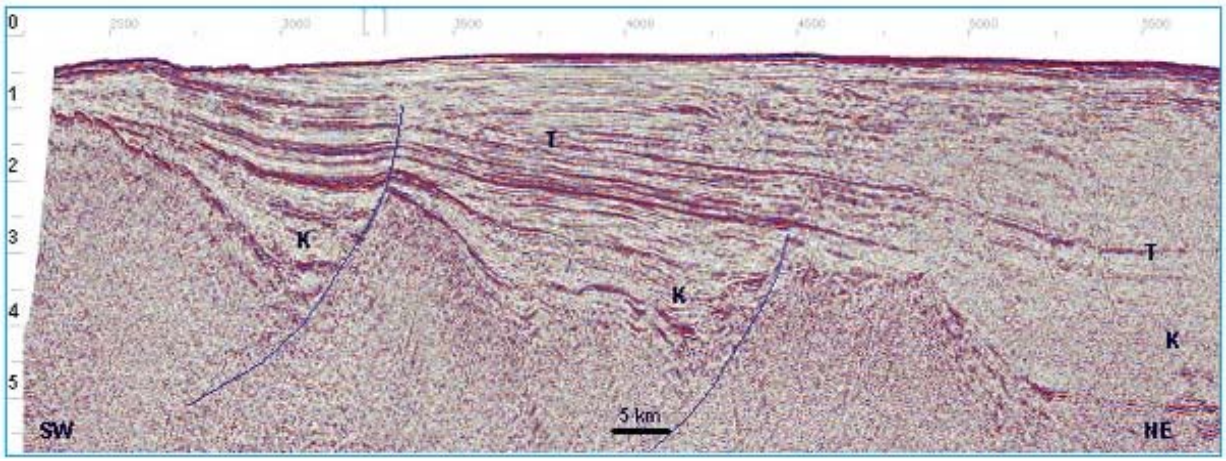


Figure 10. Regional 2D seismic section (courtesy of GSI) across the Hopedale Basin, Offshore Labrador showing large basement horsts and drape anticlines in the overlying Cretaceous and Tertiary sediments. Three large grabens that may hold mature source rocks are visible on the shelfal part of the Hopedale Basin. Annotations are T = Tertiary, K = Cretaceous.

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 11 to 14). 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 beds (Egret Member);

b) excellent reservoirs in Late Jurassic Jeanne d'Arc, Early Cretaceous Hibernia and Catalina, and Mid-Cretaceous Avalon and Ben Nevis formations (Hogg and Enachescu; 2003; Enachescu, 2004; Enachescu and Fagan, 2005).

According to Canada-Newfoundland Offshore Petroleum Board (C-NLOPB), the discovered recoverable reserves of the Jeanne d'Arc Basin, are estimated to be 2.1 billion barrels oil and 5.6 Tcf Gas with 324 million barrels of associated liquids, while total potential recoverable reserves for this basin are estimated at 4.6 billion barrels oil and 18.8 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 km^2 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 3 Tcf of recoverable gas, and the operator, Husky Energy, has sought and received proposals on ways and means to monetize the gas.

Compressed natural gas (CNG) tanker transportation is one of the promising initiatives being investigated by private firms and by Memorial University of Newfoundland.

Within the Jeanne d'Arc Basin (which has been re-targeted by industry in the 2004 and present landsale) 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 comprehensive 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).
This report also contains a comprehensive list of references. Regional illustrations of the structure, stratigraphy and petroleum potential used in the 2004 report are reproduced in Figures 4, 11 to 14 of the current report. 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.

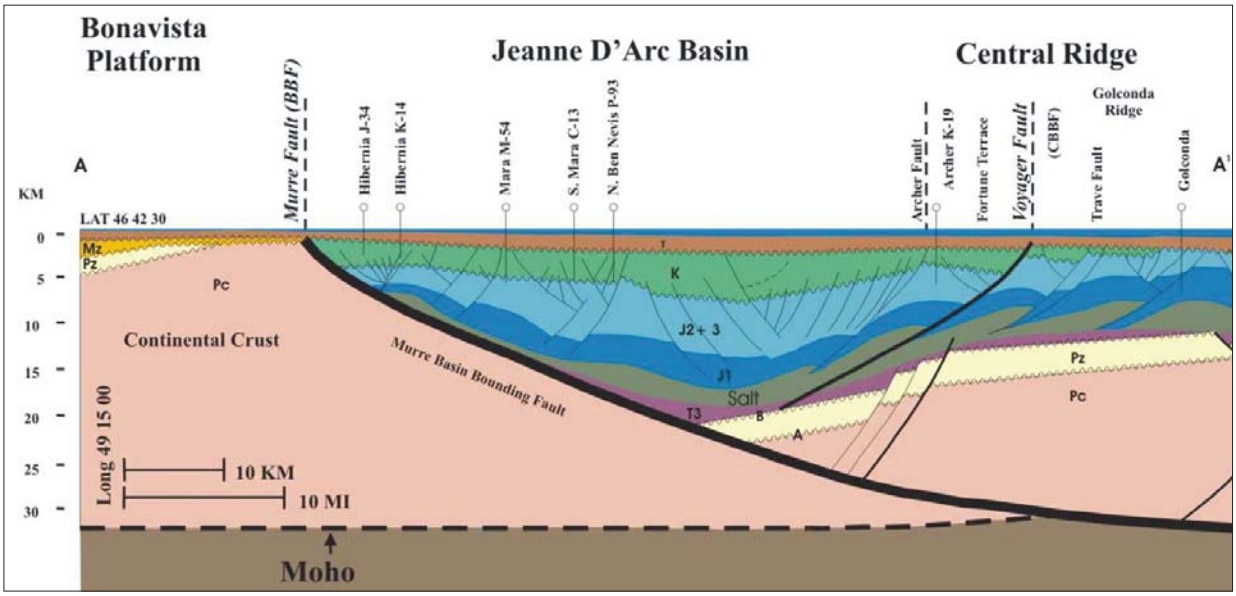


Figure 11. Regional geological cross-section A-A' across the Jeanne d'Arc Basin at the latitude of Hibernia oil field and Trans-Basin Fault Zone (modified after Enachescu, 1987). Location is given in Figure 12.

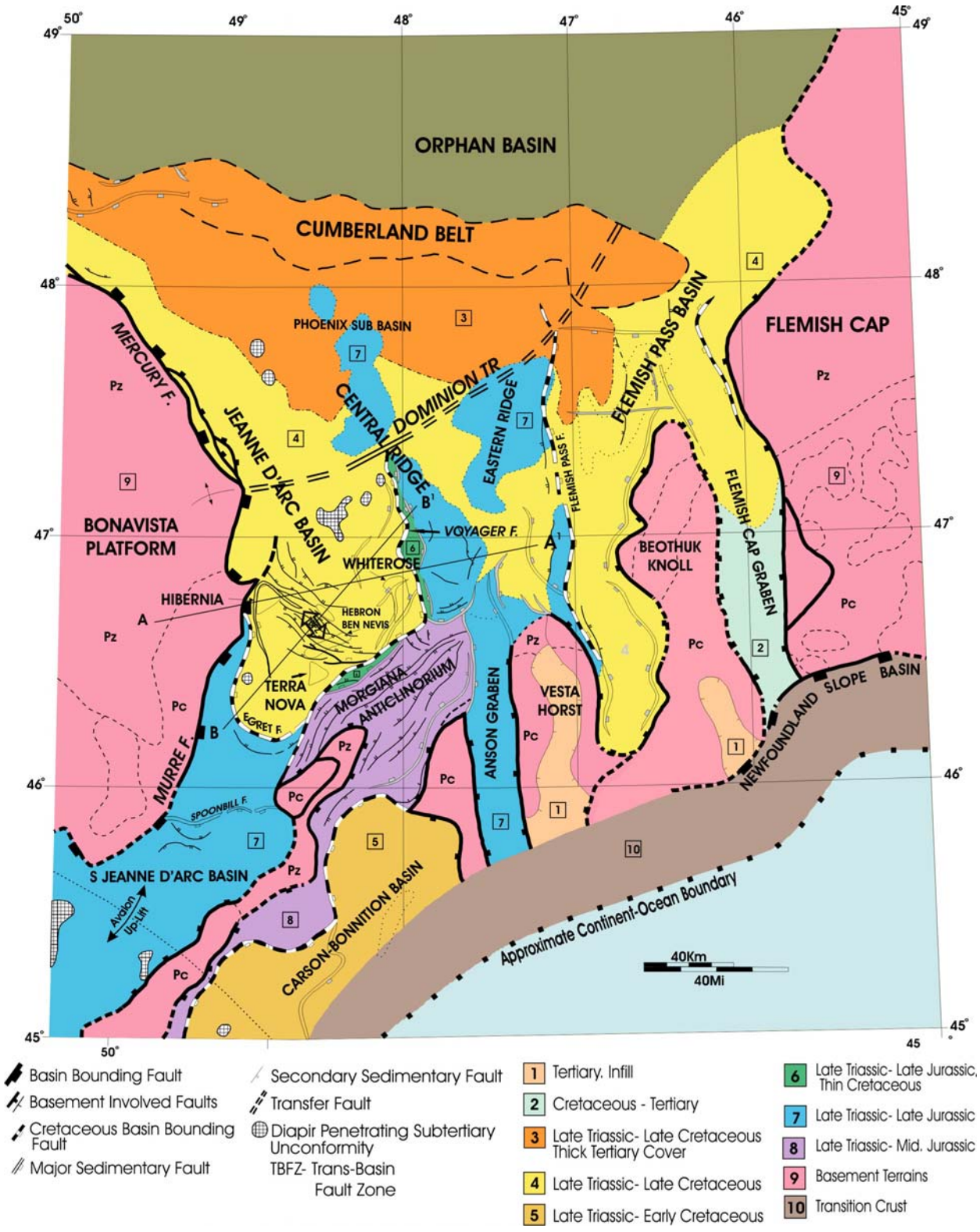


Figure 12:
Tectonic and structural framework of Grand Banks.
Modified after Enachescu 1987 and 1994

Source Rock and Maturation. The Kimmeridgian aged Egret Member of the Rankin Formation deposited at the end of a thermal subsidence stage that followed the second rift phase is the proven oil source rock for all of the significant oil and gas discoveries on the Grand Banks (Figures 4 and 13). This is a marine organic-rich shale (TOC 2-12%) that began generating hydrocarbons in Late Cretaceous, reached peak oil generation in Eocene, and in places continues to generate oil and gas up to the present time. It averages 200m thickness throughout the Jeanne d'Arc Basin and has also been encountered by the 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, 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.

