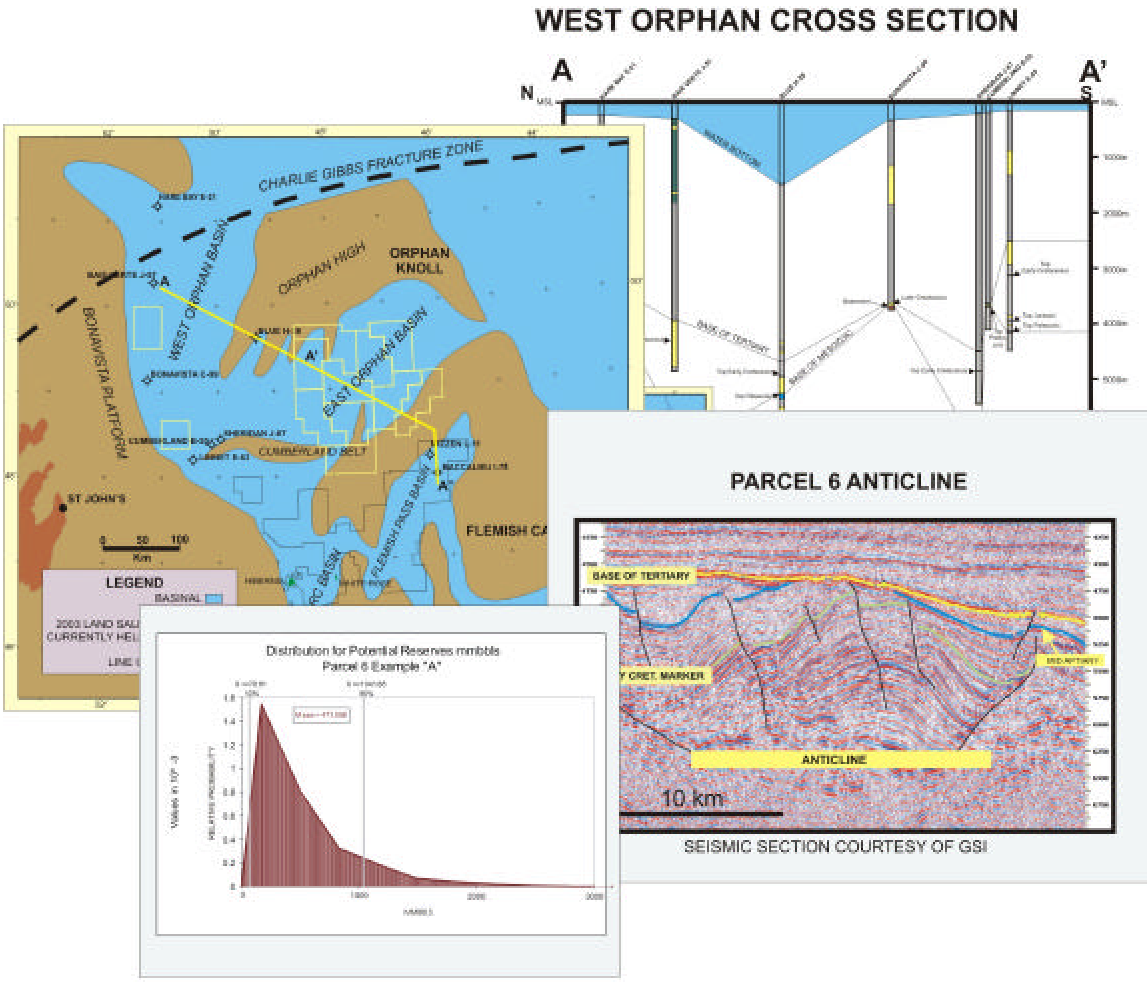
HYDROCARBON POTENTIAL OF PARCELS 1 - 12, C-NOPB CALL FOR BIDS NF 03-1 DECEMBER 17, 2003

ORPHAN BASIN OFFSHORE NEWFOUNDLAND



REPORT PREPARED FOR
DEPARTMENT OF MINES AND ENERGY
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
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G&G
EXPLORATION
CONSULTING LTD.

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ORPHAN BASIN
OFFSHORE NEWFOUNDLAND

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Foreword

Twenty-three oil and gas discoveries have been made so far in the Newfoundland and Labrador offshore area on the basis of 132 exploration wells. Discovered resources are estimated by the Canada-Newfoundland Offshore Petroleum Board (C-NOPB) at 2.1 billion barrels of oil, 10 trillion cubic feet of natural gas and 450 million barrels of natural gas liquids. Eighteen of the twenty-three discoveries are located within and around the Jeanne d'Arc Basin on the Grand Banks (Figure 1 in the main body of the report) and five are located offshore Labrador. At the time of writing approximately 360,000 barrels of oil per day are being produced from two fields on the Grand Banks (Hibernia and Terra Nova) and a third field (White Rose) is under development and will provide an additional 100,000 bopd in mid 2005.

Since the first large oil discovery on the Grand Banks in 1979, exploration in the Newfoundland and Labrador offshore has been mainly focused on the discovery area (the Jeanne d'Arc Basin and the adjacent Ridge complex), with very little attention going to the several other large Mesozoic and Paleozoic basins in the area. In recent years the industry has begun to revisit some of these lesser-explored basins through the acquisition of seismic data and licensing of lands. The Orphan Basin is one such basin, and is the subject of this report.

Between 1974 and 1985, seven wells were drilled in the Orphan basin by various operators, that did not result in any petroleum discoveries but did confirm the presence of Tertiary, Upper Cretaceous, Lower Cretaceous and, very likely, Jurassic sediments in the basin. Given its very large size (> 150,000 square km) and low well density (one well per 21,400 square km) this basin is an obvious candidate for reassessment and a renewed exploration effort, with the benefit of modern exploration technologies and geological theories.

This report has been prepared by Jerry Smee of G&G Exploration Consulting of Calgary Alberta, under contract to the Department of Mines and Energy to provide information on twelve land parcels in the Orphan Basin that are being offered in the Canada-Newfoundland Offshore Petroleum Board's Call For Bids NF-03-1 which closes on December 17, 2003.

The report discusses the general geology of the Orphan Basin and provides specific information on the twelve parcels (totaling 2,989,160 hectares) being offered in Call for Bids NF-03-1. Two additional bid parcels (totaling 178,285 hectares), located in the north Flemish Pass Basin, were not included in this study.

The term "Orphan Basin" is used here as an inclusive term for what has been referred to as the East Newfoundland - Orphan Basin by some other authors.

Detailed information on the Call for Bids NF-03-01 can be found on the C-NOPB's website: http://www.cnopb.nfnet.com/.

Executive Summary

General Geology and Reservoir Potential

The Orphan Basin is the largest basin mapped thus far, offshore Newfoundland and Labrador, encompassing an area of more than 150,000 square kilometres. Water depths in the basin range from about 200 metres in the western side to 3000 metres in the eastern side of the basin (Fig. E1). Seismic data indicates the presence of a thick Tertiary and Mesozoic sequence, underlain locally by Paleozoic sequences. The seven wells drilled in the basin were located on top of, and near the tops of, large structural highs, which generally proved to be basement blocks with thin Mesozoic cover.

The best potential for discoveries is clearly within Mesozoic and Early Tertiary sections. Good reservoir quality sands were encountered in the Upper Cretaceous section at *Linnet E-63* and *Bonavista C-99*, and within the Lower Cretaceous section at *Blue H-28*. No good Lower Tertiary reservoirs were encountered in the wells but the seismic data shows frequent examples of Lower Tertiary events, (with associated amplitude anomalies) onlapping the large ridge structures that dominate the basin (Fig. 5), suggesting that marginal marine conditions would have existed around these ridges during the Lower Tertiary.

ORPHAN BASIN

Figure E1

Paleozoic sediments (encountered at the base of four of the seven wells) range in age from Permo-Carboniferous to Ordovician and are, for the most part, considered to be petroleum basement. The seismic character indicates these rocks to be highly structured within the Orphan Basin but relatively undisturbed on the Bonavista platform to the west. No high quality Paleozoic reservoirs were encountered in the Orphan Basin wells and they are described as "metasediments" in some cases, and most likely to be over mature as potential source rocks. Nevertheless, the Paleozoic rocks located in western Newfoundland are observed to contain good oil and gas source rocks and reservoirs in outcrop, so they cannot be entirely discounted. Paleozoic carbonates have also flow tested gas at respectable rates offshore Labrador (e.g. 19 mmcf/d at *Hopedale E-33*). The Paleozoic sandstones contained in emergent blocks could also have provided an excellent provenance for reservoir quality sandstones during the Jurassic and Cretaceous.

Source Rock

The key source rock that has been recognized on the Grand Banks is the Kimmeridgian aged Egret member, which has sourced the major oil and gas discoveries of the Jeanne d'Arc Basin and is also proven to be widespread in the Flemish Pass Basin. Although this formation has not yet been penetrated in any of the seven Orphan Basin wells, it has been encountered in close proximity, in the northern part of the Flemish Pass Basin - in the *Baccalieu I-78* well. In this report the seismic data at *Baccalieu I-78* has been jump correlated to various parts of the Orphan Basin and strongly suggests that thick sequences of Jurassic and Cretaceous aged sediments are present between major ridges in the basin. Additional evidence for Jurassic sediments in the basin is the presence of reworked Jurassic fauna in the Lower Cretaceous section at *Blue H-28*, and the fact that a 200 metre section in the *Linnet E-63* well has been interpreted by Mobil as being of Oxfordian age. Direct evidence for the presence of Jurassic source rock comes from the close similarity in the chemistry of hydrocarbon shows in the *Sheridan J-87* and *Baie Verte J-57* wells, to that of the oils in the Jeanne d'Arc Basin fields. The presence of gas chimneys on seismic data (Fig. 18), also provides direct evidence for the presence of significant hydrocarbons in the Orphan Basin.

Although no mature source rock has been encountered in any of the seven wells in the Orphan Basin, good but immature oil prone shales with TOCs ranging from 1% to 7% have been encountered in Lower Tertiary and Upper Cretaceous sections in several of the wells. Lower Tertiary and Upper Cretaceous shales in *Sheridan J-87* were described by Bayliss (1982) as a moderately mature oil and associated gas source in which a moderate amount of immature napthenic oil, condensate and wet gas had been formed. Bayliss also concluded that deeper burial could render these shales as very good (and possibly prolific) oil and associated gas source facies.

The top of the oil window was determined by various analysts to range from 3100 metres to 5100 metres (Koning 1988). Given the thickness of the Tertiary section observed on seismic data, particularly in some of the shallow-water areas of the basin, these shales have a good probability of reaching full maturity. At *Blue H-28* the Oligocene and younger rocks contain primarily gas prone kerogens while the Eocene, Upper and Lower Cretaceous rocks contain higher percentages of oil generating kerogens (Koning 1988). Analysis by Dow (1979) concluded that the potential source beds within Lower Tertiary and Cretaceous at *Blue H-28* had been subjected to oxidation and would be severely diminished in their generative capacity. This conclusion "has not been recognized by all the Blue partners" (Koning 1988) but it was agreed that the zones with sufficient organic richness within the oil window are too thin for "effective" hydrocarbon generation. However, given that these beds may be thicker and un-oxidized in what would have been deeper parts of the basin during the Cretaceous and Lower Tertiary, they may still prove to be significant source rocks. The fact that the Upper Cretaceous Markland Shale is the source rock for the gas discoveries offshore Labrador (to the north) also gives credence to the possibility of Cretaceous source rocks in the Orphan Basin.

Assessment of Parcels

Based on the information presented above, a good case can be made for the presence of reservoir and source rock throughout the basin, particularly where the seismic data shows the presence of a thick Mesozoic section. With the assumption that these key factors are in place, preliminary resource assessments have been carried out for a number of very large structures located on the bid parcels. Areas of closure have been estimated from the GSI seismic data (and other released data on parcels 1 and 2) and thicknesses of sedimentary section under closure within the Lower Tertiary, Cretaceous and Jurassic sections have been estimated based on seismic character. This information has been used to generate probabilistic resource estimates for a number of these leads / prospects, the results of which are presented in Appendix "A". Although the preliminary nature of this analysis is readily acknowledged, the size and ultimate potential of the prospects and leads analyzed is very encouraging. Of fifteen structures analyzed, four had a mean potential in excess of one billion barrels recoverable, five had a mean potential of between 500 million barrels and one billion barrels recoverable, with the rest ranging from 128 million barrels recoverable to 470 million barrels.

Acknowledgments

This report has been made possible by the generous access to new high quality proprietary seismic data provided by Geophysical Services Incorporated (GS), of Calgary, to which the Department of Mines and Energy (DME) and Consultant are thankful. Paul Einarrson and Sam Nader of GSI are recognized for their support throughout the project. Jacob Raymond, also of GSI, is acknowledged for loading data, and providing maps that served as the basis for many of the illustrations, as well as facilitating electronic communication.

The project was coordinated by Phonse Fagan of DME who also edited the report. Dave Hawkins (DME) provided support throughout. Thanks are also extended to: Tim Thompson and Neil DeSilva of the C-NOPB who provided valuable input at the early stages of the project; to Trevor Bennett and Lewis Manuel of the C-NOPB who assisted in providing basemaps and seismic sections from the Board's files for use by the Department as well as well reports and well data for the Consultant; to Sheila Duff for patient assistance in the C-NOPB library; to Larry Hicks and Lisa Benson (DME), who assisted in editing, and in the initial review and assessment of seismic and well data; special thanks to Lisa Benson who created and modified many of the graphics and finalized the report design; to student Derek Simpson who assisted in preparation of graphics; to Terry Sears of the Mines Branch who helped solve some computers problems; and to the GSC who allowed use of a number of graphics from their East Coast Basin Atlas Series.

Iain Sinclair of Husky Energy and Jonathon Bujak, of Bujak-Mudge International Consultancy, are also recognized for allowing use of their illustrations.

Finally Dr. Michael Enachescu of Memorial University is thanked, not only for editing and reviewing portions of this report, but for initiating the idea for an Orphan Basin review.

HYDROCARBON POTENTIAL OF THE ORPHAN BASIN

OFFSHORE NEWFOUNDLAND

1. Introduction

The Orphan Basin (located off the coast of Newfoundland, some 370 km N.E. of St. John's) is estimated to comprise an area of over 150,000 sq. km (Fig. 1).

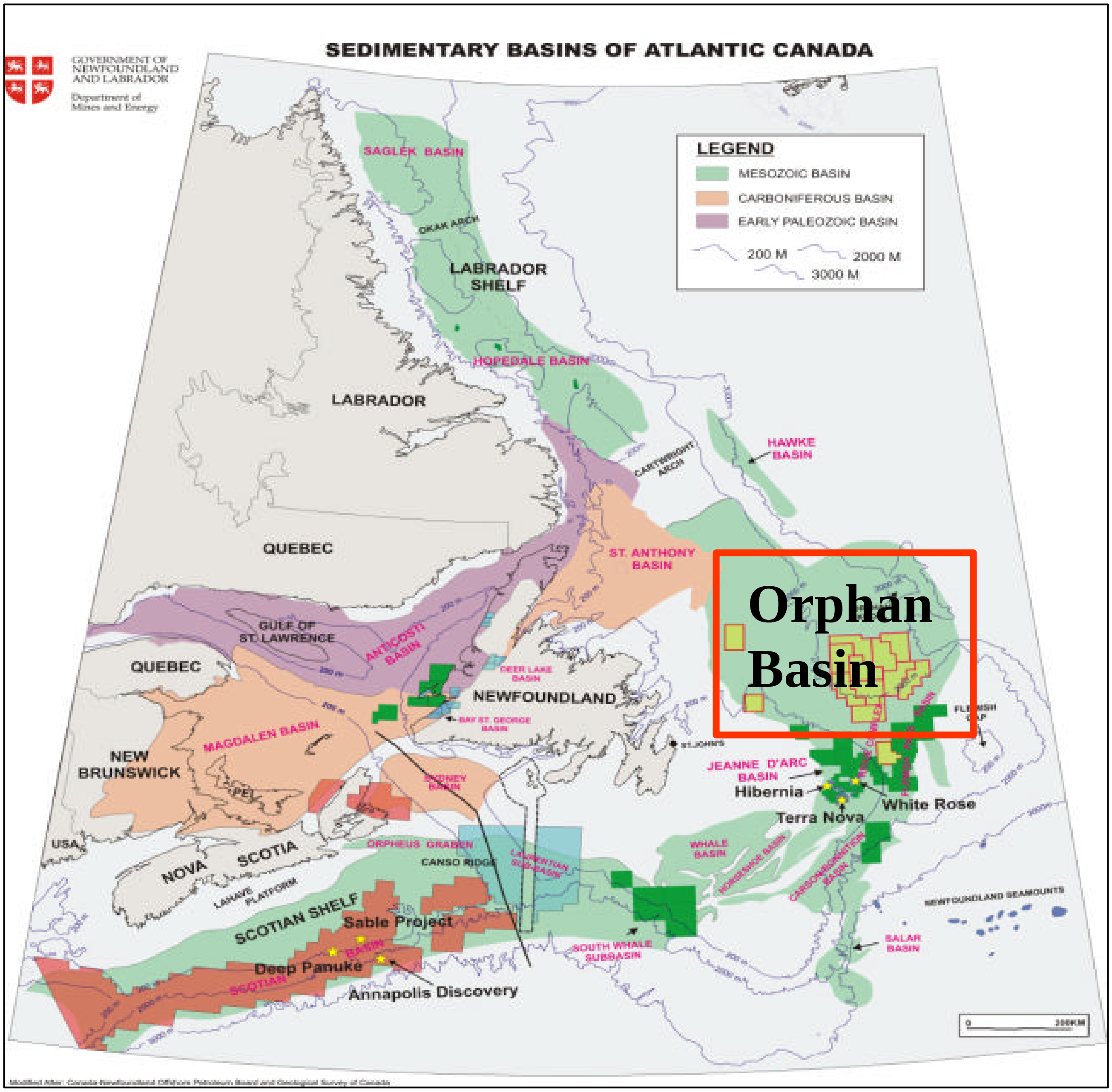


Figure 1
East Coast Basins and Land Holdings

Water depths range from 200 m in the west to over 3000 m in the eastern part of the basin (Fig. 2).

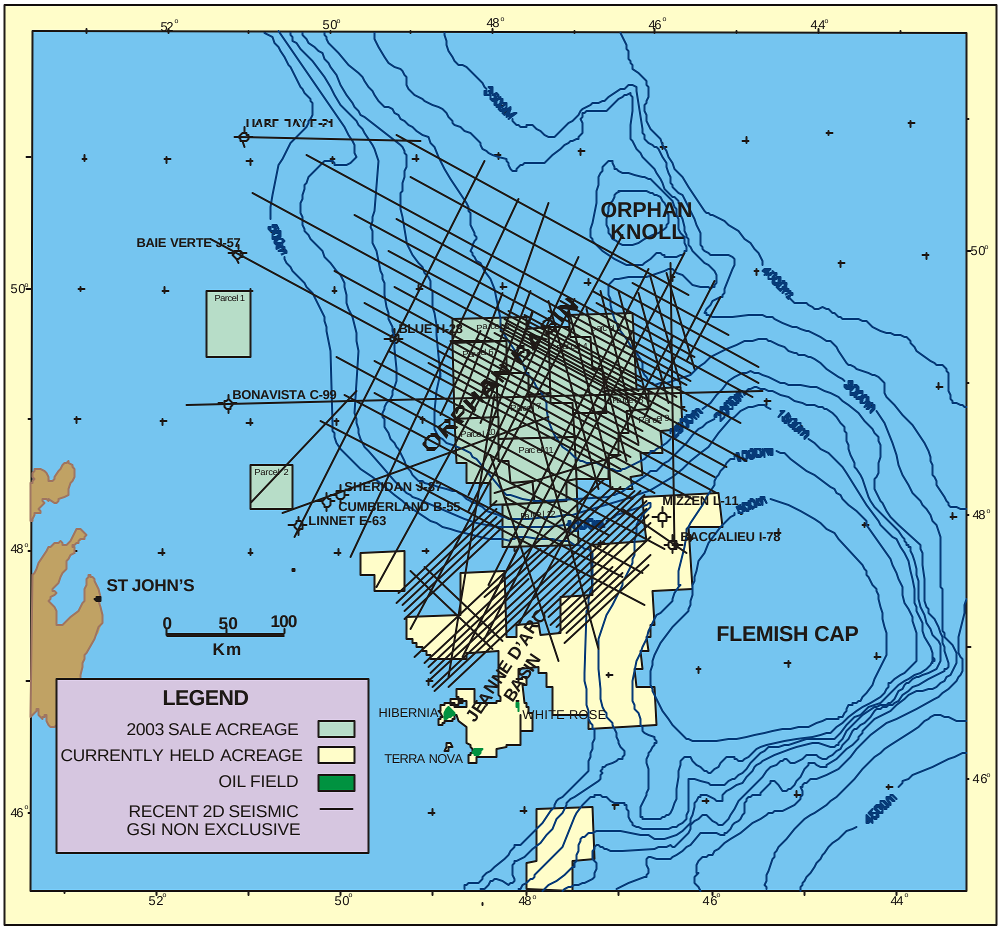


Figure 2

Land Parcel Map with new GSI Seismic Coverage

Although Exploration Permits and Licenses were held in the area throughout the 1970's and 1980's, exploration was concentrated on the shallower water western part of the basin, and much of the Orphan Basin area remains unexplored.

Seven wells, drilled in the western part of the basin between 1974 and 1985, were located on large structural closures that could be recognized on the seismic data available at the time. These features generally proved to be high basement blocks with thin Mesozoic cover, and the wells encountered Tertiary and Cretaceous sediments overlying petroleum basement. The critical Upper Jurassic section, which contains the proven source rock in the Jeanne d'Arc Basin to the south, was not definitively penetrated by any of the wells in the basin.

Recent (2000 – 2002) seismic data (Fig. 2) has revealed a large Mesozoic aged sub-basin in the eastern part of the basin, and confirmed that a thick Mesozoic section exists between the basement highs in the west. These Mesozoic sediments likely contain the Upper Jurassic and Lower Cretaceous section that is critical to the development of petroleum systems in the Jeanne d'Arc Basin, the North Sea, and other basins on the margins of the North Atlantic Ocean. The new seismic data has also revealed many large-scale structural closures that likely involve the Lower Cretaceous and Upper Jurassic section, and could contain giant-sized reserves.

The discovery of large reserves in the Jeanne d'Arc Basin drew the exploration focus to that area for the past twenty years but new geological understanding of deepwater basins and advances in deepwater development technology has brought renewed interest to the Orphan basin. Additionally it is clear that the field development techniques being developed to produce from deepwater areas around the world, together with techniques utilized in the Jeanne d'Arc Basin to the south can be applied to the Orphan Basin, which vastly improves the feasibility of developing future Orphan Basin discoveries.

Since the recently acquired seismic has become available, industry interest in the Orphan Basin has increased. After a hiatus of 18 years, 10 blocks covering most of the eastern sub-basin, and 2 blocks in the western Orphan area have been posted by the C-NOPB for the land sale scheduled to close on December 17, 2003.

This report has been prepared under contract to the Government of Newfoundland and Labrador, Department of Mines & Energy to provide relevant geologic information to interested parties.

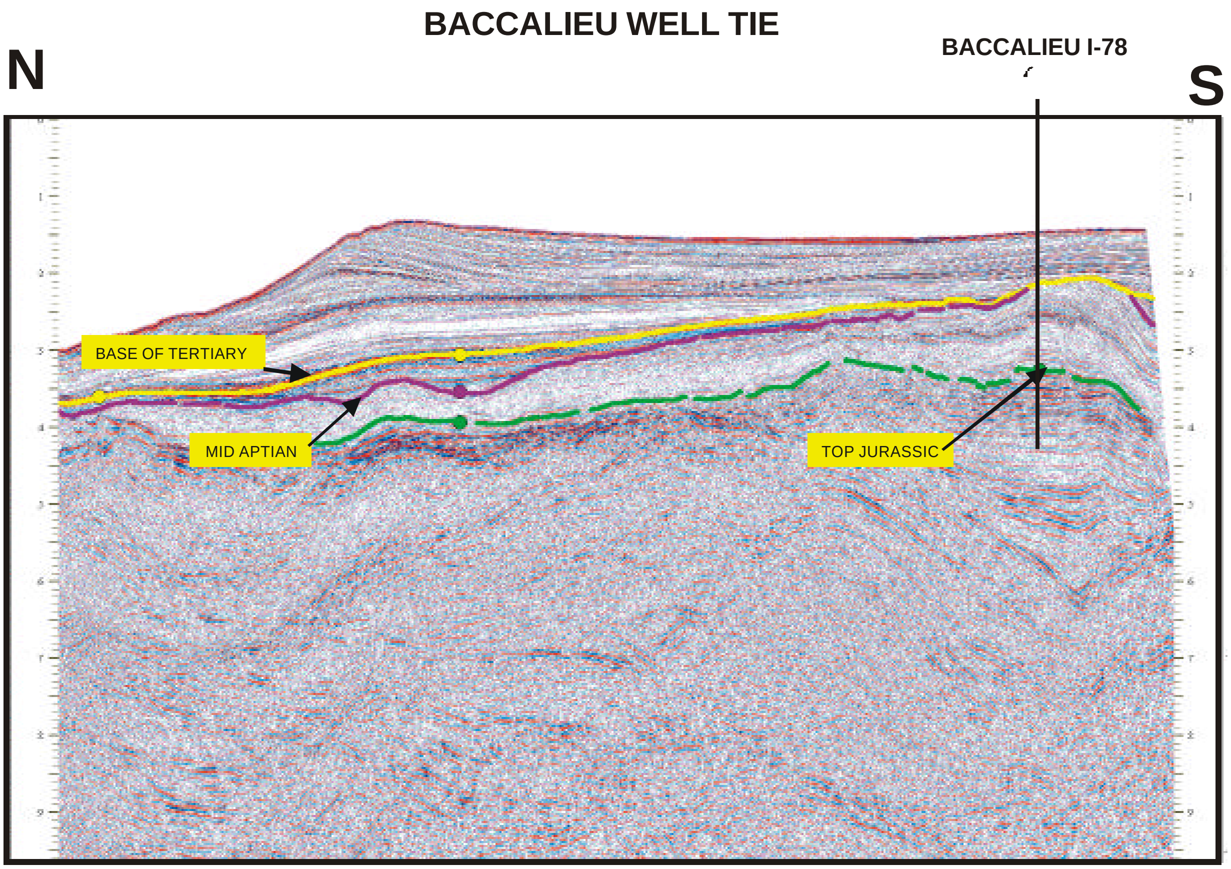
2. Data Base and Regional Correlations

Although a great deal of 2D seismic data was acquired during the 1970's and early 1980's, primarily over the western part of the Orphan Basin, it was mostly of poor quality and did not image very well below the Base of Tertiary. Recent programs in the basin by Geophysical Service Incorporated (GSI), and TGS-Nopec over the past three years (2000 – 2002) is of significantly better quality than the older data and presents a much clearer view of the Mesozoic section. This study is chiefly based on a database of over 18,000 km of good to excellent quality modern 2D seismic that has been acquired on a non-exclusive basis by GSI. This data is primarily located over the Eastern part of the basin with line spacing ranging from 3 to 12 kilometres (Fig. 2). Longer cable lengths (6 km – 8 km) and more accurate navigation (GPS) have improved data quality in the recent seismic, and achieved deeper penetration of the Mesozoic section, particularly in the deeper water areas.

The Orphan Basin is very much a virgin frontier in terms of well control. Drilling has been restricted to the western edge of the basin, with only one well (Texaco Shell et al Blue H-28) located towards the center of the Basin. The Blue well, drilled in 1979, in 1486 m of water, set a world deepwater record at the time. It penetrated a Paleozoic basement high with thin Mesozoic cover, which included porous Early Cretaceous sandstones (Figs. 11 & 21). As was the case with other wells drilled in the Basin, the thin Mesozoic section encountered provided very little information about the syn-rift rocks away from the structure.

The Baccalieu I-78 well, drilled in the Northern Flemish Pass Basin, is the closest publicly available well to the Orphan Basin to test a thick Mesozoic section. It is possible to "jump correlate" the seismic data from this well into the south-eastern part of the Orphan Basin with some degree of confidence.

For instance, although the Baccalieu well drilled through the Tertiary directly into Barremian aged section, a well defined unconformity, younger then Barremian, can be seen to the North of the Baccalieu well on a recent north-south line that runs through the Baccalieu location (Fig 3). This unconformity, shown in purple, can be correlated throughout the Eastern part of the Orphan Basin. The section above the unconformity is relatively unstructured and drapes or onlaps pre-existing highs and the margins of the basin, suggesting deposition during a period of passive subsidence. The section below has been structured, and is truncated by the unconformity on the margins of the Basin. The constraints on the age of the unconformity from the Baccalieu well, and the similarity in appearance to the Avalon Unconformity in the Jeanne d'Arc Basin strongly support a mid-Aptian age for this unconformity, which in turn supports the interpretation that Lower Cretaceous and Jurassic section is present within the Orphan Basin.



Seismic Courtesy of GSI

Figure 3
Correlation from Baccalieu I-78

Additionally, a comparison of the seismic character below the Base of Tertiary in the Orphan Basin with the seismic character of the Jurassic and Lower Cretaceous section at the Baccalieu location gives further support to the presence of a thick Lower Cretaceous and Jurassic section within the Orphan Basin (Fig. 4).

The GSI seismic data has been used to correlate major regional markers such as the Base of Tertiary and the Mid Aptian Unconformity over the entire Orphan Basin. It has also been used to identify and roughly outline potential hydrocarbon prospects and leads on which additional information is provided in Appendix "A". The seismic data across the prospects and leads presented in this report are interpreted to show major structural features and stratigraphic packages. A detailed horizon and fault interpretation of the seismic is beyond the intended scope of this report.

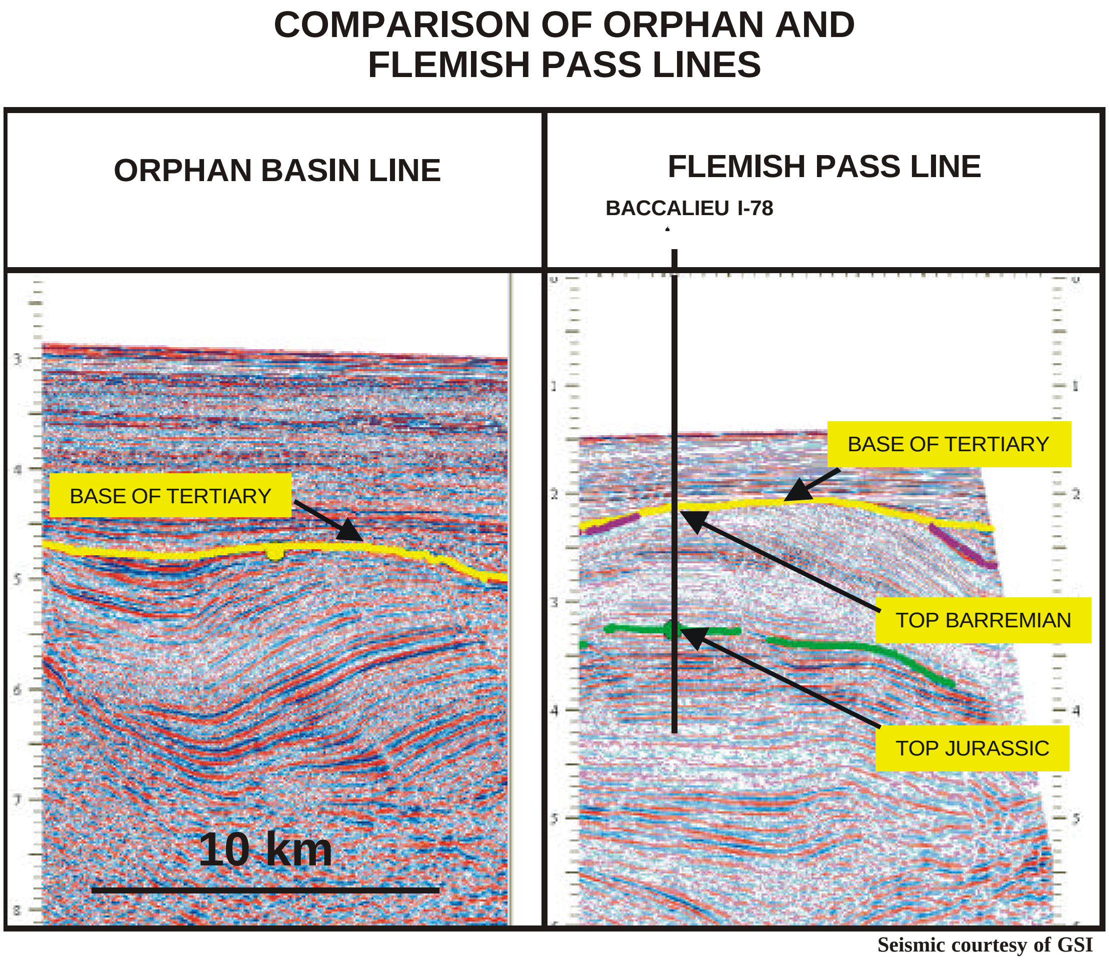


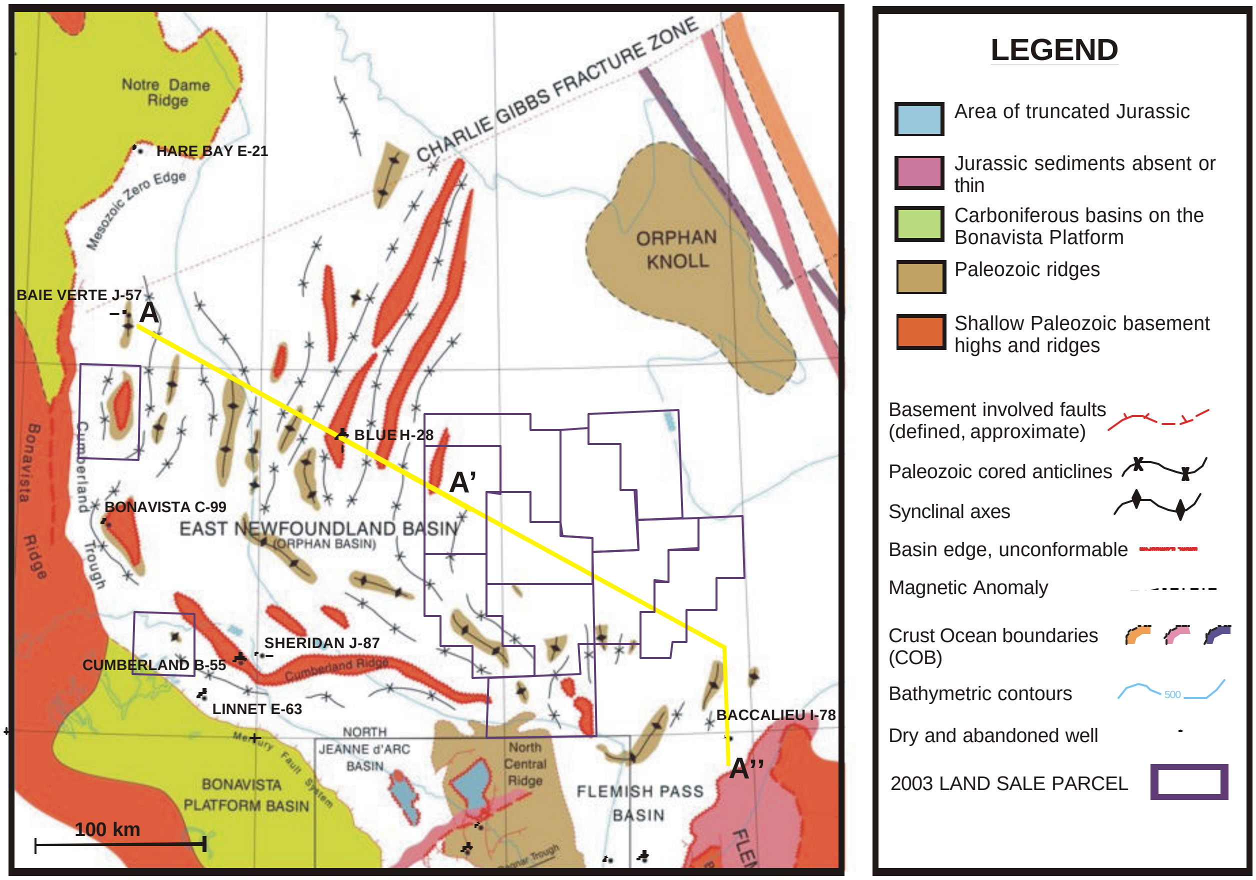
Figure 4
Comparison with Flemish Pass Mesozoic section

3. Physical Description and Naming Convention

The Orphan Basin represents an area of thinned and foundered continental crust that formed during the period from late Triassic to late Cretaceous, as a result of the opening of the North Atlantic Ocean. Stretch factors are estimated to be greater then 0.5 over most of the area (Keen and Dehler, 1993; Chian et al., 2001).