Hydrocarbon Reservoirs. Stacked sandstones intervals within the Jeanne d'Arc, Hibernia, Catalina and Avalon formations are proven quality reservoirs (Figures 4 and 13). 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 12 and 13). 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 trans-tension 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.

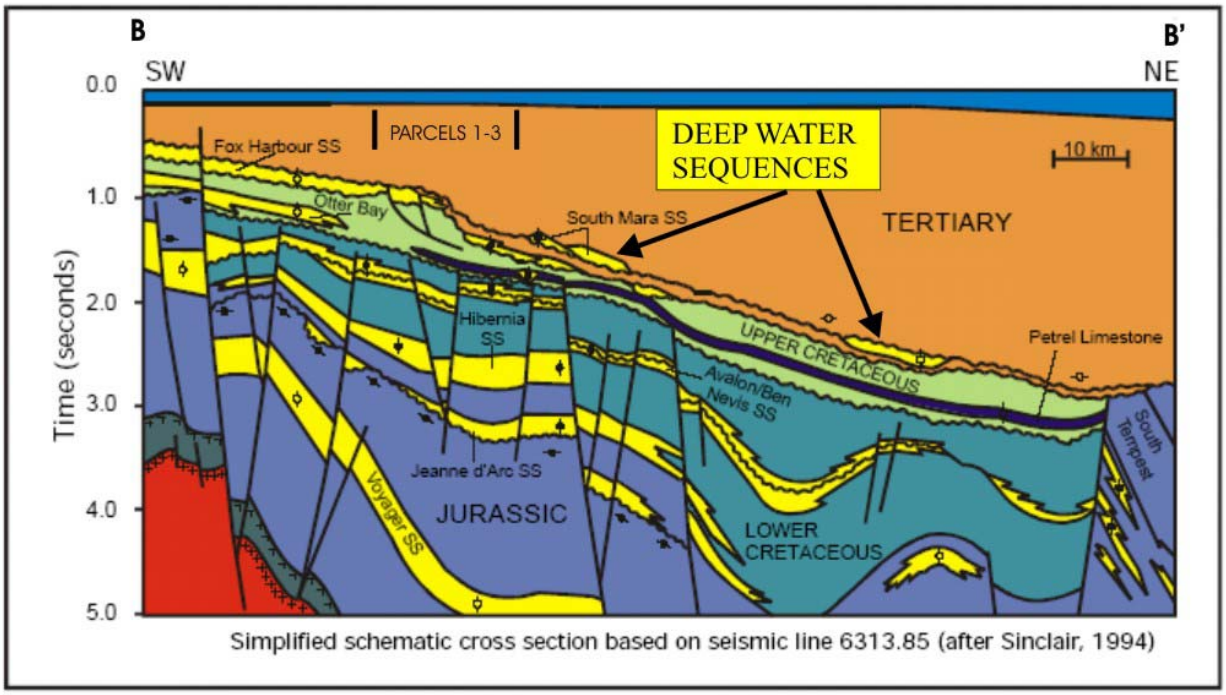


Figure 13. Regional geological cross-section of the Jeanne d'Arc Basin showing approximate locations of parcels 1 to 3. Main reservoirs and source rock intervals are indicated. Section is modified from Sinclair 1994.

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.

Exploration in the basin has been focused mainly on the proven reservoirs of the Late Jurassic and Early Cretaceous, located in the down-throw of Murre and Voyager faults and along the Trans-Basin Fault Zone where most of the large oil discoveries are found (Figures 11 to and 14, and McAlpine, 1990; Enachescu and Dunning, 1994; Enachescu and Fagan, 2004; Enachescu, 2005a; Enachescu and Hogg, 2005; Enachescu and Fagan, 2005).

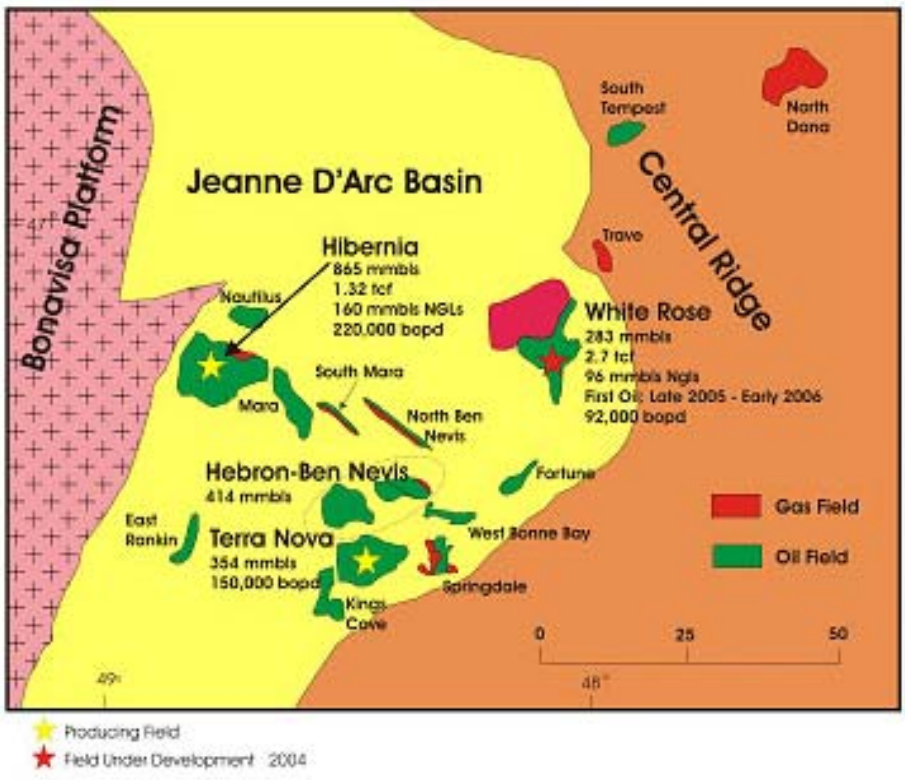


Figure 14. Jeanne d'Arc Basin and environs, producing oil fields and other discoveries (modified after C-NLOPB).

The recent 2004 landsale in the basin included parcels surrounding the Hibernia and White Rose fields that may provide for extensions of the 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 13);

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.

5. Petroleum Potential of 2005 Call for Bids Parcels 1, 2 and 3

The parcels cover a total area of 44,072 hectares (108,904acres) in the central Jeanne d'Arc Basin which has been the long-established exploration ground of oil companies involved in the basin. These three shallow water (90-100m) parcels, are located in the oil proven triangle formed by the Hibernia - Terra Nova - White Rose oil fields and very close to the Hebron-Ben Nevis multi-zone oil and gas field (Figures 11, 14 and 15). They are also in the vicinity of several smaller fields, single well discoveries and oil shows drilled during the past 25 years. 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 16. 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 13 and on the geological map of the basin (Figure 15).

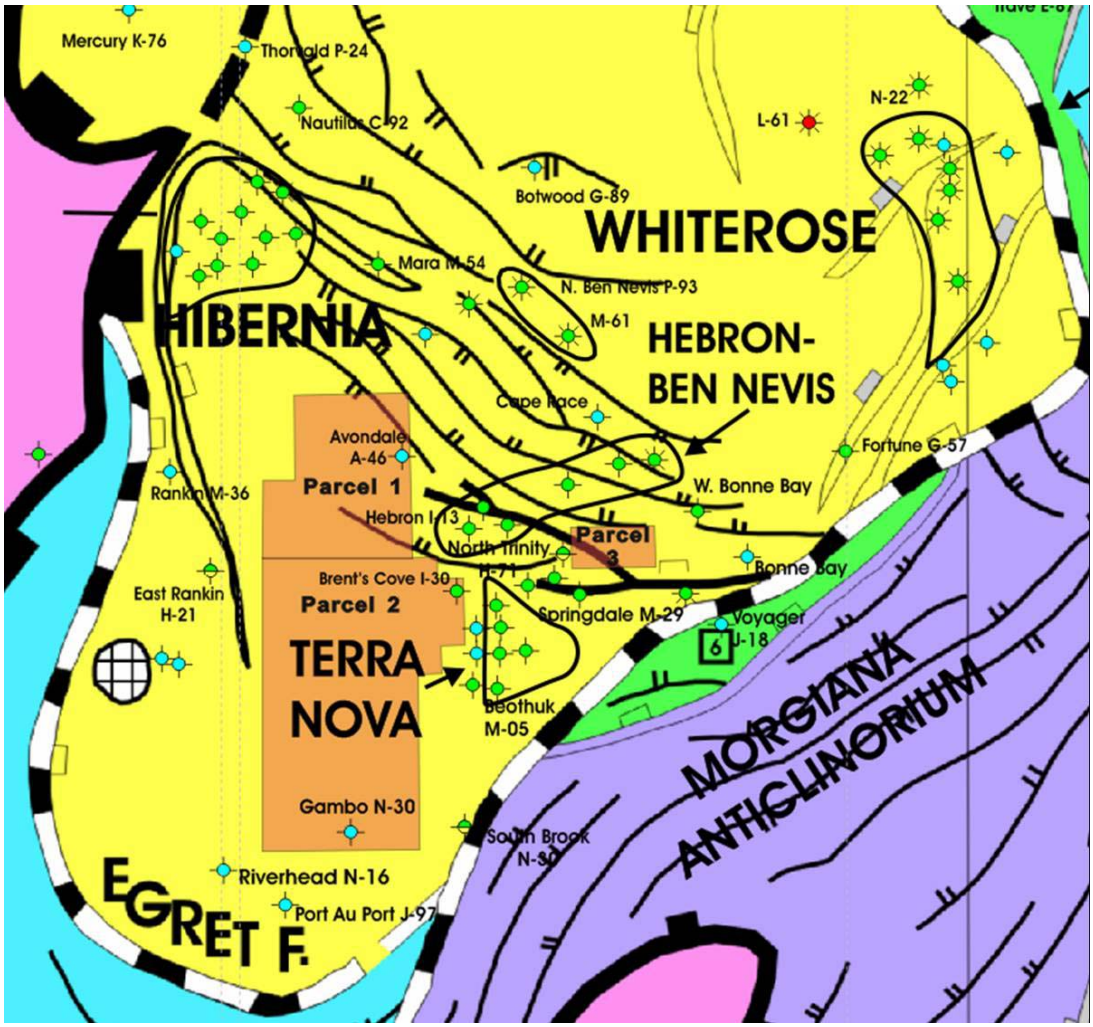


Figure 15. Structural and stratigraphic map of the Jeanne d'Arc basin with location of NF05-01 parcels, oil fields and main exploration wells (modified from Enachescu, 1987)