The Orphan Basin is bounded: to the west by the Bonavista Platform; to the south by a high block separating it from the Jeanne d'Arc and Flemish Pass Basins (Cumberland Belt of Enachescu, 1987); to the east by a high basement ridge that runs between the Orphan Knoll and the Flemish Cap; and to the north by onlap of sediments onto a basement high that extends westward from the Orphan Knoll (the Orphan High) (Figs. 5 and 6). Note that Figure 5 shows the present day tectonic elements that define the Orphan Basin, whereas Figure 6 outlines the Basin during the critical time (Late Jurassic to Early Cretaceous) for the development of the petroleum system in the area. The basement underlying the syn-rift and post-rift sediments is Precambrian and Paleozoic in age and relates to the Appalachian orogeny.

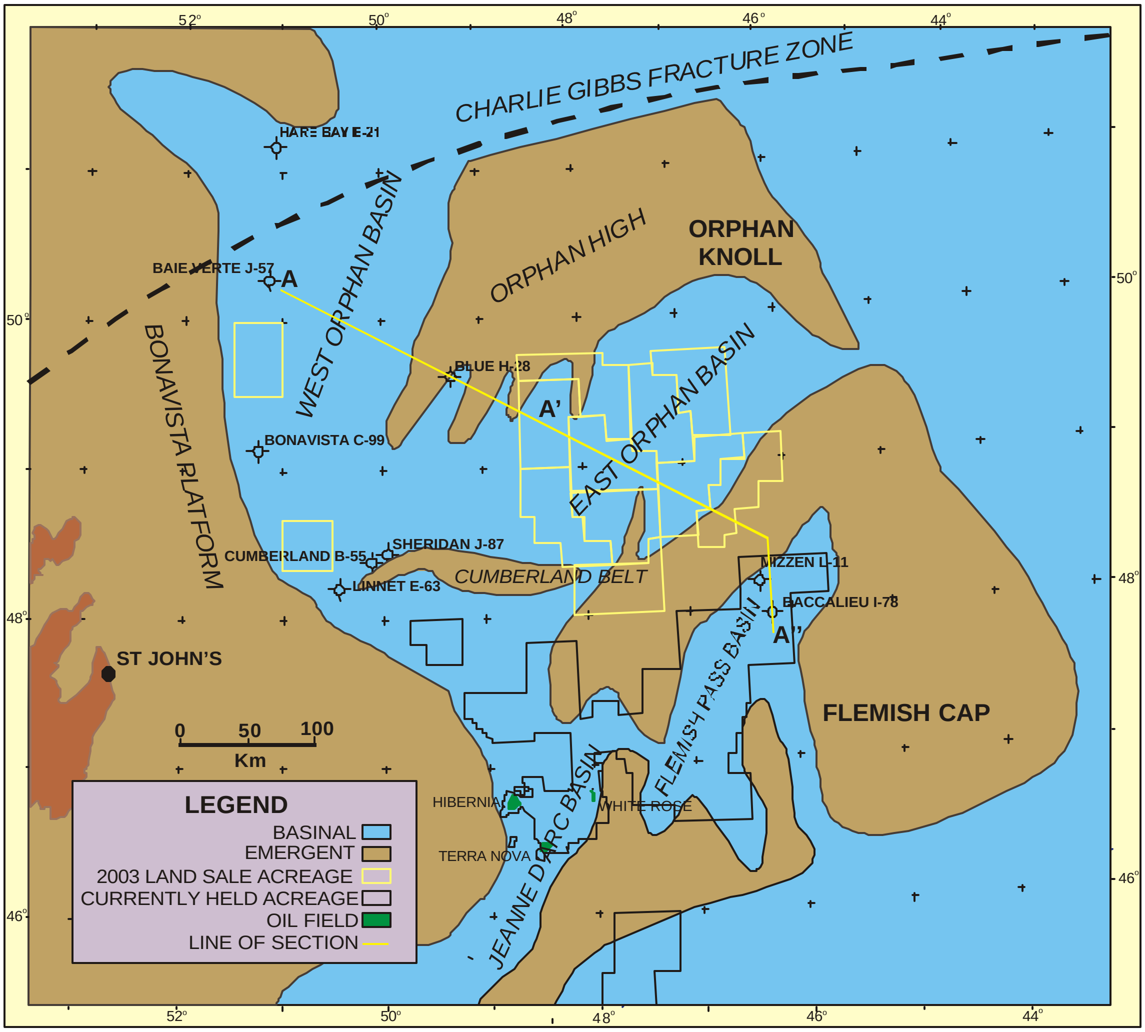
ORPHAN BASIN TECTONIC ELEMENTS



GSC East Coast Basin Atlas Series

Figure 5

The western portion of this area has been referred to as the North-East Newfoundland Shelf, the East Newfoundland Basin or the West Orphan Basin in other publications. In this study the entire area is referred to as the Orphan Basin, which contains two Mesozoic aged sub-basins (the West Orphan Basin and the East Orphan Basin) separated by the Orphan High (see Figs. 6 & 7). The Orphan High is an area of relatively thick continental crust, approximately 60,000 sq. km in area, which plunges to the S.W. of the Orphan Knoll, where it has emerged at the sea floor as a bathymetric feature. Seismic indications of onlap of deep Mesozoic horizons against the Orphan High suggests that it has existed since the Late Triassic, when extensional forces initially formed the Orphan Basin. Later extensional episodes have broken it into a series of large-scale north-south trending horsts and fault blocks, 10 - 15 km wide and 200 km long, that are seen in the present day (Figs. 5 and 7).



Modified from Enachescu, 1987 and Chian et al., 2001

Figure 6
Grand Banks and N.E. Newfoundland Late Jurassic to Early Cretaceous (Lowstand) Basin Outlines

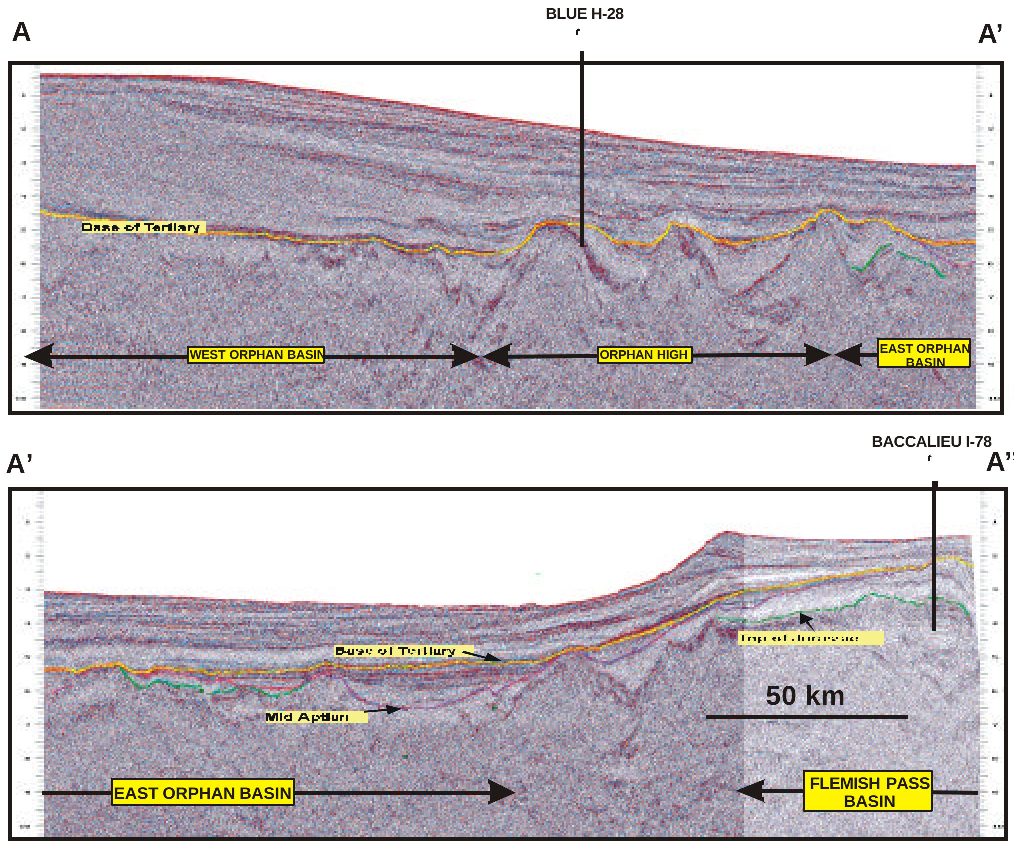
East Orphan Basin

The East Orphan Basin is an area of approximately 37,000 sq. km, lying between the Orphan High and the Flemish Cap. The basin is interpreted to contain over 4000 m of Upper Jurassic and Lower Cretaceous section (Fig. 7) with a Tertiary thickness ranging from 1000 to 2500 metres. In the eastern portion of the Basin, the earlier Mesozoic section is covered by up to 2000 m of Upper Cretaceous section.

Extensional tectonic episodes throughout the Late Cretaceous have structured the earlier sedimentary section into a number of large scale anticlinal and fault bounded structures. These structures are either related to basement involved tectonics, or structuring within the sedimentary section itself, and could contain significant hydrocarbon reserves.

Land sale parcels 3 – 12 are located within the East Orphan Basin.

ORPHAN BASIN REGIONAL LINE



Seismic Courtesy of GSI

Figure 7
Regional Seismic Section across Orphan Basin

West Orphan Basin

Land sale parcels 1 and 2 are located in the West Orphan Basin which is an area of approximately 60,000 sq. km lying between the Orphan High and the Bonavista Platform (Fig. 6).

The Tertiary section over the West Orphan Basin is significantly thicker than in the East Orphan Basin, ranging from 3250 m to 4800 m in thickness. Below the Base of Tertiary seismic marker, a thick Mesozoic section can be seen onlapping the Bonavista Platform, and other basement features over much of the area (Fig. 7). This Mesozoic section contains a significant number of potential hydrocarbon traps as tilted fault blocks, or drape closures over basement highs. Additional play potential exists in the lower Tertiary where a large amplitude anomaly is seen to terminate against a fault in parcel two.

4. Exploration History and Drilling Results

Exploration of the Orphan Basin commenced in 1969, when Shell Canada Ltd. was granted a permit covering the western portion of the basin. Other major oil companies held acreage in the Orphan Basin throughout the 1970's and early 1980's, including Imperial Oil (Esso), Mobil, BP and Texaco as operators, and Petro Canada, Canterra, Beau Canada, Norcen, Columbia Gas, Home, Dome, HBOG and others as partners.

Seismic acquisition began in 1971 with the shooting of over 2000 km of non-exclusive 2D seismic by GSI and Caravel. A number of 2D seismic programs, both exclusive, and non-exclusive were shot in the basin throughout the 1970's and early 1980's, resulting in over 50,000 km of 2D seismic coverage in the area. This data was primarily concentrated in the western portion of the basin. Data quality, particularly below the Base of Tertiary unconformity was poor due to severe multiple problems, and the relatively large thickness of the Tertiary section in the western part of the basin.

Drilling began in 1974 with the Bonavista C-99 well by BP and Columbia Gas. Six other wells were drilled in the West Orphan Basin between 1975 and 1985 with the last well, Baie Verte J-57, operated by BP.

5. Drilling Results:

All of the wells were located in the West Orphan Basin, with the exception of the Blue H-28 well, which was drilled on the Orphan high. Most wells were drilled on large structural closures identified through mapping the Base of Tertiary seismic marker, which was the deepest regionally consistent marker that could be correlated on the data available at the time.

The key tops from each of the wells are summarized in Table 1 and Figure 8 is a structural cross-section through the seven wells. A geological summary and seismic section through each well is provided in section 6.

Table 1 Drilling Results Summary

WELL NAME	PARTNERS	YEAR OF SPUD	WATER DEPTH m	BASE OF TERTIARY ELEVATION m MSL	BASE OF U. CRET ELEVATION m MSL	TOP OF PALEOZOIC ELEVATION m MSL	FTD ELEVATION m MSL
Bonavista C-99	BP, Columbia Gas	1974	329	3616	3655	3655 (Granite)	3769
Cumberland B-55	Mobil, Gulf, Imperial	1975	195	3623	3677	3677	4107
Blue H-28	Texaco, Shell, Petro Canada, Home, Dome, HBOG	1979	1487	4685	4935	5266	6088
Hare Bay E-21	BP, Gulf, Chevron, Columbia Gas, Petro Canada	1979	239	3197	3378	3378	4850
Sheridan J-87	Mobil, Petro Canada, Gulf	1981	216	4480	4840	NR	5456
Linnet E-63	Mobil, Petro Canada,Gulf, PanCanadian, Norcen, Canterra, Roxy	1982	160	2515	3123	4148	4493
Baie Verte J-57	BP, Chevron, Columbia Gas, Beau Canada	1985	303	3939	4642?	4642?	4886

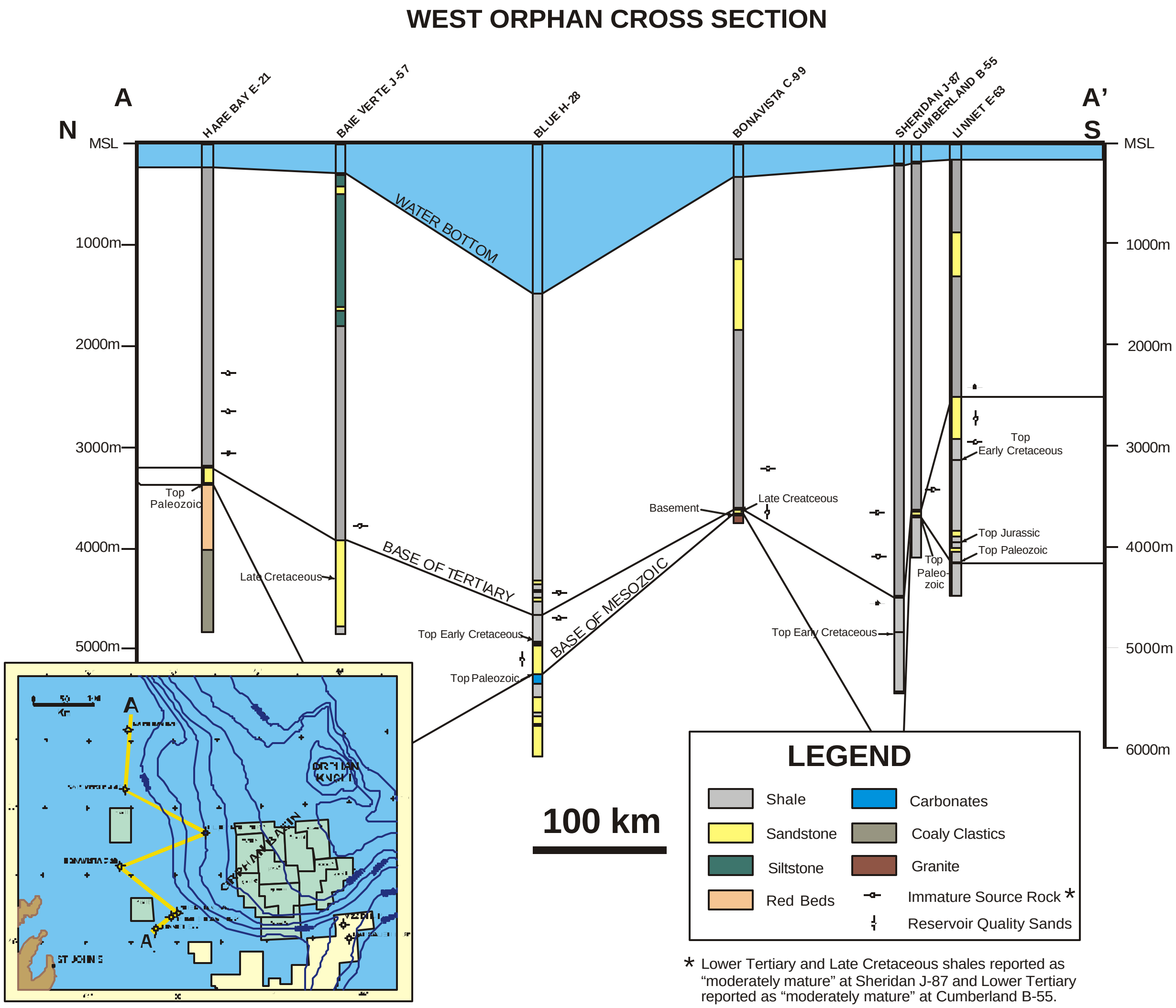


Figure 8

West Orphan Cross Section

6. Well Descriptions:

Hare Bay E-21

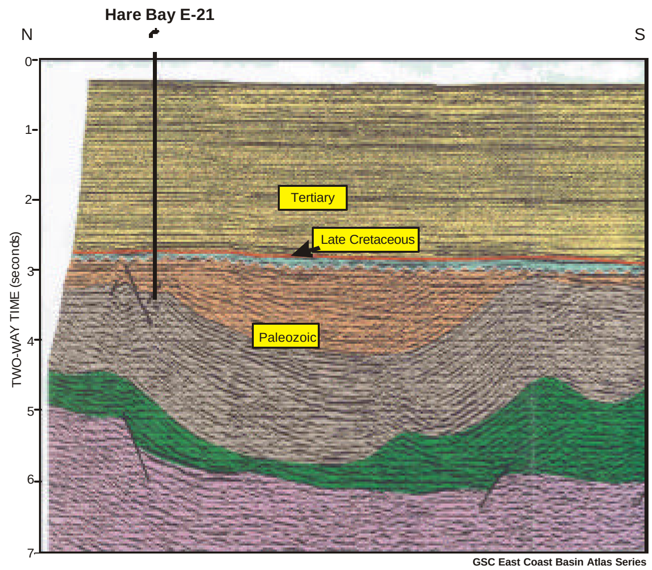


Figure 9
Hare Bay Seismic Section and Interpretation

Well name: Hare Bay E-21

Operator: BP

Partners: Gulf, Petro Canada, Chevron, and Columbia Gas

Year: 1979 (4th well drilled in the basin)

Play type: Mesozoic subcrop

Water Depth: 239 metres

Tertiary

- 2958 metres thick
- Shales and mudstones
- TOCs of 1.7% to 3.5% encountered between 2150 m – 3200 m. Immature oil and gas prone kerogens
- Base of Tertiary U/C: 3197 metres MSL

Upper Cretaceous

- Top: 3197 m
- 181 metres thick
- Tightly cemented sands

Lower Cretaceous

- Not present

Paleozoic

- Top: 3378 metres MSL
- 1472 metres thick (Pennsylvanian)
- 3378 - 4030 metre interval consists of interbedded sequence of tight, well cemented red-brown sandstones and indurated shales and siltstones (redbeds)
- 4030 to 4850 (TD) metre interval consists of more grey coloured sediments with some limestone and coaly horizons

TD (Total Depth): 4850 MSL in Paleozoics

Comments:

Organic rich shales in the lower Tertiary are immature but could become very effective source rock with sufficient depth of burial.

Baie Verte J-57

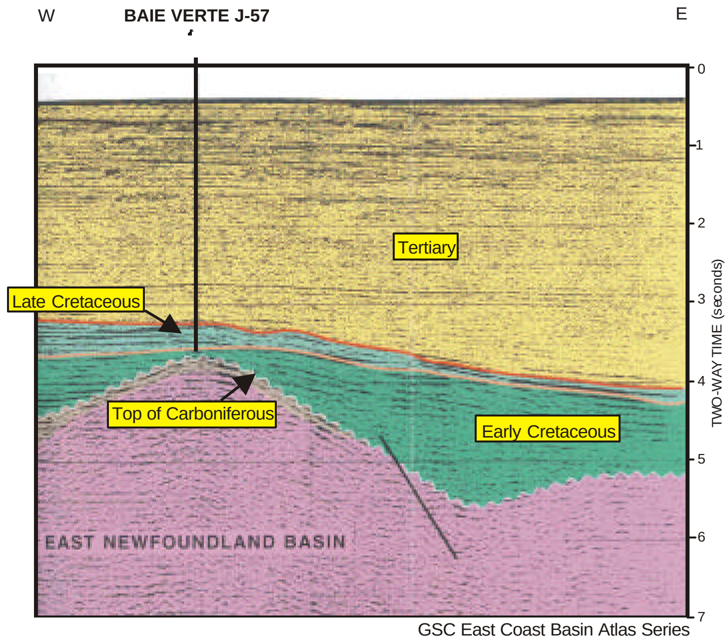


Figure 10
Baie Verte Seismic Section and Interpretation

Well name: Baie Verte J-57

Operator: BP

Partners: Chevron, Columbia Gas and Beau Canada

Year: 1985 (7th well drilled in the basin)

Play type: Basement cored anticline

Water Depth: 303 metres

Tertiary

- Thickness: 3636 metres
- Shales, mudstones, siltstones with some sands in the shallower section
- TOCs of 1.5% to 6% encountered in Lower Tertiary
- Base of Tertiary U/C: 3939 metres MSL

Upper Cretaceous

- Top: 3939 MSL (Santonian)
- 953 metres thick
- Dominantly sandstone, but described as tight, fine grained argillaceous and interpreted to have been deposited in a shallow, marginal marine or inner shelf environment

Lower Cretaceous

- Top 4892 MSL (TD)
- Albian aged mudstone

TD: 4892 MSL in Lower Cretaceous mudstone

Comments:
Organic rich shales in the Lower Tertiary are immature at this location but described by Bayliss (Geochem Labs, 1990) as having "good to excellent potential for sourcing oil liquids and associated gas, should they be buried deeper elsewhere in the basin."

Blue H-28

Well name: Blue H-28

Operator: Texaco

Partners: Shell, Petro Canada, Home, Dome and HBOG

Year: 1979 (3rd well drilled in the basin and only deep water well)

Play type: Flank of large basement high

Water Depth: 1486 metres (world record at the time)

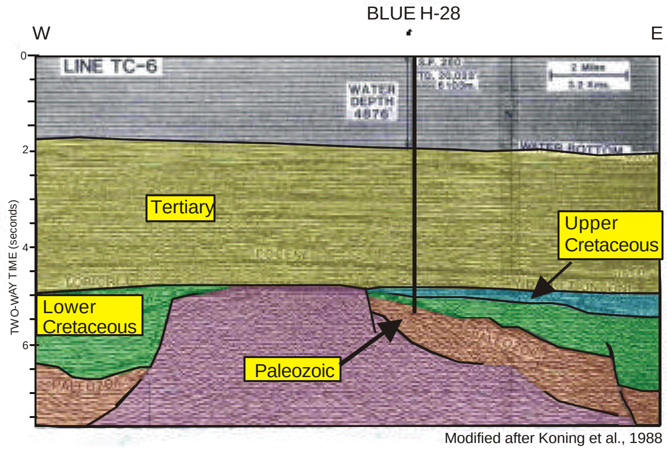


Figure 11
Blue Seismic Section and Interpretation

Tertiary
- Thickness: 3199 m MSL
- Shales, mudstones
- TOCs of 1.5% to 6% encountered in Lower Tertiary
- Base of Tertiary U/C: 4685 metres MSL

Upper Cretaceous
- Top: 4685 MSL
- 250 metres thick
- Maastrichtian aged grey shales and thin limestones

Lower Cretaceous
- Top 4935 MSL (TD)
- 225 metres thick
- Shales and sandstones
- Sandstones described as angular to sub-rounded and medium to course grained quartz with observable porosity
- Up to 19% porosity on logs (Koning 1988)

Paleozoic
- Top: 5160 m MSL
- 928 metres thick
- Top 90 metres consists of Mississippian (?) aged micritic limestones
- Underlain by fine to medium grained sandstones with shales and minor limestones to TD

TD: 6088.3 MSL in Paleozoics

Comments:
Lower Cretaceous sandstones have very good reservoir potential. TOCs in the Lower Tertiary ranged from 0.8% to 3.44%. Visual kerogen data indicate that Oligocene and younger rocks and Paleozoic rocks contain primarily terrestrial dry gas prone kerogens (Koning 1988). The Eocene and Cretaceous rocks contain higher percentages of oil-generating kerogen and if mature could yield wet gas and some crude oil as well. Analysis by Dow (1979) concluded that the oil generating kerogens in the Cretaceous and Tertiary section were oxidized, but this conclusion was "not recognized by all the partners" (Koning 1988) although there was general agreement that they were "too thin for effective hydrocarbon generation" (Koning 1988). It is possible, however, that these layers could be much thicker and un-oxidized in the "deeper" portions of the basin, away from the uplifted areas.

Bonavista C-99

Well name: Bonavista C-99

Operator: BP

Partners: Columbia Gas

Year: 1974 (1st well drilled in the basin)

Play type: Basement high

Water Depth: 329 metres

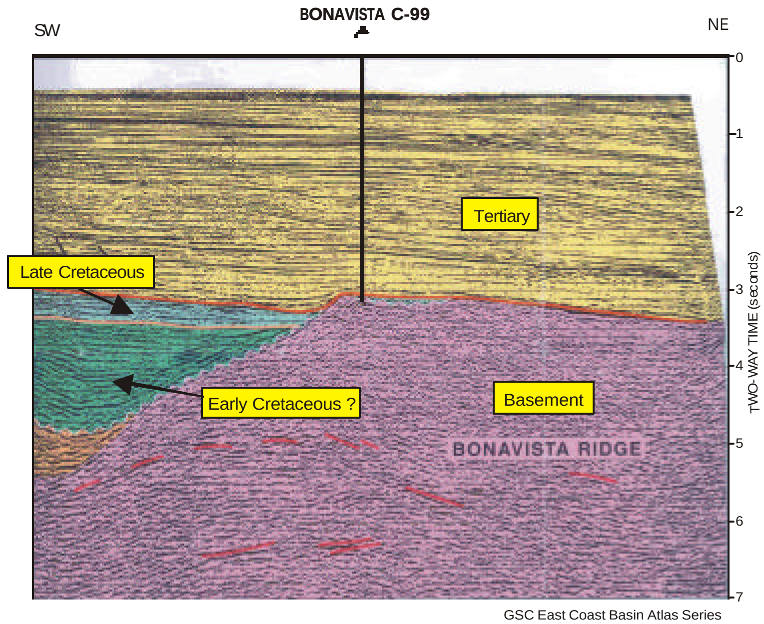


Figure 12
Bonavista Seismic Section and Interpretation

Tertiary
- 3287 metres thick
- claystones, silts and sandstones
- Base of Tertiary U/C: 3616 metres MSL

Upper Cretaceous
- Top: 3616 m MSL
- 61 metres thick
- Porous sandstones, limestones and shales

Lower Cretaceous
- Not present

Basement
- Top 3677 m MSL
- Granitic basement (dated at 146 ma) with some possible granite wash

TD: 3769 m MSL in granitic basement

Comments:
Upper Cretaceous sandstones have good reservoir potential. Organic rich shales in the lower Tertiary are immature at this location but described by Bayliss (Geochem Labs, 1990) as having "good to excellent potential for sourcing oil liquids and associated gas should they be buried deeper elsewhere in the basin."

Sheridan J-87

Well name: Sheridan J-87

Operator: Mobil

Partners: Petro Canada and Gulf

Year: 1981 (5th well drilled in the basin)

Play type: Onlap to large basement ridge

Water Depth: 215.8 metres

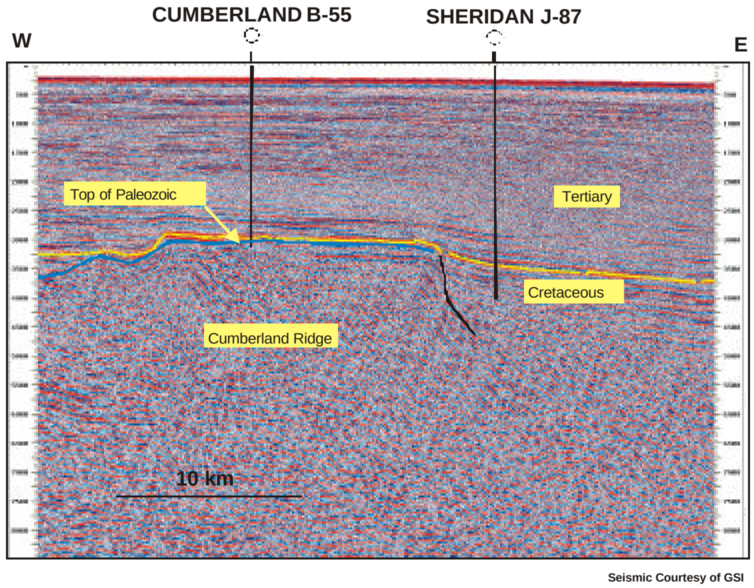


Figure 13
Sheridan Seismic Section and Interpretation

Tertiary
- 4265 metres thick
- Claystones and shales
- Base of Tertiary U/C: 4480.3 m MSL

Upper Cretaceous
- Top: 4480.3 m MSL
- 360 metres thick
- Predominantly shales with minor sandstones and silts

Lower Cretaceous
- Top: 4840 m MSL
- 617 metres penetrated
- TDed in Lower Cretaceous Hauterivian-Barremian sediments at 5457 m MSL
- Predominantly shales with minor sandstones and silts

TD: 5457 m MSL in Lower Cretaceous

Comments:
TOC content in Lower Tertiary and Late Cretaceous (3300 - 4650 m MSL) ranges from 1.5% to greater than 3%. It is described by Bayliss (1982) as ranging from a moderately mature oil, and associated gas, source in which moderate amounts of immature napthenic oil, condensate and wet gas have been formed. Deeper burial could render these shales as very good (and possibly prolific) oil and associated gas source facies (Bayliss, 1982).

Cumberland B-55

Well name: Cumberland B-55

Operator: Mobil

Partners: Gulf and Imperial

Year: 1975 (2nd well drilled in the basin)

Play type: Basement high

Water Depth: 194.8 metres

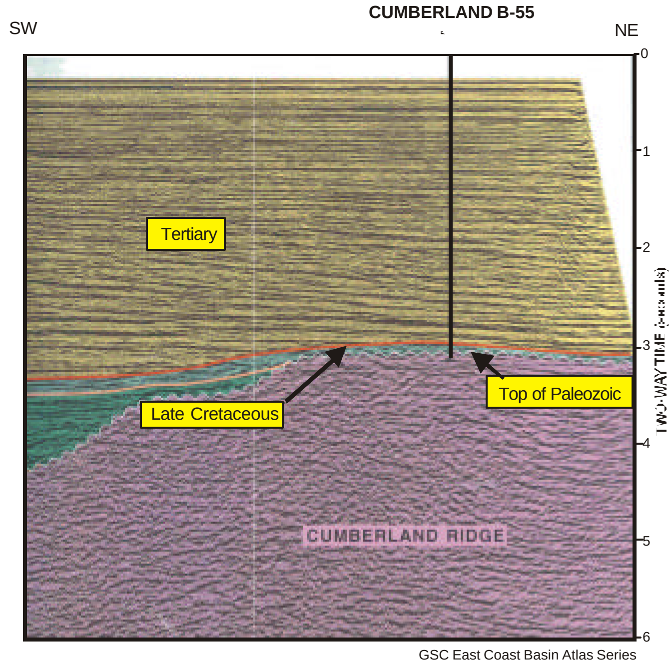


Figure 14
Cumberland Seismic Section and Interpretation

Tertiary
- 3428 metres thick
- Shales and mudstones
- Base of Tertiary U/C: 3622.5.3 metres MSL

Upper Cretaceous
- Top: 3622.3 m MSL
- 75.7 metres thick
- Shales with some marls and sandstones

Lower Cretaceous
- Not present

Paleozoic
- Top: 3698 (TD)
- 438 metres thick
- Entire section penetrated was shale

TD: 4136.5 m MSL in Paleozoic shale

Comments:
TOC content in Lower Tertiary ranges from 1% to greater than 3%, but the section is generally thermally immature and moderately mature in the deeper part of the section. Described as having good to very good potential for generating oil and associated gas if buried to sufficient depths.

Linnet E-63

Well name: Linnet E-63

Operator: Mobil

Partners: Petro Canada, Gulf, PanCanadian, Norcen, Canterra and Roxy

Year: 1982 (6th well drilled in the basin)

Play type: Tilted Paleozoic fault block and basin margin play in the Upper and Lower Cretaceous

Water Depth: 160 metres

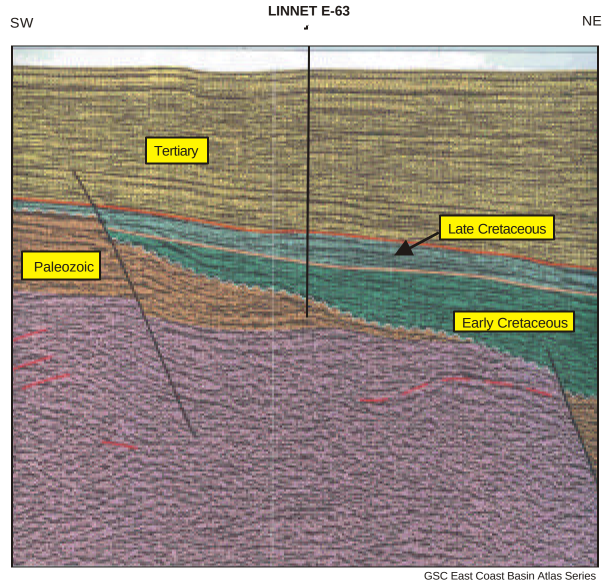


Figure 15
Linnet Seismic Section and Interpretation

Tertiary
- 2355 metres thick
- Primarily shales with sandstones in the shallower section (above 1250 m MSL)
- Base of Tertiary U/C: 2515 m MSL

Upper Cretaceous
- Top: 2515 m MSL
- 608 metres thick
- A nearly complete Maastrichtian to Cenomanian section
- Shales and marls at top overlying 350 metres of medium to course grained sandstones, with shales comprising the rest

Lower Cretaceous
- Top: 3123 m MSL
- 1025 metres thick (?) (see note on Jurassic below)
- Albian - Aptian aged shales with some thin sands near the base

Jurassic?
- 4000 - 4200 m MSL
- Mobil palynologists have dated this section as Oxfordian in age
- Shales

Paleozoic
- Top: 4148 m (?) (See note on Jurassic above)
- Thickness: had penetrated either 345 metres of Paleozoics or 148 metres (if Mobil palynologists correct) when it reached TD at 4493m MSL
- Shales
- Mississippean strata underlain by possible Ordovician and Silurian units
- Originally described as “meta-sediments” but further analysis in a comparative study of Paleozoic rocks in the Orphan Basin (Chaplin, 1982) indicates the section is only slightly metamorphosed

TD: 4493 m MSL in Paleozoic shales

Comments:

The sandstones encountered in the Upper Cretaceous may develop into excellent reservoirs in other prospects in the basin. TOCs in the Lower Tertiary and Upper Cretaceous shales ranged from 1% to 7% and are described as having excellent potential for sourcing oil should they be buried to sufficient depths.