Structurally, parcels 1, 2 and 3 are located within, or just to the south of, the Trans-Basin Fault Zone (TBFZ). Parcel 2 also extends to the south, along the basin axial plane, where the basin becomes shallower bringing the upper Jurassic rocks within 2000-3000m depth (Figure 13 and 15). The Egret source rock is mature throughout the area covered by the three parcels (McAlpine, 1990; Hogg and Enachescu, 2001). More information on the wells situated within the parcels or in the vicinity can be obtained from C-NLOPB Schedule of Wells (C-NLOPB, 2005 and http://www.cnopb.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 Hibernia and Terra Nova Development Plan Applications (DPA). Complete well history reports are available from the C-NLOPB.

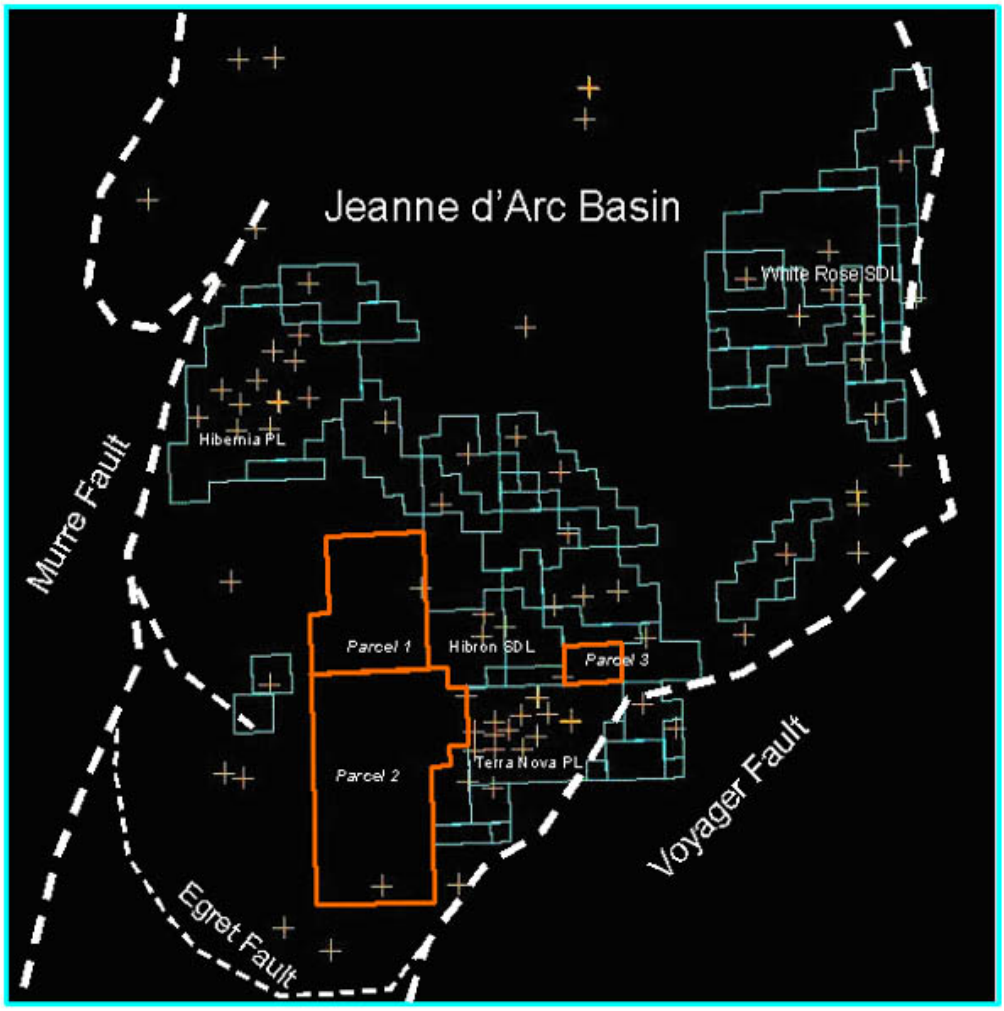


Figure 16. Location of Parcels 1, 2 and 3 within the Jeanne d'Arc Basin shown in red line. Main tectonic elements border the Jurassic+Cretaceous basin (after Enachescu, 1987). Production Licences and Significant discovery licences (SDL) are also shown in blue line.

Parcel 1

This medium size parcel (located just west of the Hebron and West Ben Nevis Significant Discovery Licences (SDLs)) occupies an area of 13,485 hectares (33,322 acres). The parcel is also equally distanced from both Hibernia and Terra Nova fields (Figures 15 and 16). The only existing well in the parcel, Avondale A-46 (TD 2025m) (Figure 17), is a shallow well that has targeted a thick basin margin prograding sedimentary sequence above the Petrel Member. The well intersected excellent reservoirs in the post-rift South Mara Member and in the Dawson Canyon Formation sandstone units, but did not encounter hydrocarbons. Other significant wells near this parcel include East Rankin H-21 (recovered oil from Hibernia and Jeanne d'Arc sandstones), Hebron I-13 (recovered increasingly lighter oil from Ben Nevis, Hibernia and Jeanne d'Arc sandstones) Hebron M-04 (recovered oil from Jeanne d'Arc sandstone and had oil on logs present within Ben Nevis and Hibernia sandstones) and Mara M-54 (recovered oil from South Mara Member and Ben Nevis sandstone).

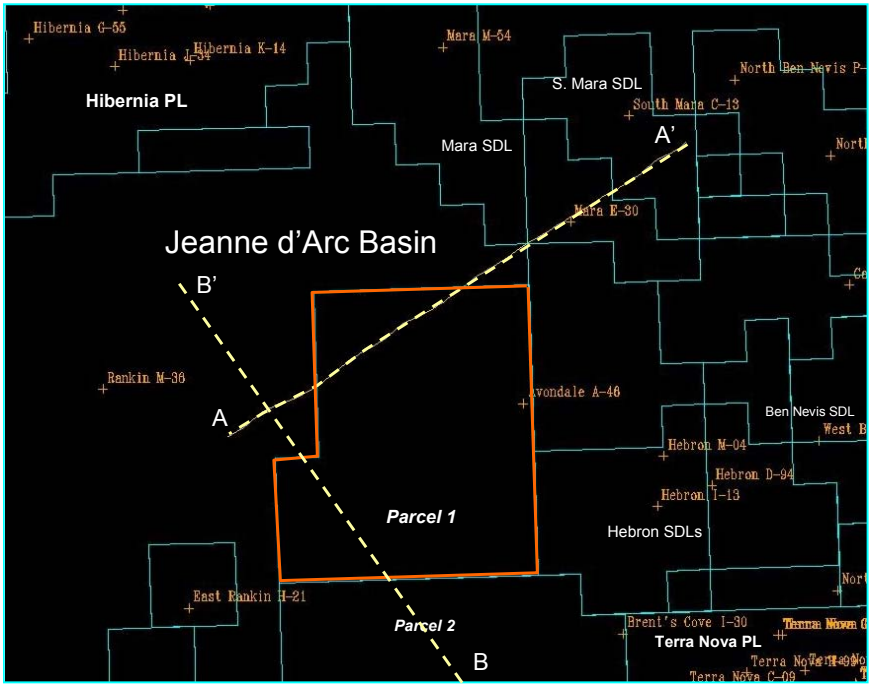


Figure 17. Location of Parcels 1 within the central Jeanne d'Arc Basin shown in red line. Two sesmic lines A-A' and B-B' are used to illustrate the petroleum geology of this parcel. The parcel is surrounded by Hibernia and Terra Nova PLs and several SDLs shown in blue line.

Seismic line A-A' (Figures 17 and 18) shows the location of Parcel 1 within the axial plane and eastern flank of the Jeanne d'Arc Basin. Several fault bounded blocks are present at the level of Jeanne d'Arc and lower Hibernia formations. The sand prone Lower Cretaceous – Early Tertiary prograding wedge including some deeply incised canyons, are interpreted to be present above the Petrel Limestone. This spectacular sedimentary wedge prograding from the west and deposited in a shelf and slope environment is noticeable on seismic sections or isopach maps (see also Enachescu et al, 1988; Deptucket al., 2003; McIntyre et al., 2004). In the eastern half of this parcel and also in Parcel 2, sand-prone submarine fans can be seen in the early Tertiary succession.