7. Geologic History

Mesozoic sedimentary basins bordering on the North Atlantic Ocean have developed largely due to episodes of crustal extension and failed rifting related to the opening of the North Atlantic. As such, all the North Atlantic marginal basins, including the Orphan Basin share a common tectonic history. Although there may be local variations in stratigraphy and structure, the major rift events that led to the opening of the North Atlantic can be recognized in all the basins. A comparison of the stratigraphic columns for the Jeanne d'Arc Basin offshore Newfoundland, and the Porcupine Basin offshore Ireland (Fig. 16) demonstrates the common evolution of these basins.

Basins initially formed in the Orphan area during the Late Triassic in response to the rift events that ultimately led to the separation of Africa from North America (R1 in Fig. 16). These basins were likely oriented in a NE-SW direction paralleling the underlying basement fabric and consistent with orientation of the Jeanne d'Arc, Flemish Pass and central Grand Banks rifts (see Fig. 6).

Sedimentation during the synrift period, (Late Triassic to Early Jurassic) was probably continental clastics, similar to the Eurydice Formation on the Scotian Shelf and southern Grand Banks. It is likely that salt deposition occurred as well, similar to Argo salt in the Central Grand Banks and Jeanne d'Arc basin, however the absence of clearly diapiric features on the seismic data does not permit making this salt interpretation with certainty.

A period of regional thermal subsidence followed and lasted throughout the Middle Jurassic, (Enachescu, 1987 and 1988) resulting in a broad epicontinental sea developing that often extended beyond the boundaries of the initial rift basins (Sinclair, 1995) (see Fig. 17). Sediments deposited during this period would likely have been shales and carbonates similar to the Whale Formation on the Grand Banks.

Tectonism, related to the initial rifting between North America and Europe in the late Jurassic (R2), resulted in areas surrounding the rift basins occasionally becoming emergent, increasing the deposition of clastics into the basins, and restricting circulation in the seas. This environment was critical for the development of source rocks and petroleum systems in the North Sea and Grand Banks basins and would likely have done the same in the Orphan Basin.

Areas surrounding the rift basins became emergent during the remainder of the Early Cretaceous. The Paleozoic section exposed in the emergent areas would also have provided provenance for deposition of coarse clastics in the basins.

Renewed rifting during the Albian (R3), as the North Atlantic continued to open, resulted in much of the earlier Mesozoic section being structured into large potential hydrocarbon traps, as anticlines or tilted fault blocks.

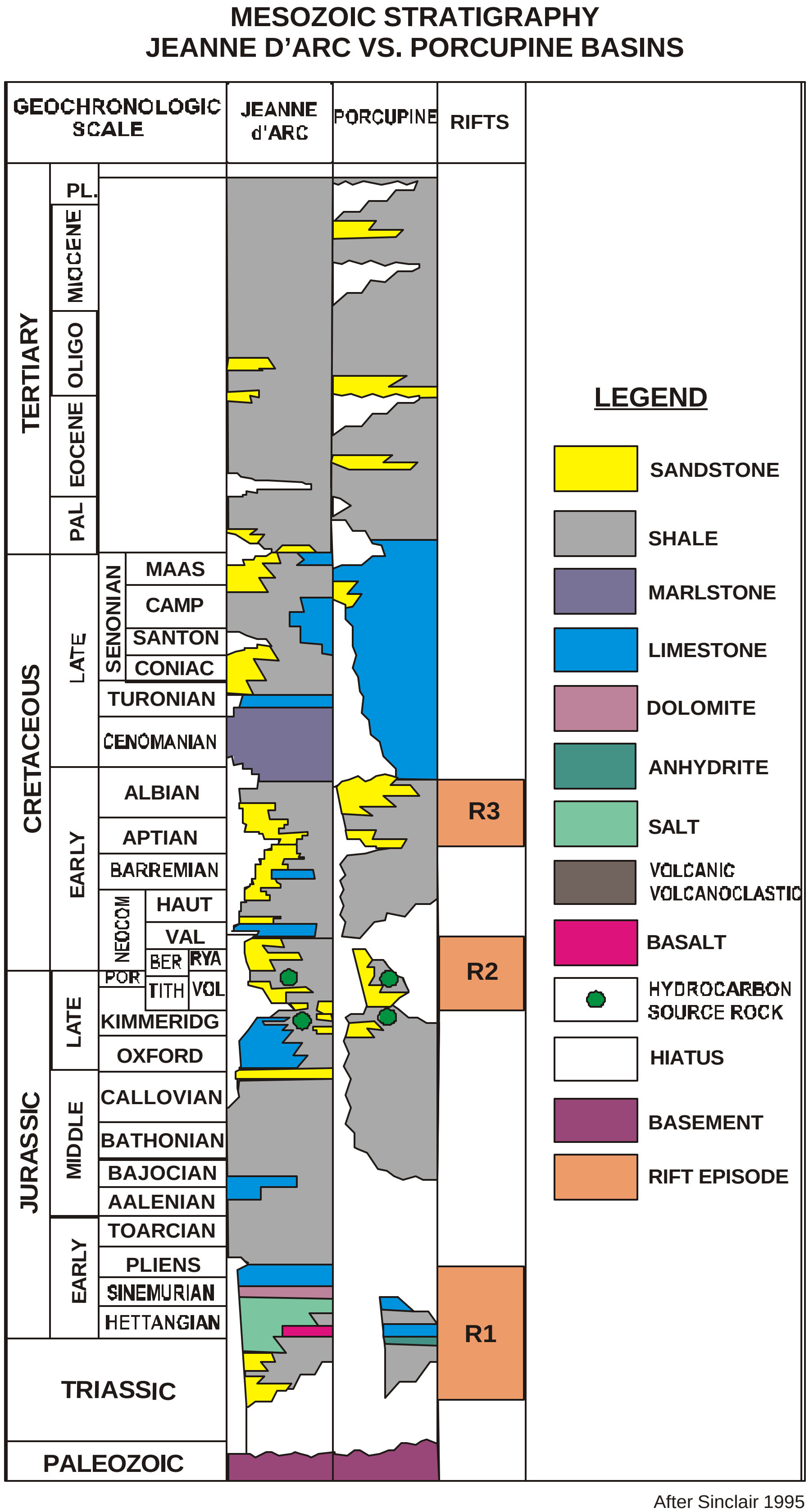
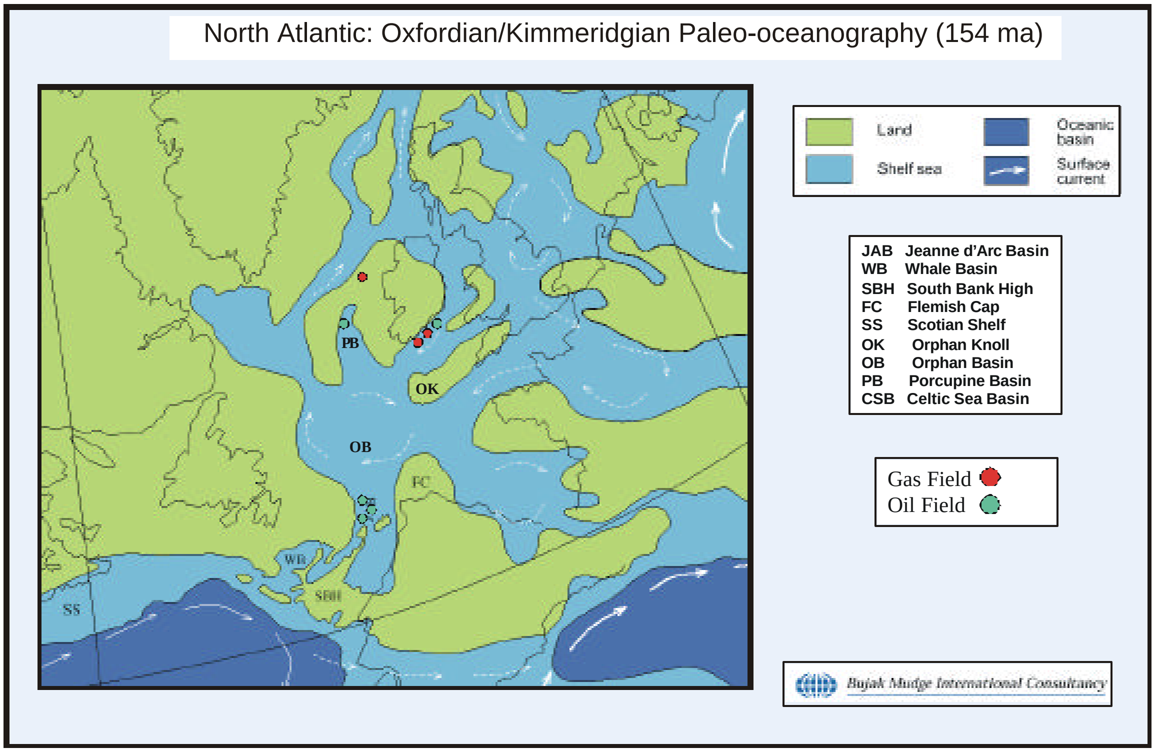


Figure 16

Comparative Stratigraphy – Jeanne d'Arc and Porcupine Basins



Courtesy of Jonathan Bujak, Bujak-Mudge

Figure 17

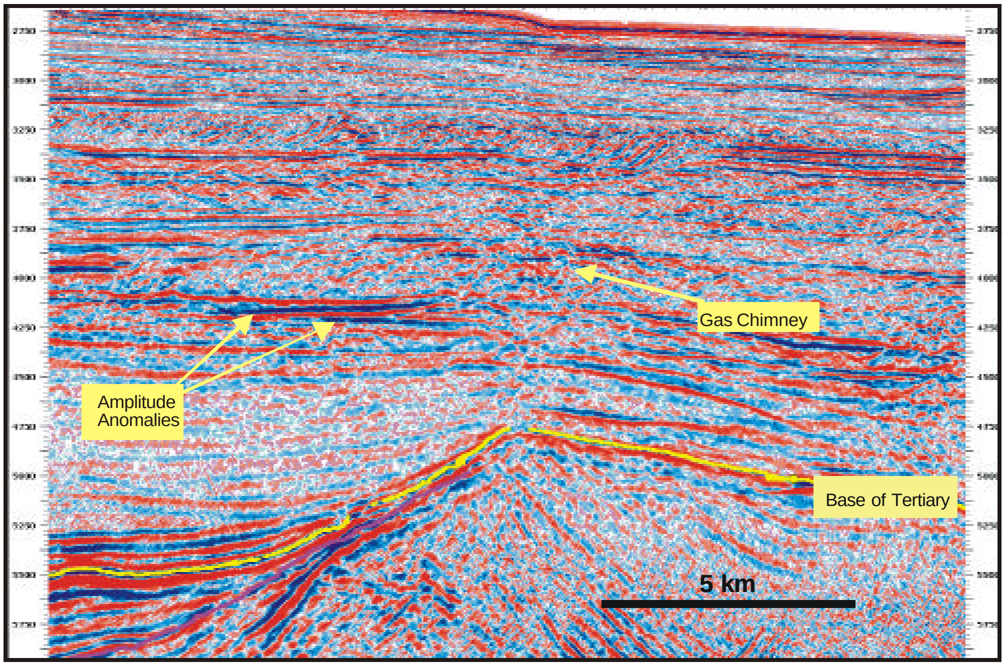
Upper Jurassic Paleoenvironment

8. Potential Source Rocks

The euxinic conditions that existed in many of the North Atlantic marginal basins during the Late Jurassic support the possibility of a good source rock in the Orphan Basin. These conditions resulted in the deposition of the Kimmeridgian aged Egret Member which has sourced the oil and gas fields of the Jeanne d'Arc Basin to the south, and the Kimmeridgian source rocks of the North sea and Porcupine Basin (see Fig. 17).

Given our current understanding of the paleogeography of the Orphan Basin and the prevalence of Upper Jurassic source rocks in the North Atlantic marginal basins, it is very likely that good oil prone source rocks are present. Geochemical analysis of wells in the West Orphan Basin have determined that "the hydrocarbon present in the sediments penetrated by the Sheridan J-87 Well and the BP Beau et al. Baie Verte J-57 well show a close similarity to the oils reservoired in the Jeanne d'Arc Basin" (Bayliss, 1990). This indicates direct evidence of the presence of Upper Jurassic source rocks in the Orphan Basin area. Other evidence for the presence of source rocks in the Orphan Basin are a number of "gas chimneys" and amplitude anomalies that can be seen on the seismic in the area (Figs. 18 and 19).

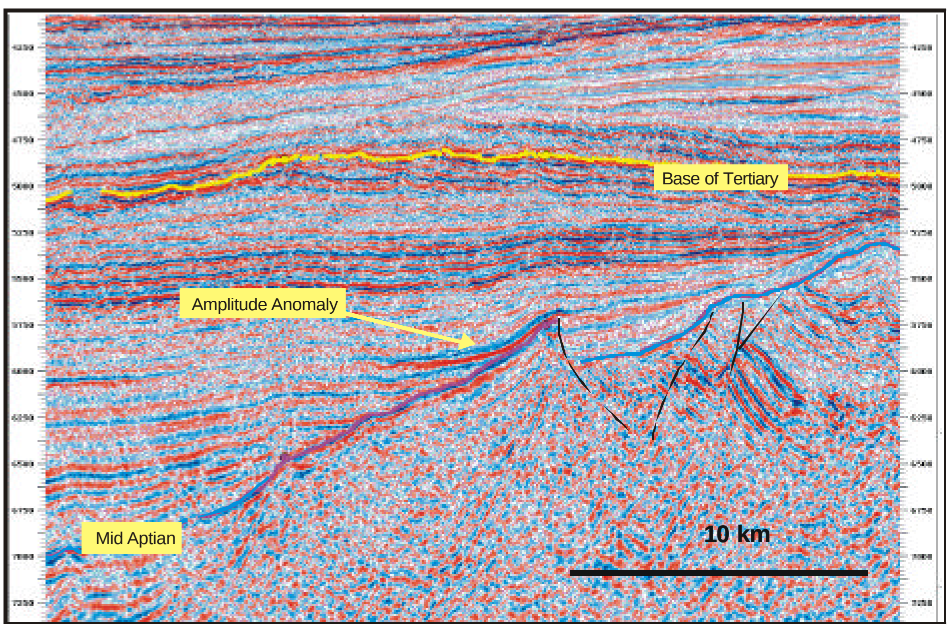
GAS CHIMNEY EXAMPLE



Seismic Courtesy of GSI

Figure 18
Gas Chimney

EAST ORPHAN DIRECT HYDROCARBON INDUCTION (DHI)



Seismic Section Courtesy of GSI

Figure 19
Onlap Amplitude Anomaly

Other potential source rocks exist in the Early Tertiary section. Geochemical analysis of the Tertiary aged shales penetrated by the wells drilled in the West Orphan area has indicated that this section contains a high proportion (2 – 6% TOC) of organic carbon that is described as "oil-prone amorphous-sapropellic kerogen" (Bayliss 1990). The Lower Tertiary and Late Cretaceous section is analyzed as being thermally immature to moderately mature in the wells. Burial depth ranging from 3100 m to 5100 m would be required to begin generation of hydrocarbons (Koning, 1988). The Tertiary section reaches a thickness of over 5000 m in much of the West Orphan Basin therefore a significant amount of oil should have been generated from these sediments.

The Late Cretaceous section penetrated in the Blue H-28 is described as containing relatively high percentages of amorphous oil generating kerogen (Dow, 1979). Dow concluded that this section had been oxidized and therefore severely diminished in its generative capacity, but this conclusion was "not recognized by all the Blue H-28 partners" (Koning, 1988). Although these potential source beds were thin and possibly oxidized at the Blue H-28 location it is possible that they could be thicker and un-oxidized in the deeper water areas of the basin during the Cretaceous. The fact that the key source rock off Labrador (Markland Shale) is of Late Cretaceous age also lends credence to the possibility of a Cretaceous source rock in the Orphan Basin.

9. Potential for Reservoir

Data from the Blue H-28 well and other wells drilled in the West Orphan area as well as DSDP 111 drilled on the Orphan Knoll, suggest that the emergent blocks surrounding the Orphan basinal areas are partly composed of Paleozoic sandstones. These blocks would therefore have provided an excellent provenance for reservoir quality sandstones to be deposited in the basin during the late Jurassic and Cretaceous (Fig. 20). The porous sandstones described in the Early Cretaceous section of the Blue H-28 well (porosities up to 19%, Koning 1988) and the Late Cretaceous section of the Linnet E-63 and Bonavista C-99 wells confirm reservoir quality sands are present in the Orphan Basin.

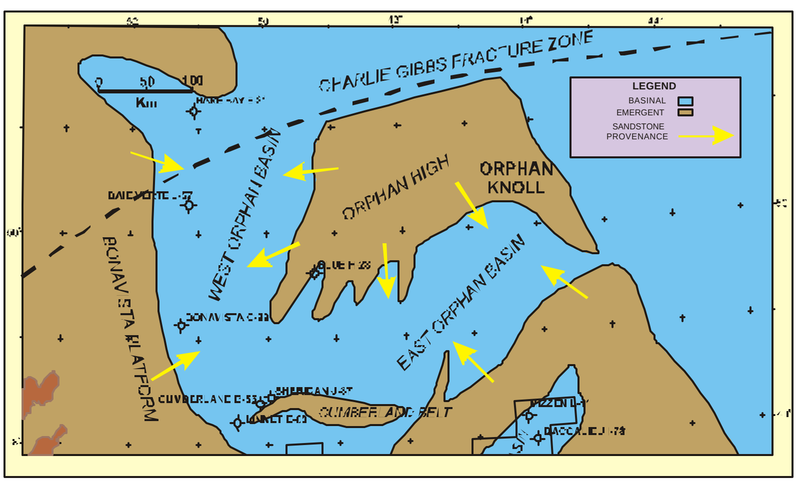


Figure 20

Provenance for Late Jurassic to Cretaceous Sands

Another reservoir target, may be in the Paleocene section where reservoir quality sandstones may have been deposited as fan sands during regressive episodes in the Early Tertiary, similar to the South Mara sands found in the Paleocene of the Jeanne d'Arc Basin, and submarine fans described in the Paleocene – Oligocene section in the Porcupine Basin (Shannon 1993). Seismic data shows many examples of Early Tertiary events onlapping the major ridges (Fig. 18 for example), with associated amplitude anomalies, suggesting that marginal marine conditions would have existed against the old highs during the Lower Tertiary.

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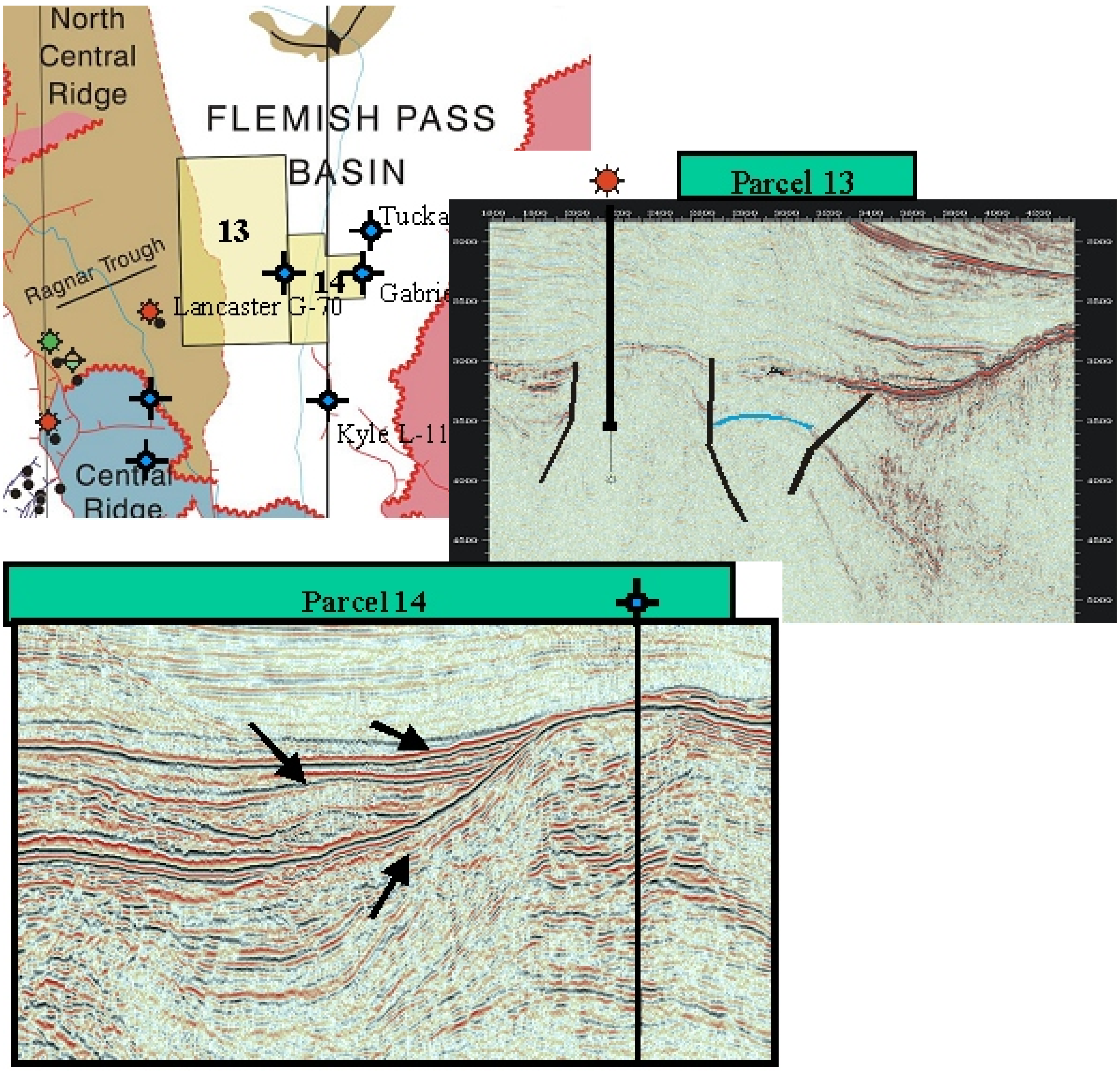
C-NOPB Request for Bids NF-03-01
Parcels 13 – 14 Flemish Pass Basin



Mines and Energy

Government of Newfoundland & Labrador

Foreword

This report has been prepared by the Department of Mines and Energy to provide information on two land parcels in the Flemish Pass Basin that are being offered in the Canada-Newfoundland Offshore Petroleum Board's (C-NOPB) Call For Bids NF-03-1 which closes on December 17, 2003. A separate report has been prepared by G&G Exploration Consultants to provide information on twelve other parcels being offered in this land sale, which are located in the Orphan Basin.

Users of this report are advised that the figures have been prepared for illustrative purposes to give a general picture of the geology. Land parcels were plotted on the geology maps and seismic sections without the use of a GIS system and therefore small errors may have been introduced.

Detailed information on the Call for Bids NF-03-01 can be found on the C-NOPB's website:
http://www.cnopb.nfnet.com/

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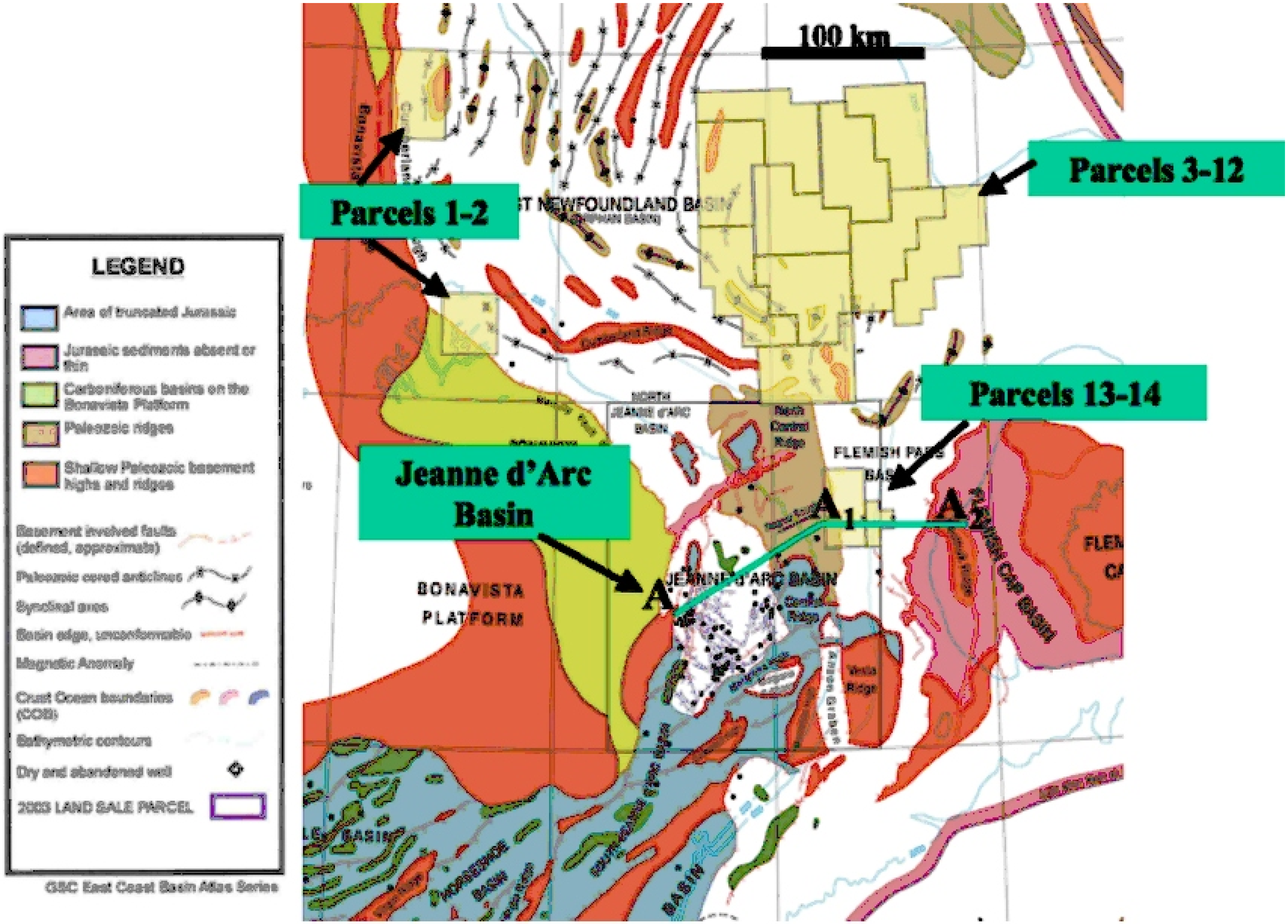
List of Figures



LEGEND
Area of truncated Jurassic
Jurassic sediments absent or thin
Carboniferous basins on the Bonavista Platform
Paleozoic ridges
Shallow Paleozoic basement highs and ridges
Basement involved faults (defined, approximate)
Paleozoic cored anticlines
Synclinal axes
Basin edge, unconformable
Magnetic Anomaly
Crust Ocean boundaries (COB)
Bathymetric contours
Dry and abandoned well
2003 LAND SALE PARCEL
GSC East Coast Basin Atlas Series
100 km
Parcels 1-2
Parcels 3-12
Parcels 13-14
Jeanne d'Arc Basin
BONAVISTA PLATFORM
NEWFOUNDLAND BASIN
FLEMISH PASS BASIN
JEANNE D'ARC BASIN
FLEMISH CAP BASIN
Anson Graben
Vesta Ridge
North Central Ridge
NORTH JEANNE D'ARC BASIN
HORSESHOE BASIN
A
A1
A2

Figure 1

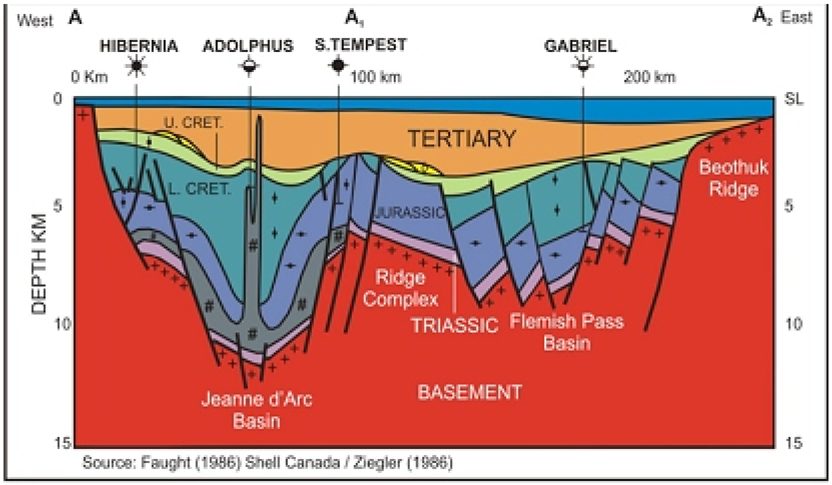


Figure 2

Cross section through the Jeanne d'Arc and Flemish Pass Basins

Petroleum Geology and Drilling History

The Flemish Pass Basin is a deep water (1100 - 1200 metres) Mesozoic aged rift basin located directly east of the Jeanne d'Arc Basin / Ridge Complex area of the Grand Banks. The Mesozoic section is overlain by a prograding Tertiary wedge that onlaps the basement cored Beothuk Ridge and Flemish Cap which combine to form the eastern boundary of the basin (Figs. 1 and 2). Although no discoveries have yet been made in the Flemish Pass Basin, the few wells drilled there have proven the presence of high quality Kimmeridgian aged source rock and Lower Cretaceous reservoir sands. Despite the presence of the key ingredients for a prolific petroleum system only four wells (Gabriel C-60, Baccalieu I-78, Lancaster G-70 and Kyle L-11) had been drilled in the basin prior to 2003. Gabriel was drilled in 1979, Baccalieu in 1985 and both Lancaster and Kyle were drilled in 1986. In recent years Petro-Canada and its partners Norsk-Hydro and Encana have established a large land position in the basin and acquired extensive 3D seismic coverage. These partners drilled two wells in the basin during 2003, at Mizzen L-11 and Tuckamore B-27. Although these two wells are still under confidential status, the partners have announced that Mizzen L-11 well encountered non-commercial hydrocarbons and Tuckamore B-27 was a dry hole.

Land Parcels

Parcel thirteen (141,525 hectares) lies adjacent to the North Dana significant discovery license (472 bcf recoverable), straddling the eastern flank of the Ridge Complex and the western boundary of the Flemish Pass Basin in water depths ranging from about 400 to 800 metres (Fig. 3). North Dana flow-tested 12.8 million cubic feet per day of gas, and 292 barrels per day of condensate from a 10.4 metre net pay interval in Upper Jurassic "Lower Tempest" sandstones. This bid parcel contains one well, Lancaster G-70 which had a good gas show in the Upper Jurassic, but reservoir sections encountered were thin. As this well was drilled on an old Jurassic high the more prospective Lower Cretaceous section was not present (Fig. 6).

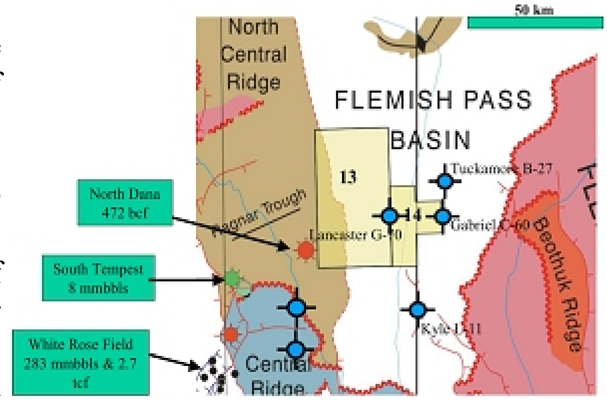


Figure 3

Well locations and geology – parcels 13 and 14

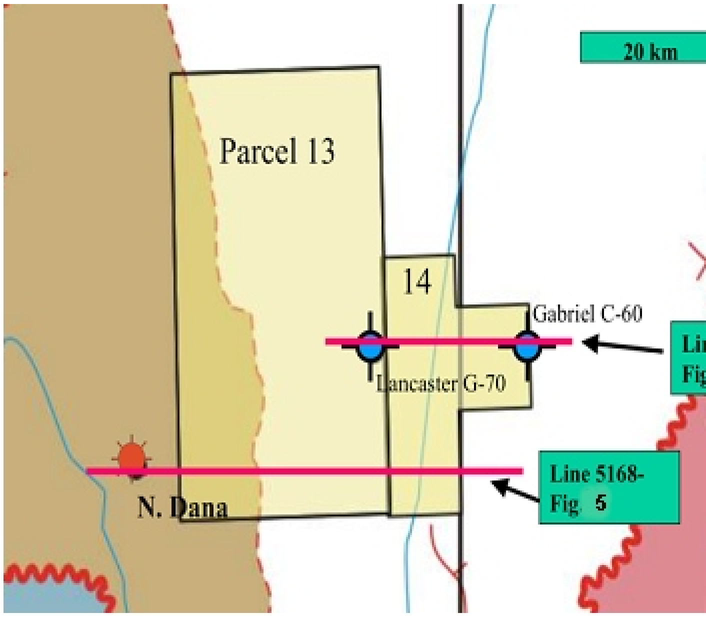


Figure 4
Seismic line locations – for figures 5 and 6

An extensive grid of moderate to generally poor quality,1983 vintage (Soquip) data, covers these parcels and the surrounding area. This data, and the well data, is available for the cost of reproduction from the C-NOPB, in accordance the data release provisions of the Canada-Newfoundland Atlantic Accord legislation. Line 5168 (Figs. 4 & 5) is an east-west line that runs through the parcel and shows its structural relationship to the North Dana discovery. Although imaging of the Cretaceous and Jurassic is very poor, the structure at the base of Tertiary indicates the presence of a possible fault-bounded anticline or tilted fault block abutting the eastern flank North Dana structure.

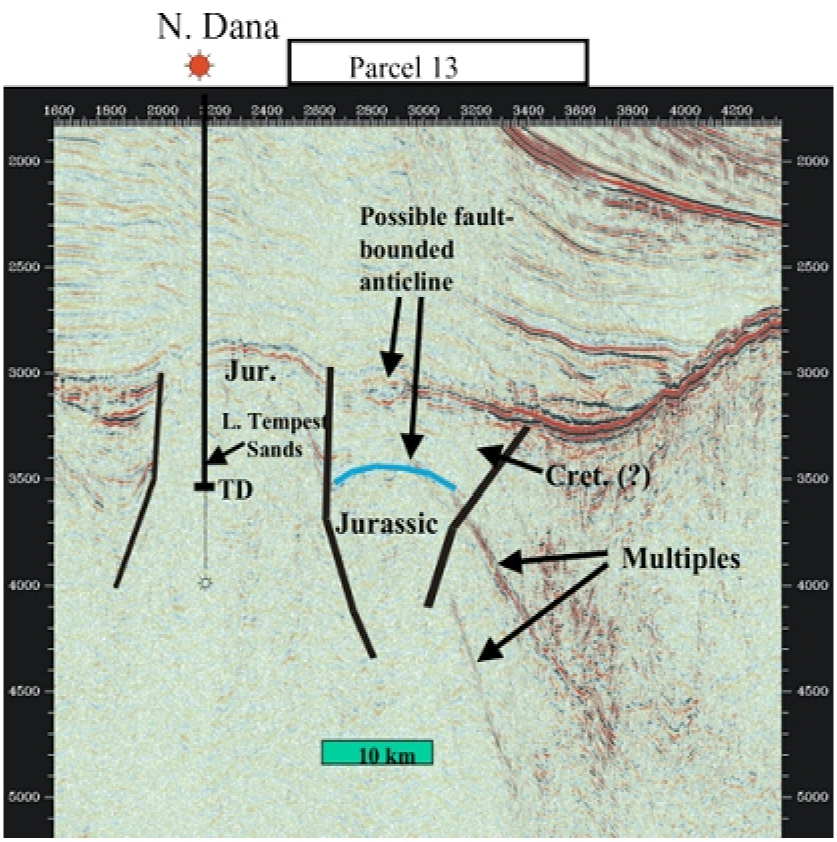


Figure 5
Line 5168: Shows possible fault-bounded anticline in the Jurassic and Cretaceous(?) on Parcel 13

Weak reflections within the Jurassic support this interpretation. A similar feature seen on line 5192 (Figs. 4, 6 & 7) about 20 km to the northeast (on parcel 14), suggests that a large terrace or a series of tilted fault blocks may be present along the eastern flank of the ridge complex. This sets up the possibility of large traps in the Lower Cretaceous and Jurassic. The best potential would likely be in the Lower Cretaceous which had thick high quality reservoir sands at Gabriel C-60 (a portion of which bled oil from core), and which appears to be present above the “terrace” on both parcels. Seismic line 5192 (Fig. 8) shows that parcel fourteen (36,760 hectares) also has the potential for Cretaceous and Lower Tertiary pinchouts against the Gabriel high, as well as fan deposits in the Lower Tertiary.