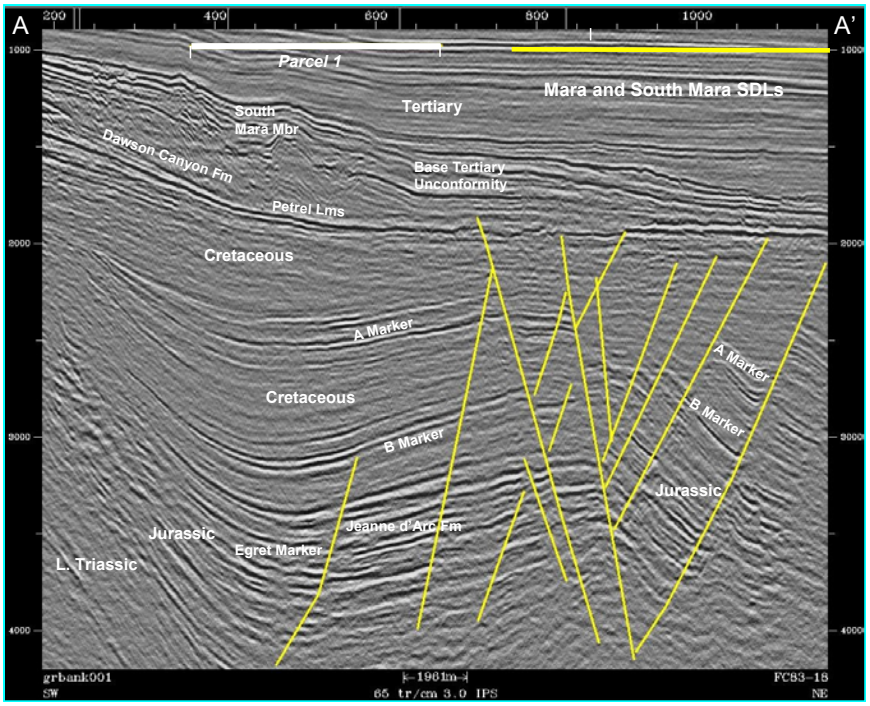


Figure 18. SW-NE 2D seismic line A-A'(courtesy of GSI) through Parcel 1 and environs showing the structure, stratigraphy and play types present in the area. The Parcel is located just south of the Trans-Basin Fault Zone.

Seismic line B-B' (Figures 17 and 19) is located in the southwestern part of the parcel and intersects the northeasterly plunging East Rankin salt cored anticline. The Hibernia and Jeanne d'Arc formations appear folded and faulted. The thick sedimentary wedge consisting of the Dawson Canyon Formation and South Mara Member is also present within the parcel.

The primary targets in this parcel are the Jeanne d'Arc and Hibernia sandstones within structural-stratigraphic traps. Secondary targets are provided by the Avalon-Ben Nevis sandstones of late Early Cretaceous age and sandstone members of the Dawson Canyon (Late Cretaceous) and Banquerau (Early Tertiary) formation which are more likely to be within stratigraphic than structural traps within the boundaries of the parcel. The key risks on this parcel are trap integrity, 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 2D seismic data that is available for purchase from GSI and TGS Nopec. A large volume of older reprocessed data is also available from seismic vendors. This parcel was covered in 1997 by a three-dimensional seismic survey (1997 PGS) financed by a consortium of oil companies (Hogg and Enachescu, 2001; McIntyre et al., 2004).

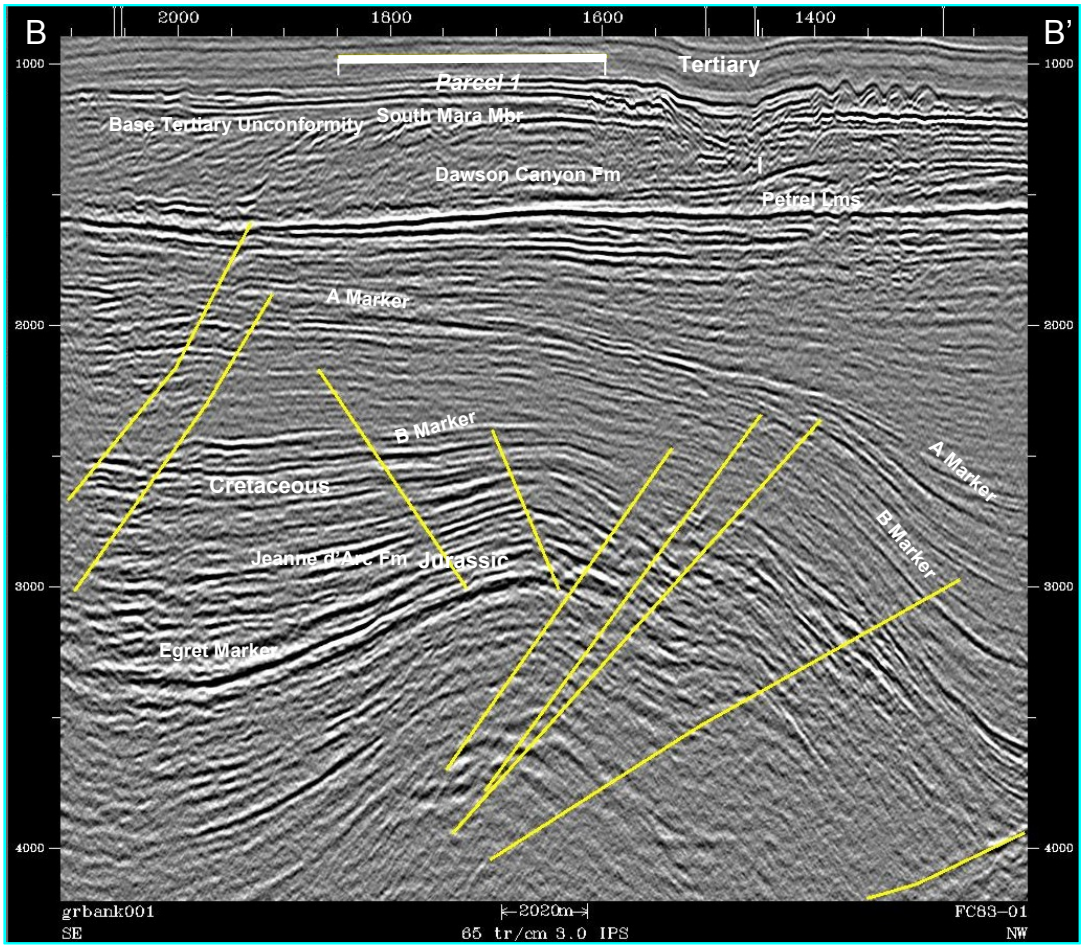


Figure 19. SE-NW 2D seismic line B-B' (courtesy of GSI) through Parcel 1 and environs showing the structure, stratigraphy and play types present in the area. The line is crossing the northern plunge of the east Rankin anticline and trends toward basin axis.

Parcel 2

This is the largest and likely most attractive parcel of the present Call for Bids in the Jeanne d'Arc basin. Parcel 2 occupies an area of 28,457 hectares (70,319 acres) located just west of the Terra Nova PL, and west and southwest of the King's Cove SDL (Figure 20). Only two wells have been drilled in this large parcel. The 1999 Brent's Cove I-30 (TD 4070m) to the north, has intersected Jeanne d'Arc sandstones within a structural-stratigraphic trap on the West Flank of the Terra Nova field, but was a dry hole (Figure 21). To the south, the Gambo N-70 (TD 2515), intersected sandstones and conglomerates in a Late Jurassic paleo-valley fill, but did not find hydrocarbons.

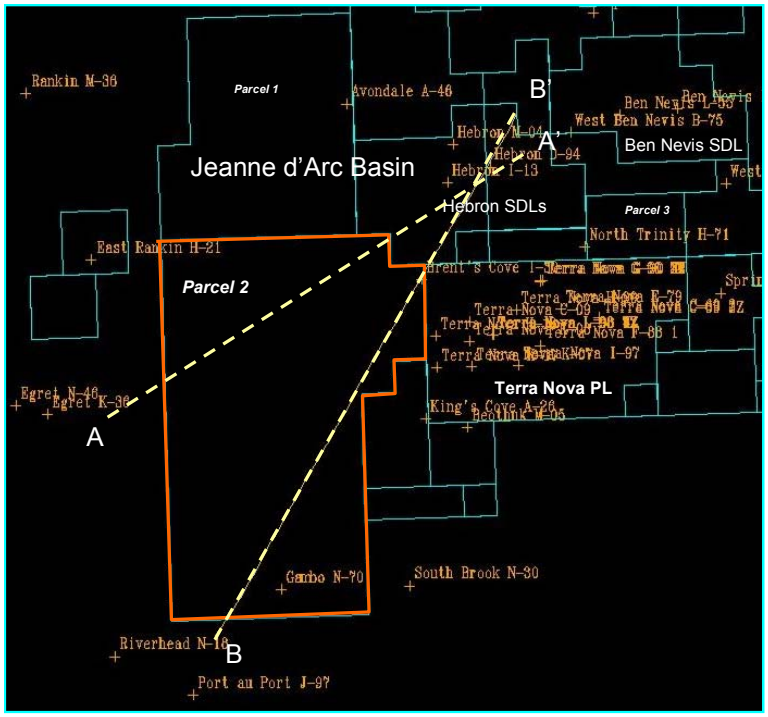


Figure 20. Location of Parcel 2 within the south-central Jeanne d'Arc Basin shown in red line. Two SW-NE 2D seismic lines are used to illustrate the petroleum geology of this parcel. The parcel is surrounded by Terra Nova PL and several SDLs shown in blue line.

The main play in the parcel 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. 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 200m) 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.