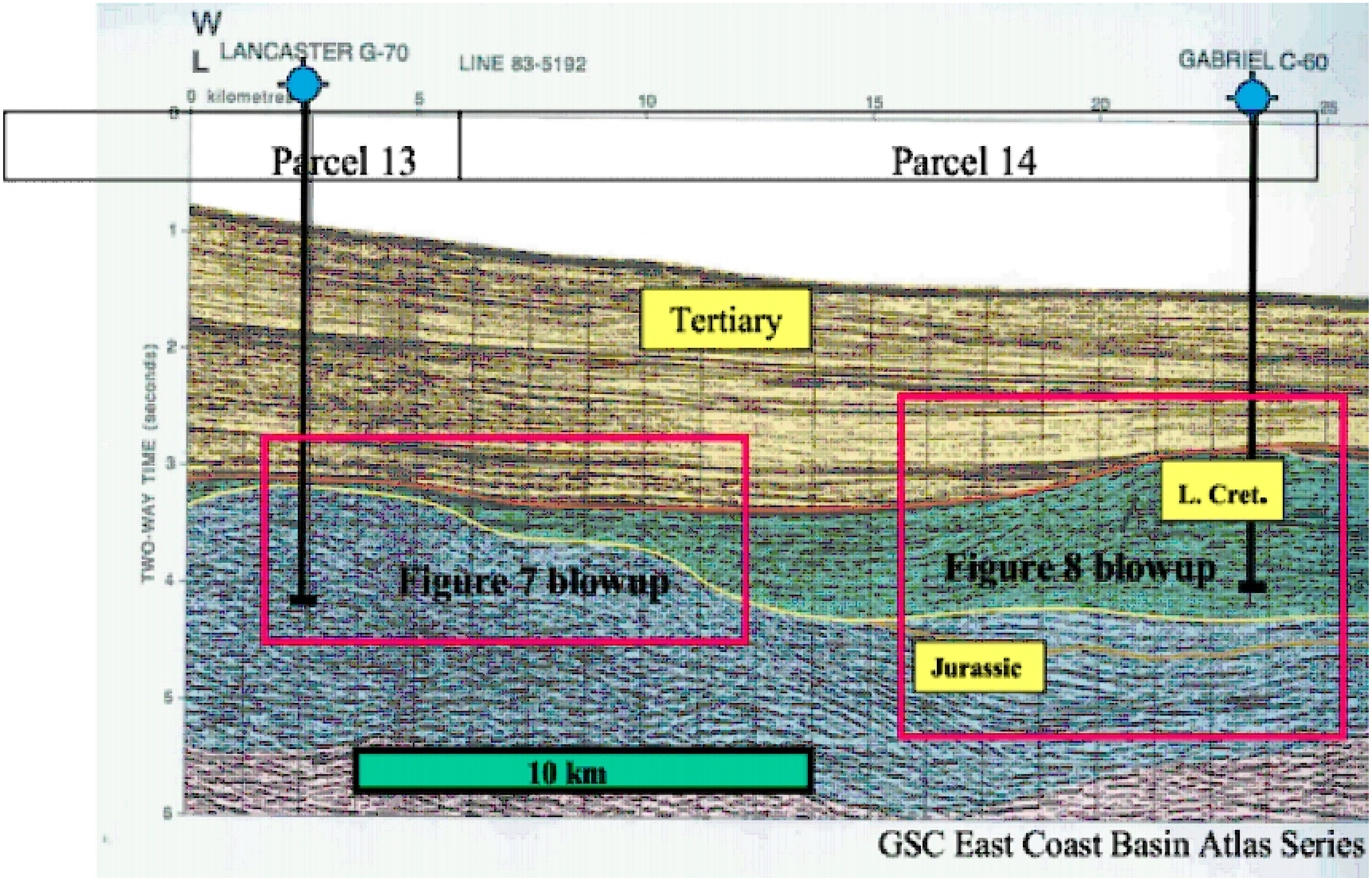


Figure 6

Line 5192 - Section and interpretation from GSC Basin Atlas Series. More detailed views are given in figures 7 and 8.

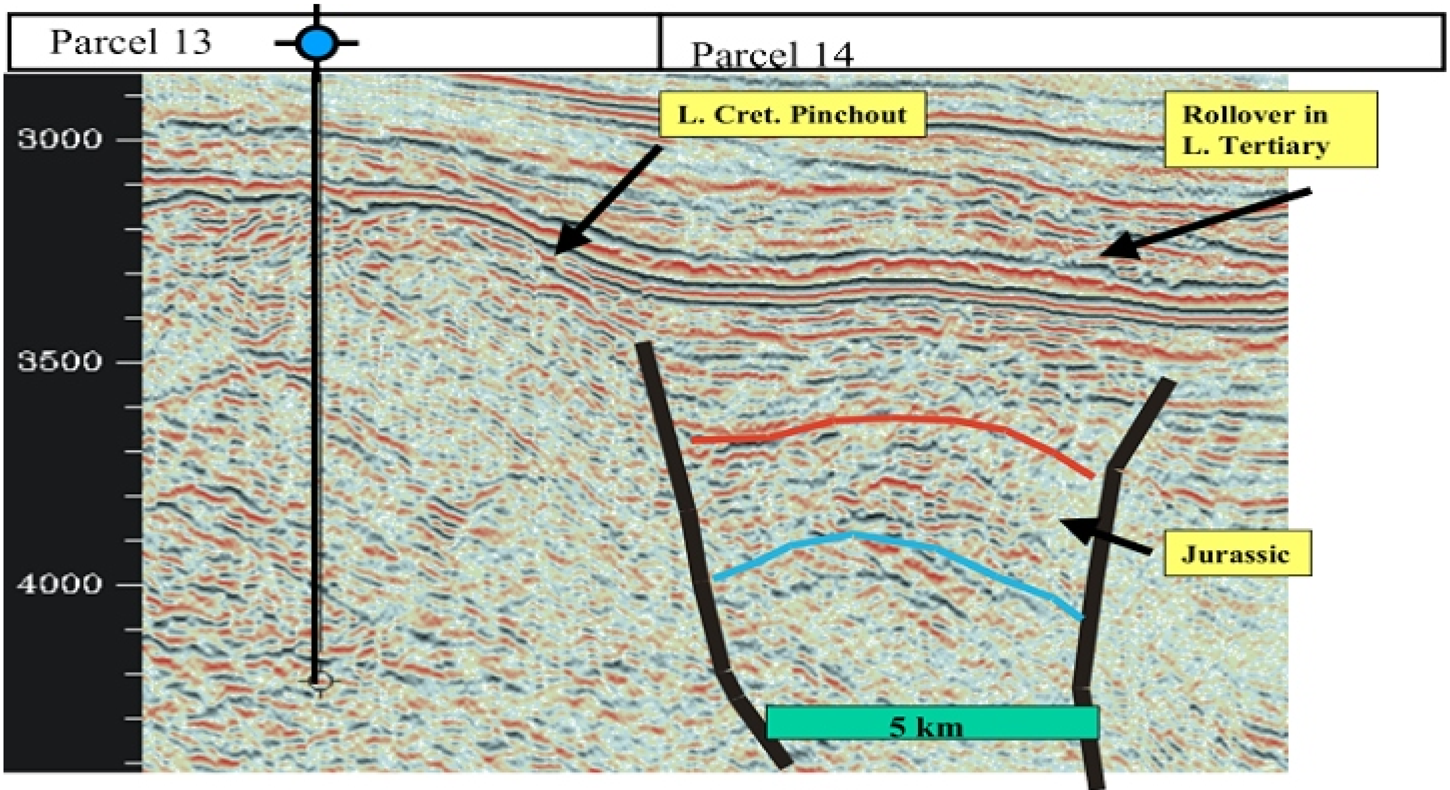


Figure 7

Line 5192: Play possibilities on parcel 14 – Jurassic fault-bounded anticline and Lower Cretaceous pinchout

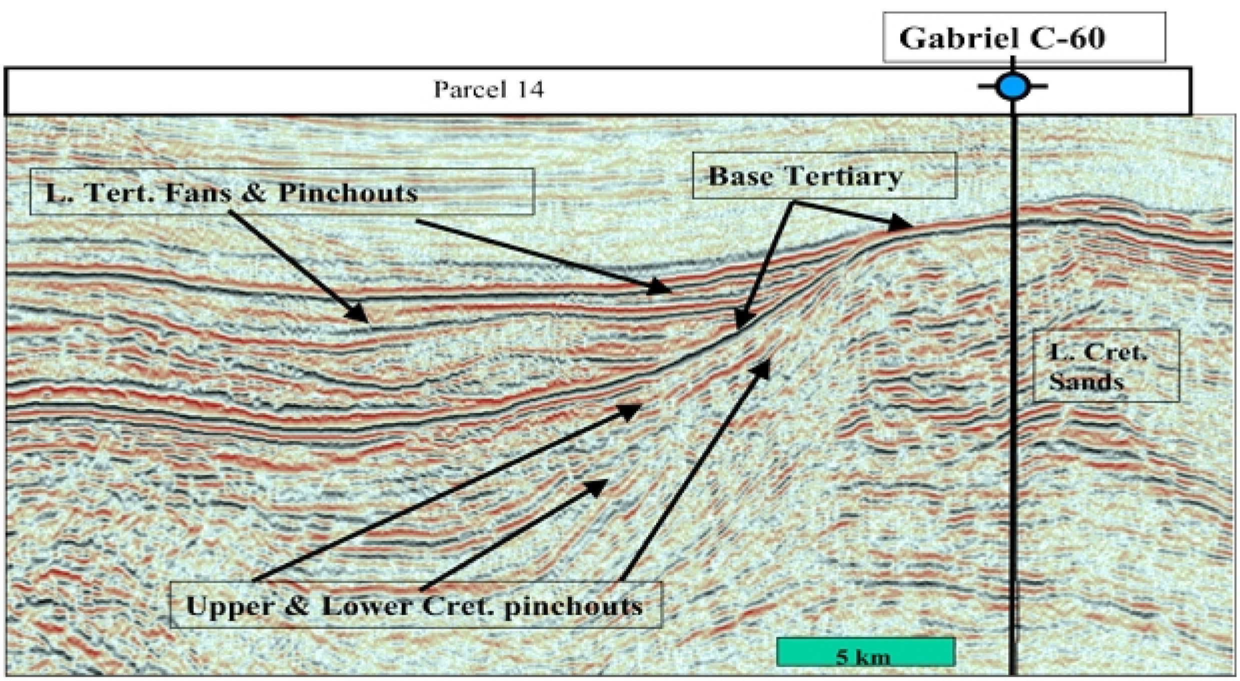


Figure 8

Line 5192: Play possibilities on parcel 14.

Appendix “A”

Well descriptions (Gabriel, Lancaster and North Dana)

Well Name: Gabriel C-60
Operator: Esso Resources Canada Limited
Partners: Voyager
Year: 1979 (1st well drilled in Flemish Pass Basin)
Water Depth: 1109.0 m
RT: 24.1 m

Tertiary

- 1364.9 m thick
- Claystone, minor marlstone
- No reservoir quality intervals or hydrocarbon shows encountered
- Base of Tertiary U/C: 2473.9 m MSL

Upper Cretaceous

- Top: 2473.9 m MSL
- 7.0 m thick
- Marlstone, limestone
- No reservoir quality intervals or hydrocarbon shows encountered

Lower Cretaceous

- Top: 2480.9 m MSL
- 2666.0 m thick to TD
- Predominantly sandstone, siltstone and shale; minor limestone, dolostone beyond 4800 m to TD
- Reservoir quality intervals and hydrocarbon shows encountered

TD (Total Depth): 5146.9 m MSL in Fortune Bay (Lower Cretaceous) shales

Comments:
A 1613.0 m section of Hibernia equivalent sandstone, siltstone and shale were encountered in this well. Reservoir quality shallow marine facies sands occur sporadically throughout the section with one interval exhibiting 10 to 20 % porosity and numerous oil shows over 215 metres (Report GP - CNOPB - 89 - 1). A core cut between 4436.5 to 4451.9 m, within the above referenced reservoir section, showed bleeding oil distributed along a sandstone / shale interface at 4451.75 metres (Esso et al. Gabriel C-60 Well History Report, 1981). Geochemical analysis of this oil indicates a Kimmeridgian source.

Well Name: Lancaster G-70
Operator: Petro-Canada
Partners: Petro-Canada
Year: 1986
Water Depth: 726 m
RT: 24.1 m

Tertiary
- 2456.9 m thick
- Interbedded claystone and shale with minor friable sandstone; limestone towards base
- No shows encountered within Tertiary section
- Base of Tertiary U/C: 3182.9 m MSL

Upper Cretaceous
- Not present

Lower Cretaceous
- Not present

Upper Jurassic
- Top: 3182.9 m MSL
- 1987.0 m thick
- Interbedded sandstone, limy sandstone, limestone, marlstone, siltstone and shale
- Occasional thin, reservoir quality sandstone intervals
- No oil shows, good presence of gas in sandstone at 3348 m

Mid Jurassic
- Top: 5169.9 m MSL
- 507.0 m thick to TD
- Predominantly shale; minor interbedded sandstone, siltstone, limestone and marlstone
- No reservoir quality sandstone intervals encountered
- No oil shows throughout section

TD: 5676.9 m MSL in Voyager Fm. (Mid Jurassic) shales

Comments:
Although numerous, thin to moderately thick sands were encountered throughout the Jurassic interval, most were tightly cemented thereby reducing overall reservoir quality. Porosity logs and RFT data in combination with cuttings examination however indicate narrow zones of good porosity and permeability in non- to weakly cemented sections. Since most sand intervals, whether porous or non-porous appear well sorted and moderately clean, reservoir quality would be expected to improve as the percentage of cementation decreased elsewhere in the basin. No oil shows were observed in this well but geochemical analysis (Fowler et al, 1990) and wireline log interpretation (GP-C-NOPB -94-01) supports the presence of significant source potential within the Kimmeridgian section.

Well Name: North Dana I-43
Operator: Mobil
Partners: Petro-Canada, Gulf, Pan Canadian, Norcen, Canterra, Roxy
Year: 1982 (re-entry 1985)
Play Type: Tilted fault block
Water Depth: 220.8 m
RT: 27.4 m

Tertiary
- 3118.8 m thick
- Claystone and marlstone grading with depth to shale
- No shows encountered within Tertiary section
- Base of Tertiary U/C: 3339.6 m MSL

Upper Cretaceous
- Top: 3339.6 m MSL
- Interbedded lime mudstones and shale
- No shows encountered within Upper Cretaceous section
- 193 m thick

Lower Cretaceous
- Not present

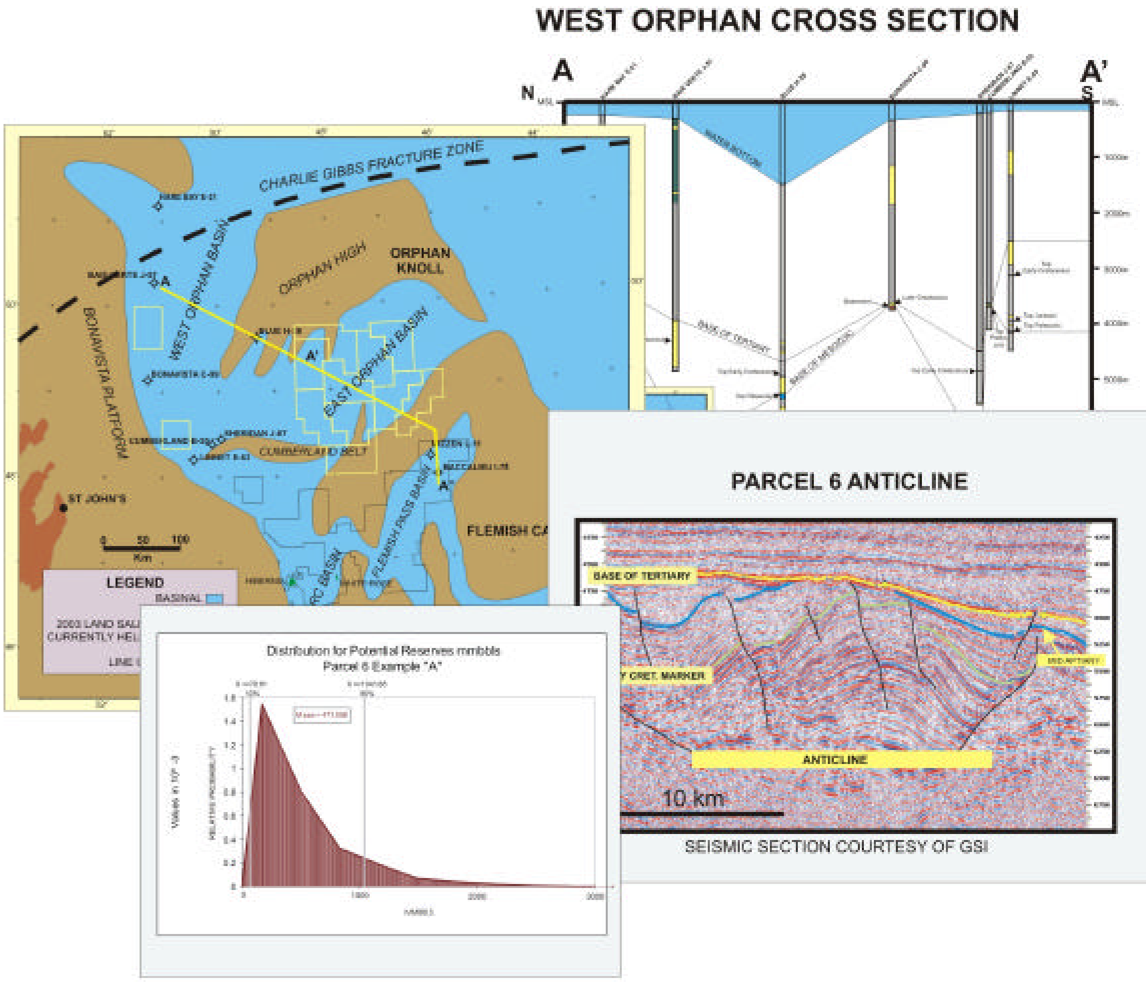
Upper Jurassic
- Top: 3532.6 m MSL
- Interbedded shale, siltstone and sandstone, minor limestone
- Between 4440 - 4455 m, patchy, light brown to black oil stain in sandstone, poor to good (up to 15%) inferred porosity
- 1743.6 m thick to TD