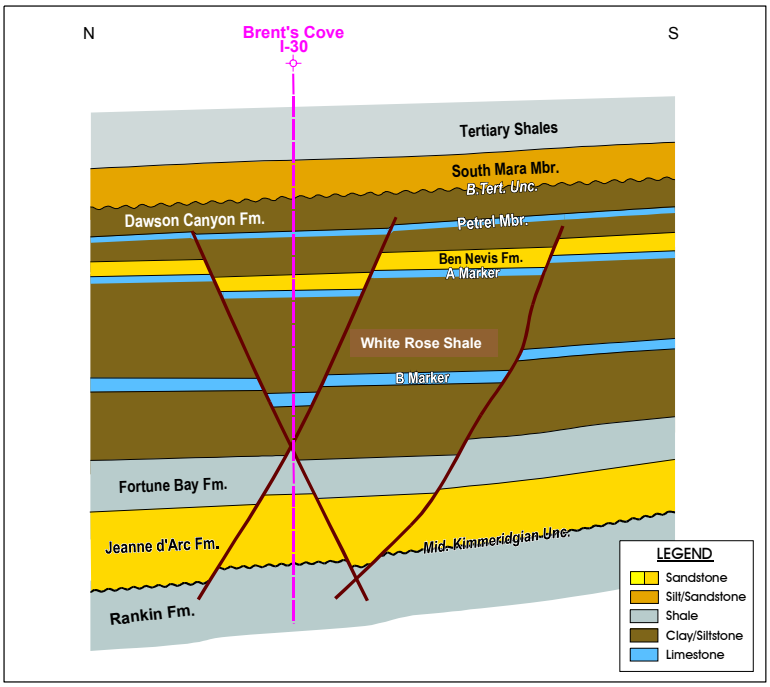


Figure 21. Geological cross-section showing the play drilled by the Brent's Cove I-30 well (after Enachescu et al., 2001) a small horst within the Jeanne d'Arc Formation where a large stratigraphic trapping component was expected.

Several other wells, just outside the parcel, have chased the Kimmeridgian valley-fill play. King's Cove A-26 (TD 3092) encountered hydrocarbons in sandstones of the Jeanne d'Arc Formation. Two other wells located just outside the parcel, Port au Port J-97 (TD 2700m) and Riverhead N-18 (TD 2626m), 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.

The seismic line A-A' (Figure 20 and 22) crosses the area from the eastern flank of the Egret diapir to the Hebron field area. The axial plane of the basin is densely faulted. Numerous fault blocks with trapping potential in Avalon/Ben Nevis, Hibernia and Jeanne d'Arc formation are interpreted on the seismic data. Immediately to the east of the parcel oil was found at multiple levels (including the Jeanne d'Arc sandstones) in the fault blocks forming the Hebron field. Additionally, there is secondary potential in sandstone members of the Dawson Canyon and Banquereau formations.

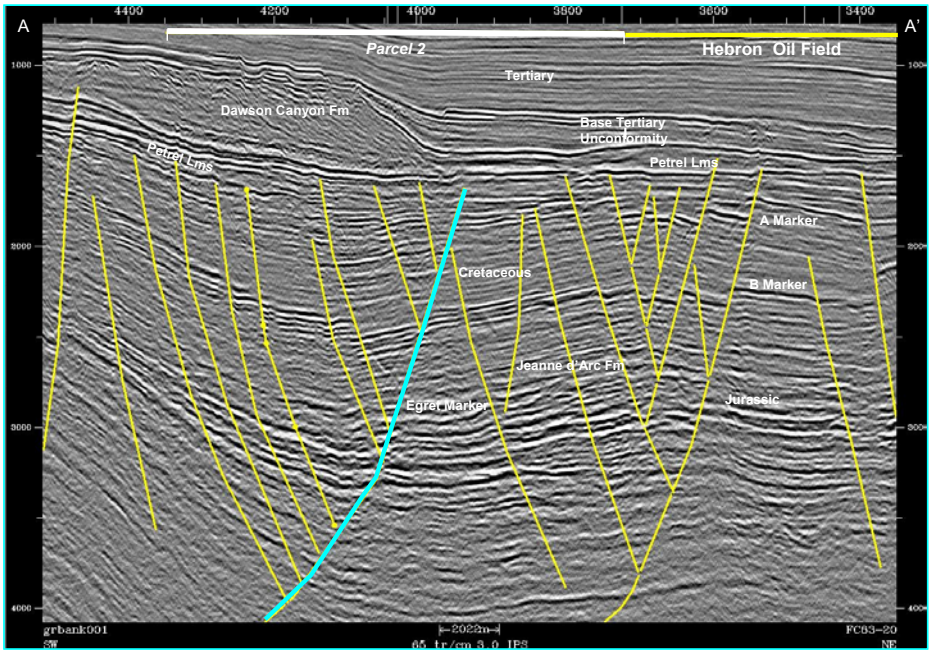


Figure 22. SW-NE 2D seismic line A-A'(courtesy of GSI) through Parcel 2 and environs showing the structure, stratigraphy and play types present in the area. The parcel is located in a highly faulted area extending between the Egret Salt Wall and the Hebron Ben Nevis field.

The regional seismic line B-B' (Figures 20 and 23) crosses the area from the Riverhead N-18 well to the approximate Hebron field area. In the south, the line shows shallow Late Jurassic paleo-valley incisions. To the north, the line illustrates the regional plunge of the Jurassic sequence and the significant drop across the Trinity Fault. The line also crosses the Brent's Cove I-30 location. This exploration well is also shown on a 3D seismic amplitude map covering a portion of this parcel (Figures 24 and 25). This map demonstrates that the complexity of the Kimmeridgian paleo-drainage system can be adequately mapped using modern 3D seismic.

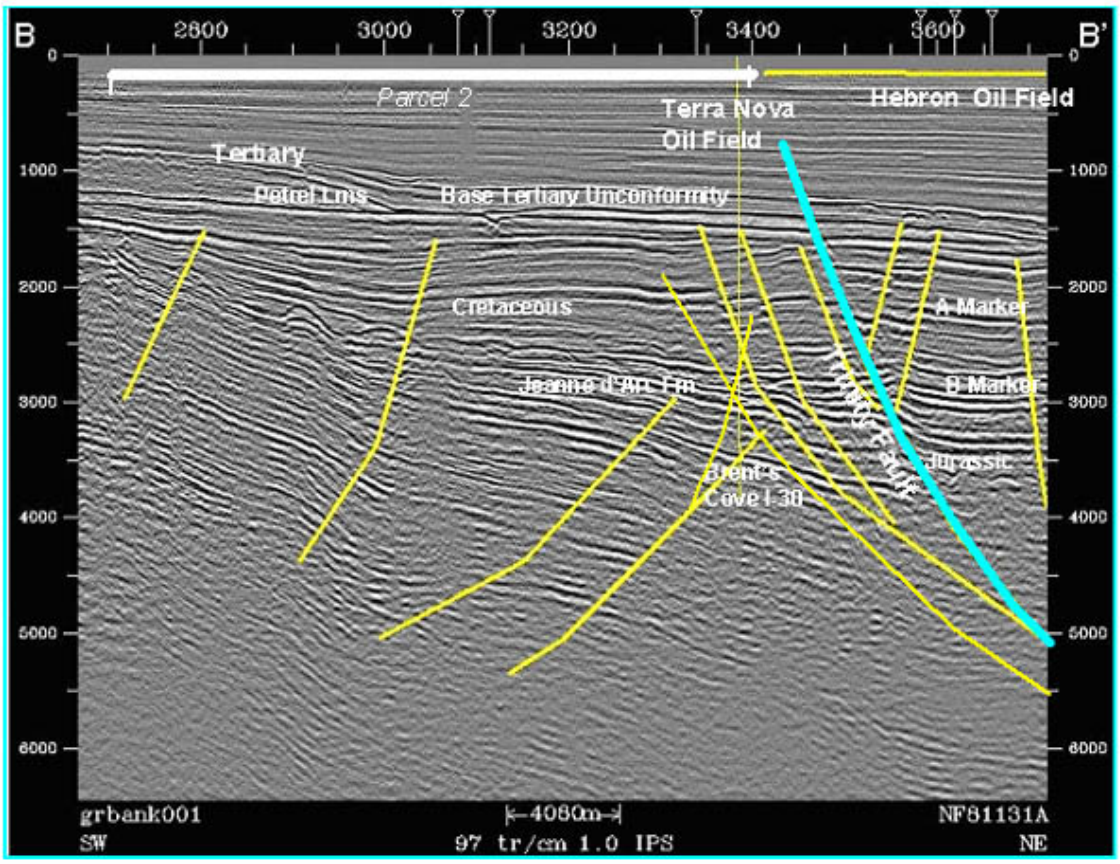


Figure 23. SW-NE regional 2D seismic line B-B' (courtesy of GSI) through Parcel 2 and environs illustrating the structure, stratigraphy and play types present in the area. The line shows the basin deepening toward the northeast and the location of the Brent's Cove line in a small horst block.

The amplitude map (Figure 24) shows the extension of the Riverhead drainage system east of the King's Cove Fault and a possible east-west trending highstand shore line, north of which Jeanne d'Arc sandstone pulses terminate with a marginal marine episode (Enachescu et al., 1993 and 1997).

The Riverhead N- 18 well has unsuccessfully tested one of the largest incised-valleys in the area. The play is illustrated in Figure 25. Seismic data indicates that similar prospects to the one tested by Riverhead 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 2500m).

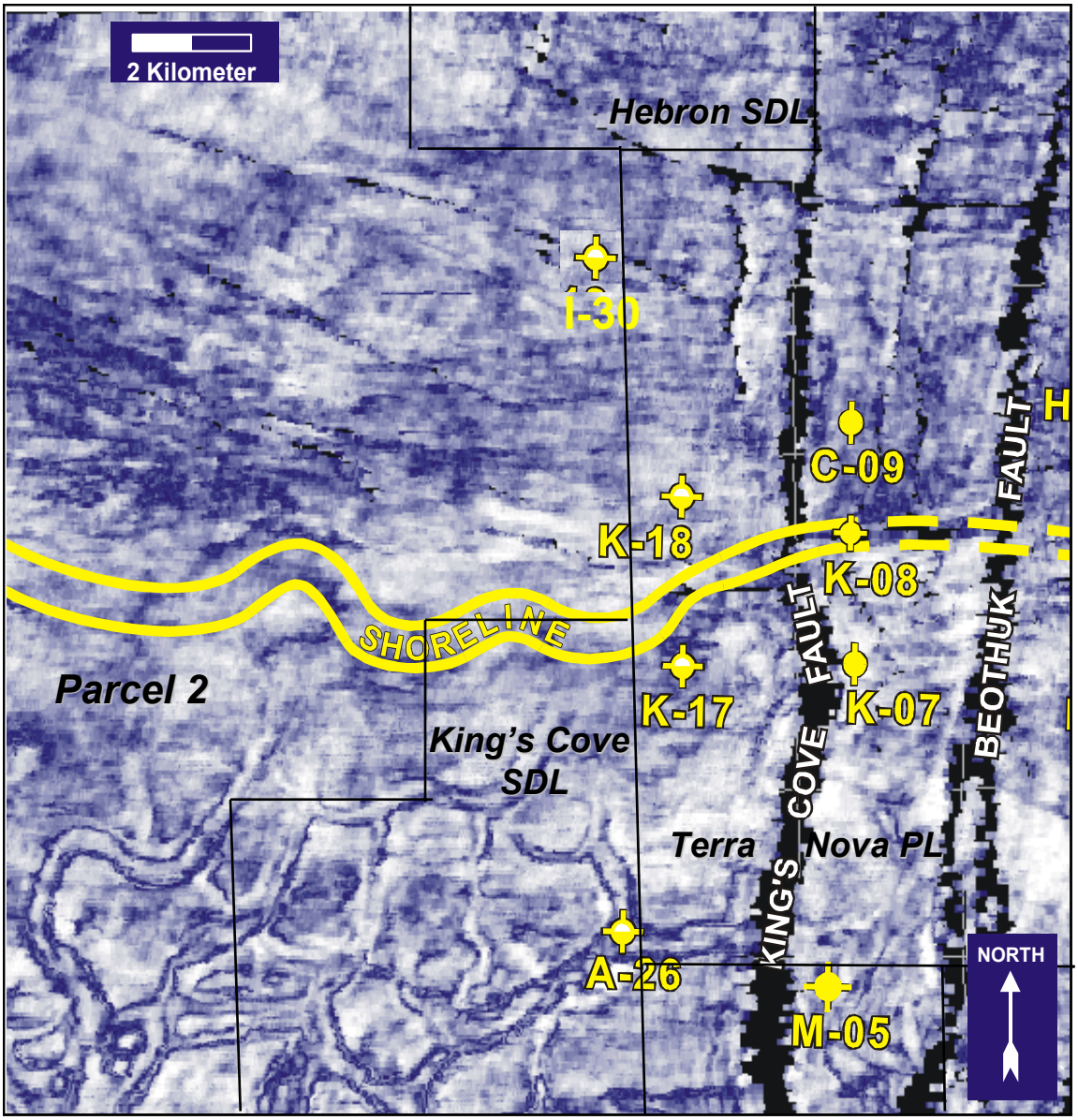


Figure 24. Seismic 3D Amplitude map of the Kimmeridgian Unconformity showing incised paleo-drainage system (cca155Ma) over the northern portion of Parcel 1 and covering parts of the Terra Nova PL and King's Cove and Beothuk SDLs (after Enachescu, 1993). The paleodrainage system develops to the south where spectacular paleo-valleys can be mapped with the available 3D data base. Paleo-valleys are filled with Jeanne d'Arc formation sandstone and shale.

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 (Terra Nova DPA and http://www.cnlopb.nl.ca/publicat/other/d02_01/d02_01e.pdf).

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.

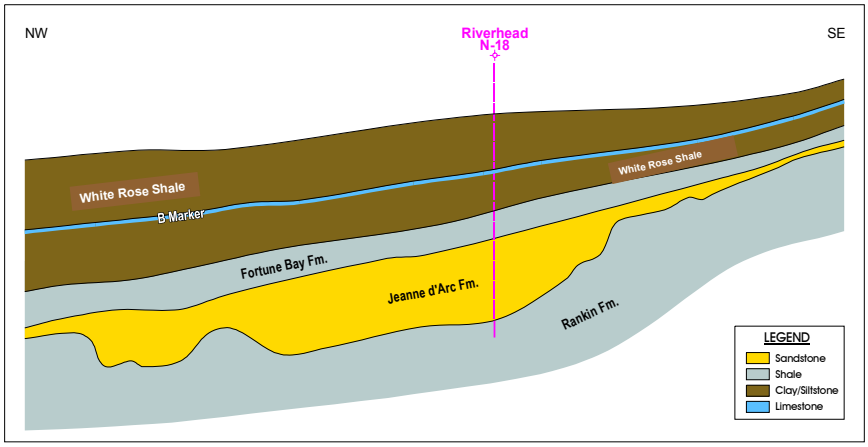


Figure 25. Geological cross-section showing the play drilled by the Riverhead N-18 well (after Enachescu et al., 2001): a large Kimmeridgian paleo-valley filled with Jeanne d'Arc Formation sandstones.

Modern 2D seismic on the parcel is available from both GSI and TGS Nopec. Older reprocessed data is also available from several seismic vendors. A 3D seismic survey (Riverhead 1998) financed by a consortium of oil companies is also available from the owners (Petro-Canada et al.) (Hogg and Enachescu, 2001; McIntyre et al., 2004).

Parcel 3

This small size parcel occupies an area of 2,130 hectares (5,263 acres) located just north of the Terra Nova PL and is surrounded by several SDLs including Springdale, the Far East Block of the Terra Nova field, West Bonne Bay, and Hebron-Ben Nevis (Figure 26). The North Trinity H-71 well (TD 4758m), located just outside the parcel, was drilled for the Jeanne d'Arc sandstones, but found only oil shows.

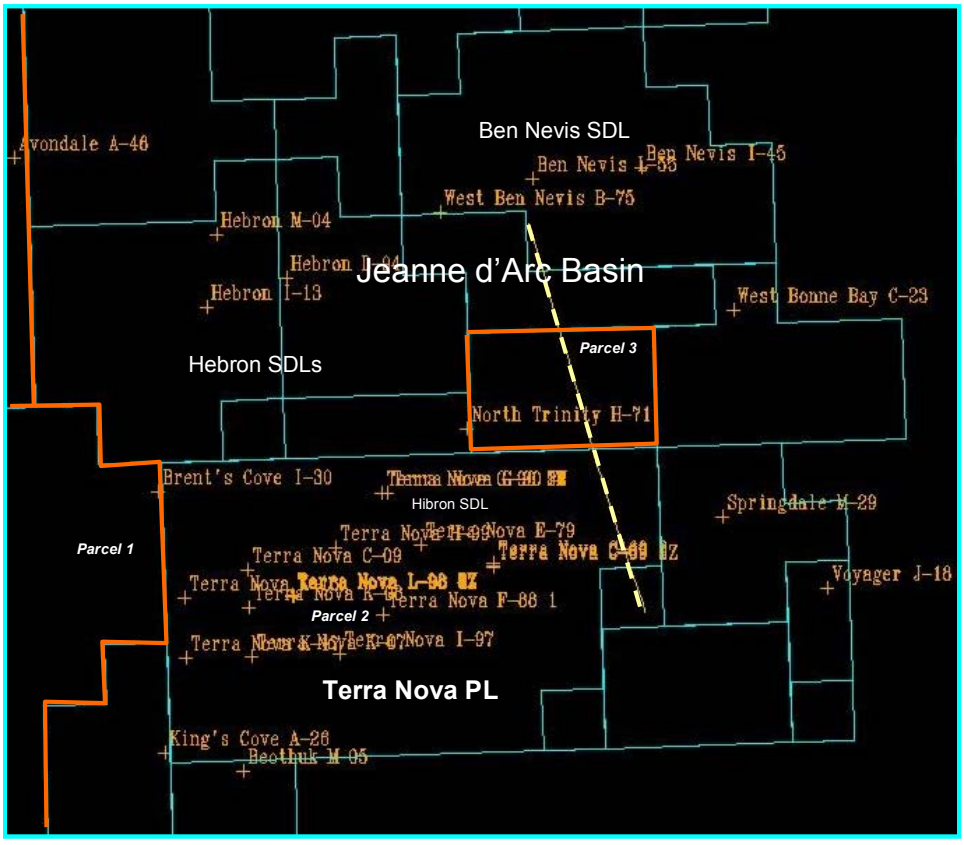


Figure 26. Location of Parcels 3 within the east-central Jeanne d'Arc Basin shown in red line. A 2D seismic lines is used to illustrate the petroleum geology of this parcel. The parcel is surrounded by the Terra Nova PL and several SDLs shown in blue line.

The parcel is located on the downthrown side of the Trinity Fault (Enachescu et al., 1993 and 1997 and Terra Nova DPA) and contains several fault bounded blocks with potential for reservoir within the Jeanne d'Arc, Hibernia and Avalon/Ben Nevis sandstones (Figure 27). The Jeanne d'Arc sandstone is the reservoir sandstone in the Terra Nova field and has tested in excess of 40,000 bopd from individual zones and is located in the up-thrown side of the Trinity Fault. Also the Hibernia and Avalon/Ben Nevis sandstones are high quality reservoirs in the surrounding Hebron and Ben Nevis SDLs. These reservoirs should be sealed by intra-formational seals and by thick overlying shales of the Fortune Bay, White Rose, Nautilus and Dawson Canyon formations.

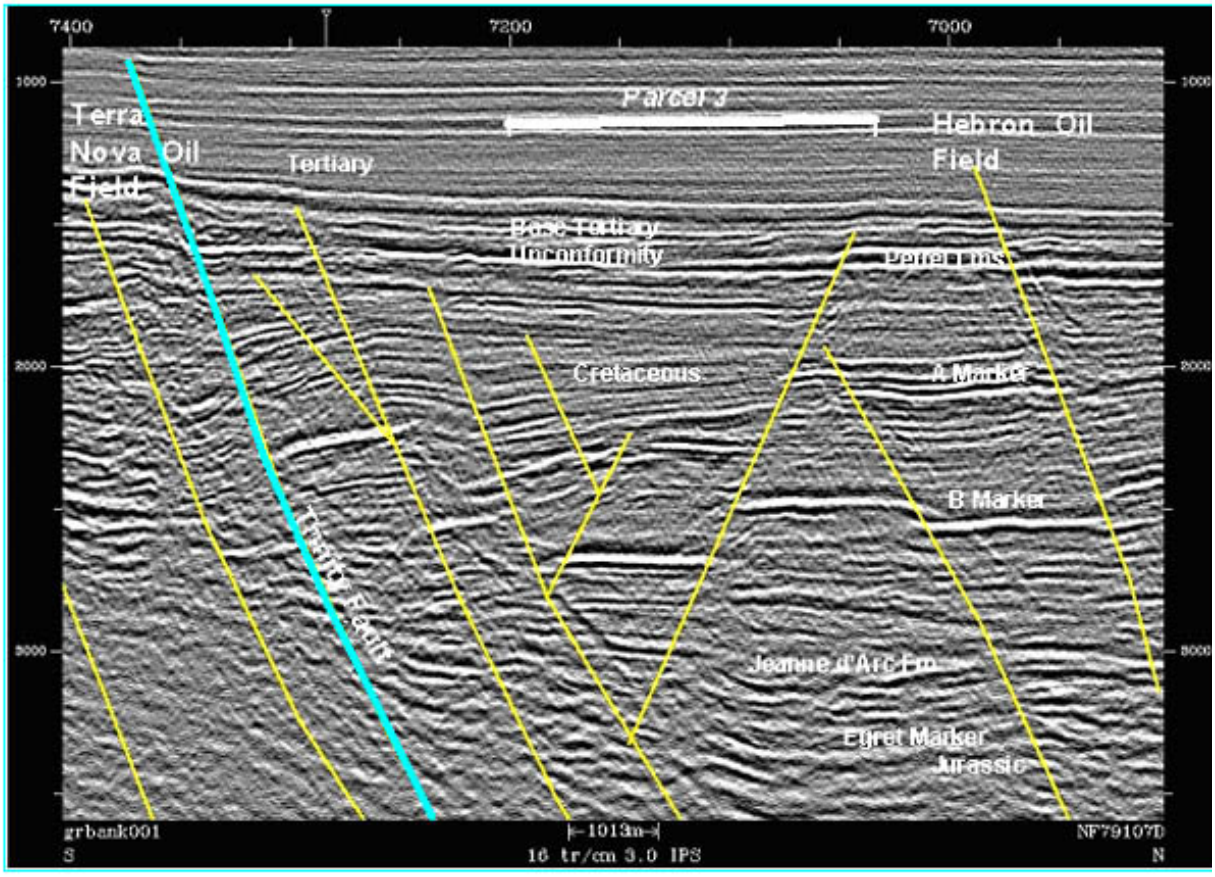


Figure 27. S-N 2D seismic line (courtesy of GSI) through Parcel 3 and environs illustrating the structure, stratigraphy and play types present in the area. The line shows the basin significantly dropping toward the north across the Trinity Fault and its imbricates. A horst and graben pair occupies most of this parcel's area. A similar play was successfully drilled at the neighbouring W. Bonne Bay structure (see also Figure 28).

Figure 28 illustrates the geological setting to the West Bonne Bay discovery which has structural and stratigraphic similarities with the geology of the Parcel 3 (Figure 27). Sealing across fault is the risk factor for this play. Both 2D and 3D seismic data should be available from seismic vendors (GSI and TGS NOPEC) 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.

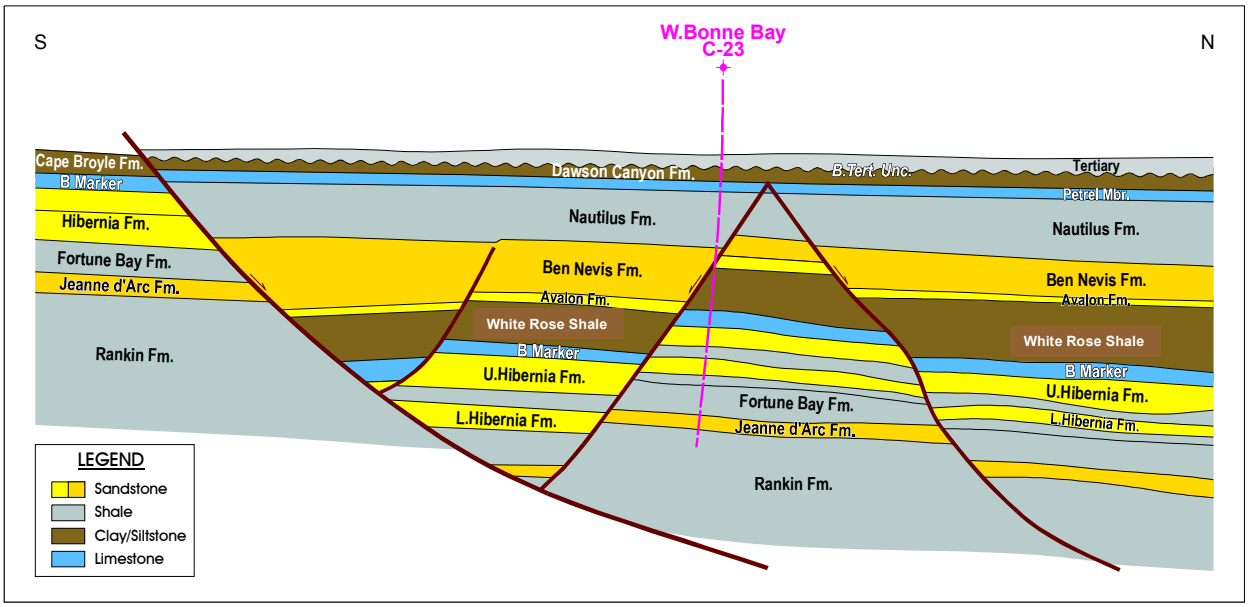


Figure 28. Geological cross-section showing the play drilled by the W. Bonne Bay C-23 well (after Enachescu et al., 2001): a large horst block with multiple plays in the Jeanne d'Arc, Hibernia and Avalon/Ben Nevis sandstones.

Discussion

The size of the parcels in Call for Bids NL05-01 is rather modest by comparison to other Grand Banks offerings but this is a reflection of the lands being located within the heart of a key discovery area. All three parcels are located in areas with excellent reservoirs, mature source rocks and proven migration paths.

Numerous leads and prospects in the south-central Jeanne d'Arc Basin including some mapped on the bid parcels have previously been considered too small to drill, or to present too great a trap/seal risk. New mapping with modern data may lower the geological risk, and proximity to existing infrastructure in a high price environment most certainly lowers the economic risk. This is a scenario in which smaller fields with thinner reservoirs can become attractive and entice companies to include such features in their exploration plans.

The three parcels contain multiple reservoir targets within the proven Avalon/Ben Nevis, Hibernia, Jeanne d'Arc sandstones reservoirs. Additionally, secondary quality reservoirs have been identified in post-rift successions. These multiple target zones can be tested by drilling relatively shallow wells (2500-3500m). The geological risk 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.

Parcel 1 has significant potential for multiple plays and for finding satellite pools of the Hebron or Mara fields. 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 covered by 3D data. It also has greater upside potential because it may contain large structural-stratigraphic prospects. Parcel 2 is situated in a part of the fairway of the Jeanne d'Arc basin drainage system 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 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 is an example of the size of accumulation that can be encountered with an effective up-dip seal in this area.

Numerous 3D seismic amplitude or other attribute anomalies are observed on the parcels and may indicate hydrocarbons in reservoirs or lateral changes associated with porosity development. Systematic mapping and post-stack analysis of seismic attributes may further reduce the geological risks associated with reservoir and trap integrity. Sub-unconformity (Base Tertiary, Cenomanian, Avalon Unconformities) traps also remain to be tested in the area.

Conclusions

The three Jeanne d'Arc Basin parcels are well situated just west and north of the Terra Nova field and west of Hebron-Ben Nevis oil fields and are surrounded by other smaller discoveries, as well as several shows.

The main potential petroleum plays in the parcels are Jeanne'Arc, Hibernia and Avalon/Ben Nevis sandstones trapped in fault blocks. The Jeanne'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-central 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 recoginized 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 ones portfolio in a proven basin. While no big structural traps have been 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. Nevertheless the attractiveness of these parcels is considerably enhanced by the potential for development by subsea tie-back to the nearby Terra Nova FPSO – or to whatever system is eventually put in place at Hebron-Ben Nevis.

Acknowledgements
John Hogg (Encana), Steve Kearsey (MUN), Paul and Davey Einarsson, GSI for seismic data donation, Dave Hawkins (C-NLOPB), Ian Atkinson (MUN), Jim Wright, Sam Nader, C-NLOPB, Husky Energy, Petro-Canada, Pan-Atlantic Petroleum Systems Consortium (PPSC), Memorial University, Larry Hicks and Leona Stead, Department of Natural Resources, Government of Newfoundland and Labrador and Landmark Graphics.

Further Reading

Balkwill, H R, 1987. Labrador Basin: Structural and stratigraphic style in Sedimentary Basins and Basin-forming Mechanisms, C. Beaumont and A.J. Tankard (eds), Atlantic Geoscience Soc Sp Pub 5, and Can Soc Petrol Geol Mem 12, 1987, p 17-43

Balkwill, H.R. and F.D. Legall, 1989. Whale Basin, Offshore Newfoundland: Extension and Salt Diapirism, *in* Extensional Tectonics and Stratigraphy of the North Atlantic Margins, Tankard A.J., and Balkwill, H.R. (eds.). American Association of Petroleum Geologists, Memoir 46, pp. 233-246.

C-NLOPB, Schedule of Wells, Newfoundland & Labrador offshore areas - March 2005

Deptuck, M.E., MacRae, R.A., Shimeld, J.W. Williams, G.L. and R.A. Fensome, 2003. Revised Upper Cretaceous and lower Paleogene lithostratigraphy and depositional history of the Jeanne d'Arc Basin, offshore Newfoundland, Canada, AAPG Bulletin v. 87, p. 1459-1483.

Enachescu, M.E., 1987. Tectonic and structural framework of the Northeast Newfoundland continental margin, Sedimentary basins and basin-forming mechanisms, (Eds.) Beaumont, C. and A. J. Tankard,., Basins of Eastern Canada and worldwide analogues, Canadian Society of Petroleum Geologists Memoir 12, Atlantic Geoscience Society Special Publication, vol. 5, p. 117-146.

Enachescu, M.E., 1988. Extended basement beneath the intracratonic rifted basins of the, Grand Banks of Newfoundland, Journal of the Canadian Society of Exploration Geophysicists, vol. 24, no. 1, p. 48-65.

Enachescu, M. E., 1993. Amplitude interpretation of 3-D reflection data, Geophysics: The Leading Edge of Exploration, vol. 12, no. 6, p. 678-685.

Enachescu, M.E., Harding, S.C. and D.J. Emery, 1994. Three-dimensional seismic imaging of a Jurassic paleodrainage, system, Geology, earth sciences and environmental factors; Proceedings of the 1994 Offshore Technology Conference, Houston, TX, vol. 26, Vol. 1, p. 179-191.

Enachescu, M. and G. Dunning, 1994. Grand Banks Basin, Canada, Basin Monitor. Report, 85 p., 16 figures, published by PetroConsultants, Geneva, Switzerland (now IHS).

Enachescu, M.E., Harding, S.C., Smee, G.R., Briscoe, R.G., Emery, D.J., Hallstrom, S. K., 1997. Structural, tectonic and seismo-stratigraphic study of the Terra Nova oil field, Jeanne d'Arc Basin, offshore Newfoundland. Geological Association of Canada, Newfoundland Section; 1997 Annual Technical Meeting; Saint John's, NF, Atlantic Geology, vol. 33, no. 2, p. 170-171.

Enachescu, M.E., Smee, G.W., Negut, D.D., Skuce, A., Cilensek, S., Mewhort, L.E., Hedlin, K.J., Emery, D.J., Hale, C.A, 1998. Structural and stratigraphic resolution of marine 3-D seismic data, Jeanne d'Arc Basin offshore Newfoundland, First Joint Convention of the CSPG, CSEG and the CWLS, Geo-Triad '98, Calgary, AB, Canada, p. 383-386.

Enachescu, M.E., Hodder J., Emery D., Ghanem M and B.Wrathall, 2001. Grand Banks 2001: Exploration and Production Update. CIM Conference, St Johns, NL.

Enachescu, M.E., 2004a. Atlantic Canada: An emerging energy powerhouse. Atlantic Business Magazine, Volume 15, No 2, p. 12-19.

Enachescu, M.E., 2004b. Doing business in the Atlantic offshore: Essential information every explorer needs to know. Atlantic Business Magazine, Volume15, No 4, p.12-22

Enachescu, M.E., Hogg, J.R. and K.E. Meyer, 2004a. Orphan Basin, Offshore Newfoundland, Canada: structural and tectonic framework, petroleum system and exploration potential, CSEG Annual Meeting, Calgary, Expanded Abstract 4p.

Enachescu, M., Kearsey, S., Hogg J, Einarsson P., Nader, S. and J. Smee, 2004b. Orphan Basin, Offshore Newfoundland, Canada: Structural and Tectonic framework, Petroleum System and Exploration Potential. Expanded Abstract, 74 Annual Meeting and Exposition, Denver, Colorado.

Enachescu, M. and Fagan, P., 2004. Newfoundland and Labrador Call for Bids NF04-01, Government of Newfoundland and Labrador, Department of Natural Resources, 35p, 20 fig.; also available at http://www.gov.nl.ca/mines&en/oil/call_for_bids_nf04_01.stm

Enachescu M E., 2005a. Offshore Newfoundland and Labrador: An Emerging Energy Powerhouse. Offshore Technology Conference Paper #17570, Houston, Tx, 8p., 13 figures.

Enachescu, M., 2005b. A story of stranded gas. Hopedale Basin, offshore Labrador: its geologic evaluation and petroleum potential, Atlantic Business Magazine, v. 16, no. 3, p. 18-22 and website http://www.atlanticbusinessmagazine.com/inserts/NRfinal-07-2005.pdf

Enachescu M. and P. Fagan, 2005. Newfoundland's Grand Banks presents untested oil and gas potential in eastern North America, Oil and Gas Journal, February 14, vol. 103.6, p. 32-39.

Enachescu, M., Fagan, P and J. Smee, 2005. Orphan Basin, offshore Newfoundland: current and future oil and gas exploration opportunities, Oil and Gas Journal, August, in press

Enachescu, M.E. and J.R. Hogg, 2005. Exploring for Atlantic Canada's next giant petroleum discovery. CSEG Recorder, v. 30, no. 5. p.19-30.

Atkinson, I. and Fagan, P., 2000. Sedimentary Basins and hydrocarbon potential of Newfoundland and Labrador, Government of Newfoundland and Labrador Report 2000-01, also available at http://www.gov.nl.ca/mines&en/oil

Foster, D.J. and Robinson, A.G., 1993. Geological History of the Flemish Pass Basin, Offshore Newfoundland", Bulletin of the American Association of Petroleum Geologists, v.77, p. 588-609.

Geological Survey of Canada (GSC) Atlantic, East Coast Basin Atlas Series, Grand Banks of Newfoundland Basin Atlas available on the website http://gsca.nrcan.gc.ca/pubprod/atlas/grandbank_e.php

Grant, A.C., and, K.D., McAlpine1990. The continental margin around Newfoundland. In: M.J. Keen and G.L. Williams (Eds.). Geology of the Continental Margin of Eastern Canada. Geological Survey of Canada, Geology of Canada 2, 239-292.

Hardy, V. and M. Enachescu, 2005. The Quest for a Younger Petroleum System: Are There Any Cretaceous Source and Reservoir Rocks in the Orphan Basin, offshore Newfoundland? Abstract CSPG/ GAC-MAC Conference Halifax 2005.

Hogg, J.R. and M.E. Enachescu, 2001. Frontier Exploration: Yesterday, Today, Tomorrow. CSPG Luncheon Presentation, Calgary Convention Center, also available as webcast.

Hogg, J. R. and M. E. Enachescu, 2003. An Overview of the Grand Banks and Scotian Basins Development and Exploration, Offshore Canada, AAPG International Meeting Barcelona, Spain

Hogg, J. R. and M. E. Enachescu, 2004. Deepwater Mesozoic and Tertiary Depositional Systems Offshore Nova Scotia and Newfoundland, Atlantic Canada, Deep-Water Sedimentary Systems of Arctic and North Atlantic Margins Conference, Abstract and Presentation, Stavanger, Norway.

Kearsey, S. J., and M. E. Enachescu, 2005. Orphan Basin: Integrated Geophysical Study and implications for conjugate margin exploration, 67th EAGE Conference and Exhibition, Expanded Abstracts, E012.

Koning, T., Campbell, R.H., Hibbs, D.C., and G.W. Leonhardt, 1988. An Exploration case study of a world record deepwater wildcat well drilled in the Orphan Basin, Newfoundland: Blue H-28, *in* Offshore Technology Conference, 395-406.

McAlpine, K.D., 1990. Mesozoic stratigraphy, sedimentary evolution, and petroleum potential of the Jeanne d'Arc Basin, Grand Banks of Newfoundland. Geological Survey of Canada Paper 89-17. 50p.

McCracken, J. N., Haager, A., Sounders, K.I., and B. W. Veilleux, 2000. Late Jurassic source rocks in the northern Flemish Pass basin, Grand Banks of Newfoundland. CSEG Conference, Abstract.

McIntyre, J., DeSilva, N. and T. Thompson, 2004. Mapping of key geological markers in the Jeanne d'Arc Basin based on 3D seismic, CSPG Convention Abstract and Poster.

McWhae, J.R.H., Elie, R., Laughton, K.C., P.R. Gunther, 1980. Stratigraphy and Petroleum Prospects of the Labrador Shelf. Bulletin of Canadian Petroleum Geology, v. 28, no. 4. p. 460-488.

Meneley, R.A., 2003. Exploration History of Frontier Basins in Canada - Ignore It At Your Peril. Abstract and presentation, CSPG/CSEG Convention.

Power, B. 2005. Hebron Challenges and Opportunities, Ocean Resources, v. 23, no. 3, p. 6-7.

Sinclair, I.K., 1988. Evolution of Mesozoic-Cenozoic sedimentary basins in the Grand Banks area of Newfoundland and comparison with Falvey's (1974) rift model; Bulletin of Canadian Petroleum Geology, 36, 255-273.

Sinclair, I.K., 1994. Tectonism and Sedimentation in the Jeanne d'Arc Basin, Grand Banks Newfoundland, Ph.D. Thesis, University of Aberdeen.

Smee, J., Nader S., Einarsson, P., Hached, R. and M. Enachescu, 2003. Orphan Basin, Offshore Newfoundland: New seismic data and hydrocarbon plays for a dormant Frontier Basin. Extended Abstract, CSPG/ CSEG Convention.

Smee, J., 2003. Hydrocarbon Potential of Parcels 1-12, C-NOPB call for bids NL 03-1, Orphan Basin Offshore Newfoundland, prepared by G & G Exploration Consulting Limited.

Tankard, A.J. and H.J. Welsink, 1987. Extensional tectonics and stratigraphy of Hibernia oilfield, Grand Banks, Newfoundland. Bulletin of AAPG, 71, 1210-1232.

Tankard, A.J. and H.J. Welsink, 1989. Mesozoic extension and styles of basin formation in Atlantic Canada, *in* Extensional Tectonics and Stratigraphy of the North Atlantic Margins, edited by A.J. Tankard and H.R. Balkwill, AAPG Memoir 46, 175 - 196.

Wade, J.A. and B.C. MacLean, 1990. The geology of the southeastern margin of Canada, Chapter 5 in Geology of the Continental Margin of Eastern Canada, M.J. Keen and G.L. Williams (ed.); Geological Survey of Canada