TD: 5276.2 m MSL in Lower Kimmeridgian (Jurassic) source rock

Comments:
A total of four DST's were attempted for this well, of which only one was successful. DST #2 (4536.7 - 4548.3 m RT) flowed gas at 361,606 m^3/d (12.8 MMCF/day) and 52.7^0 API condensate (292 bbls/day) through a 6.35 mm choke from "Lower Tempest" sandstones of the Upper Jurassic Rankin Formation (C-NOPB, Schedule of Wells). Net pay interval was 10.4 m and overall reserves are estimated at 472 BCF gas and 11 MMBbls NGL. Geochemical analysis indicates good source potential within both the upper and lower Kimmeridgian zones. According to Geochem Laboratories (1984), Upper Kimmeridgian source rocks between 4058 and 4403 m RT exhibit TOC values between 0.57 to 2.67 % (avg. 1.48%) with an HI range of 64 to 170. A subsequent report by Fowler and McAlpine (1994) indicate a TOC range of 1.22 to 1.93 % (avg. 1.58 %) between 3883 to 4000 m RT. HI values for the same interval plot from 157 to 219. These upper source rocks are mature (Geochem Laboratories; Avery (1988)) and considered to be a good to very good source of oil and associated gas in the well (Geochem Laboratories, 1984). Lower Kimmeridgian source rocks between 4588 and 5303.6 m RT (FTD) exhibit a TOC range from 0.41 to 1.85 % (avg. 1.19 %) with a HI range of 14 to 92. Low TOC and HI values at North Dana as compared to other wells drilled along the Outer Ridge Complex appear related to greater oxidizing conditions prevalent during deposition of the Egret Member (Fowler and McAlpine, 1994). Other wells located within the Outer Ridge area consistently exhibit higher TOC values (eg., Panther P-52, up to 8.22%) and elevated HI values (500 to 700 range) where the Egret Member is immature (Fowler and McAlpine, 1994).

HYDROCARBON POTENTIAL OF PARCELS 1 - 12, C-NOPB CALL FOR BIDS NF 03-1 DECEMBER 17, 2003

ORPHAN BASIN OFFSHORE NEWFOUNDLAND



REPORT PREPARED FOR
DEPARTMENT OF MINES AND ENERGY
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
AUGUST, 2003

G&G
EXPLORATION
CONSULTING LTD.

HYDROCARBON POTENTIAL OF PARCELS 1 – 12,
C-NOPB CALL FOR BIDS NF 03-1
December 17, 2003

ORPHAN BASIN
OFFSHORE NEWFOUNDLAND

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Foreword

Twenty-three oil and gas discoveries have been made so far in the Newfoundland and Labrador offshore area on the basis of 132 exploration wells. Discovered resources are estimated by the Canada-Newfoundland Offshore Petroleum Board (C-NOPB) at 2.1 billion barrels of oil, 10 trillion cubic feet of natural gas and 450 million barrels of natural gas liquids. Eighteen of the twenty-three discoveries are located within and around the Jeanne d'Arc Basin on the Grand Banks (Figure 1 in the main body of the report) and five are located offshore Labrador. At the time of writing approximately 360,000 barrels of oil per day are being produced from two fields on the Grand Banks (Hibernia and Terra Nova) and a third field (White Rose) is under development and will provide an additional 100,000 bopd in mid 2005.

Since the first large oil discovery on the Grand Banks in 1979, exploration in the Newfoundland and Labrador offshore has been mainly focused on the discovery area (the Jeanne d'Arc Basin and the adjacent Ridge complex), with very little attention going to the several other large Mesozoic and Paleozoic basins in the area. In recent years the industry has begun to revisit some of these lesser-explored basins through the acquisition of seismic data and licensing of lands. The Orphan Basin is one such basin, and is the subject of this report.

Between 1974 and 1985, seven wells were drilled in the Orphan basin by various operators, that did not result in any petroleum discoveries but did confirm the presence of Tertiary, Upper Cretaceous, Lower Cretaceous and, very likely, Jurassic sediments in the basin. Given its very large size (> 150,000 square km) and low well density (one well per 21,400 square km) this basin is an obvious candidate for reassessment and a renewed exploration effort, with the benefit of modern exploration technologies and geological theories.

This report has been prepared by Jerry Smee of G&G Exploration Consulting of Calgary Alberta, under contract to the Department of Mines and Energy to provide information on twelve land parcels in the Orphan Basin that are being offered in the Canada-Newfoundland Offshore Petroleum Board's Call For Bids NF-03-1 which closes on December 17, 2003.

The report discusses the general geology of the Orphan Basin and provides specific information on the twelve parcels (totaling 2,989,160 hectares) being offered in Call for Bids NF-03-1. Two additional bid parcels (totaling 178,285 hectares), located in the north Flemish Pass Basin, were not included in this study.

The term "Orphan Basin" is used here as an inclusive term for what has been referred to as the East Newfoundland - Orphan Basin by some other authors.

Detailed information on the Call for Bids NF-03-01 can be found on the C-NOPB's website: http://www.cnopb.nfnet.com/.

Executive Summary

General Geology and Reservoir Potential

The Orphan Basin is the largest basin mapped thus far, offshore Newfoundland and Labrador, encompassing an area of more than 150,000 square kilometres. Water depths in the basin range from about 200 metres in the western side to 3000 metres in the eastern side of the basin (Fig. E1). Seismic data indicates the presence of a thick Tertiary and Mesozoic sequence, underlain locally by Paleozoic sequences. The seven wells drilled in the basin were located on top of, and near the tops of, large structural highs, which generally proved to be basement blocks with thin Mesozoic cover.

The best potential for discoveries is clearly within Mesozoic and Early Tertiary sections. Good reservoir quality sands were encountered in the Upper Cretaceous section at *Linnet E-63* and *Bonavista C-99*, and within the Lower Cretaceous section at *Blue H-28*. No good Lower Tertiary reservoirs were encountered in the wells but the seismic data shows frequent examples of Lower Tertiary events, (with associated amplitude anomalies) onlapping the large ridge structures that dominate the basin (Fig. 5), suggesting that marginal marine conditions would have existed around these ridges during the Lower Tertiary.

ORPHAN BASIN

Figure E1

Paleozoic sediments (encountered at the base of four of the seven wells) range in age from Permo-Carboniferous to Ordovician and are, for the most part, considered to be petroleum basement. The seismic character indicates these rocks to be highly structured within the Orphan Basin but relatively undisturbed on the Bonavista platform to the west. No high quality Paleozoic reservoirs were encountered in the Orphan Basin wells and they are described as "metasediments" in some cases, and most likely to be over mature as potential source rocks. Nevertheless, the Paleozoic rocks located in western Newfoundland are observed to contain good oil and gas source rocks and reservoirs in outcrop, so they cannot be entirely discounted. Paleozoic carbonates have also flow tested gas at respectable rates offshore Labrador (e.g. 19 mmcf/d at *Hopedale E-33*). The Paleozoic sandstones contained in emergent blocks could also have provided an excellent provenance for reservoir quality sandstones during the Jurassic and Cretaceous.

Source Rock

The key source rock that has been recognized on the Grand Banks is the Kimmeridgian aged Egret member, which has sourced the major oil and gas discoveries of the Jeanne d'Arc Basin and is also proven to be widespread in the Flemish Pass Basin. Although this formation has not yet been penetrated in any of the seven Orphan Basin wells, it has been encountered in close proximity, in the northern part of the Flemish Pass Basin - in the *Baccalieu I-78* well. In this report the seismic data at *Baccalieu I-78* has been jump correlated to various parts of the Orphan Basin and strongly suggests that thick sequences of Jurassic and Cretaceous aged sediments are present between major ridges in the basin. Additional evidence for Jurassic sediments in the basin is the presence of reworked Jurassic fauna in the Lower Cretaceous section at *Blue H-28*, and the fact that a 200 metre section in the *Linnet E-63* well has been interpreted by Mobil as being of Oxfordian age. Direct evidence for the presence of Jurassic source rock comes from the close similarity in the chemistry of hydrocarbon shows in the *Sheridan J-87* and *Baie Verte J-57* wells, to that of the oils in the Jeanne d'Arc Basin fields. The presence of gas chimneys on seismic data (Fig. 18), also provides direct evidence for the presence of significant hydrocarbons in the Orphan Basin.

Although no mature source rock has been encountered in any of the seven wells in the Orphan Basin, good but immature oil prone shales with TOCs ranging from 1% to 7% have been encountered in Lower Tertiary and Upper Cretaceous sections in several of the wells. Lower Tertiary and Upper Cretaceous shales in *Sheridan J-87* were described by Bayliss (1982) as a moderately mature oil and associated gas source in which a moderate amount of immature napthenic oil, condensate and wet gas had been formed. Bayliss also concluded that deeper burial could render these shales as very good (and possibly prolific) oil and associated gas source facies.

The top of the oil window was determined by various analysts to range from 3100 metres to 5100 metres (Koning 1988). Given the thickness of the Tertiary section observed on seismic data, particularly in some of the shallow-water areas of the basin, these shales have a good probability of reaching full maturity. At *Blue H-28* the Oligocene and younger rocks contain primarily gas prone kerogens while the Eocene, Upper and Lower Cretaceous rocks contain higher percentages of oil generating kerogens (Koning 1988). Analysis by Dow (1979) concluded that the potential source beds within Lower Tertiary and Cretaceous at *Blue H-28* had been subjected to oxidation and would be severely diminished in their generative capacity. This conclusion "has not been recognized by all the Blue partners" (Koning 1988) but it was agreed that the zones with sufficient organic richness within the oil window are too thin for "effective" hydrocarbon generation. However, given that these beds may be thicker and un-oxidized in what would have been deeper parts of the basin during the Cretaceous and Lower Tertiary, they may still prove to be significant source rocks. The fact that the Upper Cretaceous Markland Shale is the source rock for the gas discoveries offshore Labrador (to the north) also gives credence to the possibility of Cretaceous source rocks in the Orphan Basin.

Assessment of Parcels

Based on the information presented above, a good case can be made for the presence of reservoir and source rock throughout the basin, particularly where the seismic data shows the presence of a thick Mesozoic section. With the assumption that these key factors are in place, preliminary resource assessments have been carried out for a number of very large structures located on the bid parcels. Areas of closure have been estimated from the GSI seismic data (and other released data on parcels 1 and 2) and thicknesses of sedimentary section under closure within the Lower Tertiary, Cretaceous and Jurassic sections have been estimated based on seismic character. This information has been used to generate probabilistic resource estimates for a number of these leads / prospects, the results of which are presented in Appendix "A". Although the preliminary nature of this analysis is readily acknowledged, the size and ultimate potential of the prospects and leads analyzed is very encouraging. Of fifteen structures analyzed, four had a mean potential in excess of one billion barrels recoverable, five had a mean potential of between 500 million barrels and one billion barrels recoverable, with the rest ranging from 128 million barrels recoverable to 470 million barrels.

Acknowledgments

This report has been made possible by the generous access to new high quality proprietary seismic data provided by Geophysical Services Incorporated (GS), of Calgary, to which the Department of Mines and Energy (DME) and Consultant are thankful. Paul Einarrson and Sam Nader of GSI are recognized for their support throughout the project. Jacob Raymond, also of GSI, is acknowledged for loading data, and providing maps that served as the basis for many of the illustrations, as well as facilitating electronic communication.

The project was coordinated by Phonse Fagan of DME who also edited the report. Dave Hawkins (DME) provided support throughout. Thanks are also extended to: Tim Thompson and Neil DeSilva of the C-NOPB who provided valuable input at the early stages of the project; to Trevor Bennett and Lewis Manuel of the C-NOPB who assisted in providing basemaps and seismic sections from the Board's files for use by the Department as well as well reports and well data for the Consultant; to Sheila Duff for patient assistance in the C-NOPB library; to Larry Hicks and Lisa Benson (DME), who assisted in editing, and in the initial review and assessment of seismic and well data; special thanks to Lisa Benson who created and modified many of the graphics and finalized the report design; to student Derek Simpson who assisted in preparation of graphics; to Terry Sears of the Mines Branch who helped solve some computers problems; and to the GSC who allowed use of a number of graphics from their East Coast Basin Atlas Series.

Iain Sinclair of Husky Energy and Jonathon Bujak, of Bujak-Mudge International Consultancy, are also recognized for allowing use of their illustrations.

Finally Dr. Michael Enachescu of Memorial University is thanked, not only for editing and reviewing portions of this report, but for initiating the idea for an Orphan Basin review.

HYDROCARBON POTENTIAL OF THE ORPHAN BASIN
OFFSHORE NEWFOUNDLAND

1. Introduction

The Orphan Basin (located off the coast of Newfoundland, some 370 km N.E. of St. John's) is estimated to comprise an area of over 150,000 sq. km (Fig. 1).

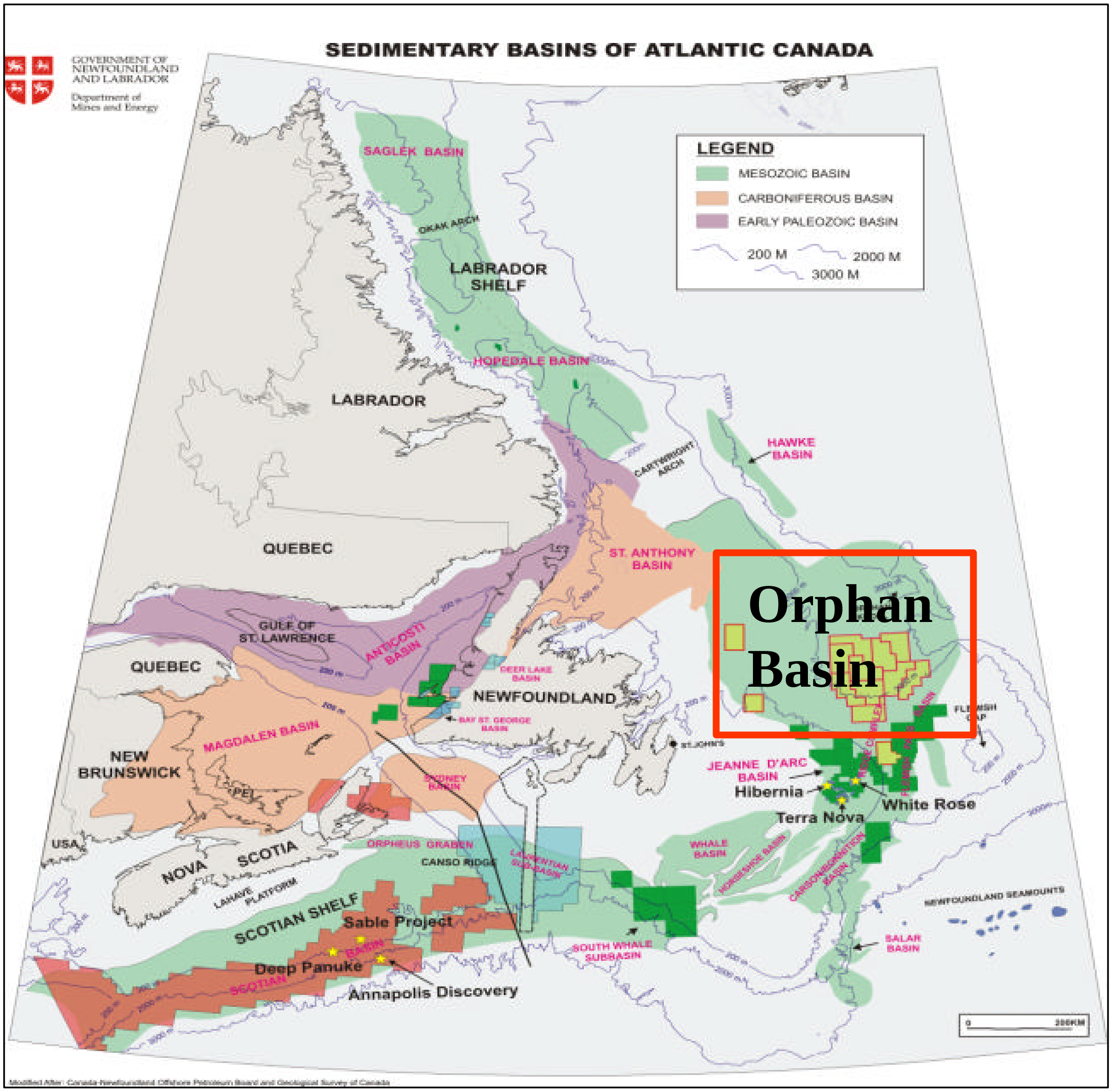


Figure 1
East Coast Basins and Land Holdings

Water depths range from 200 m in the west to over 3000 m in the eastern part of the basin (Fig. 2).

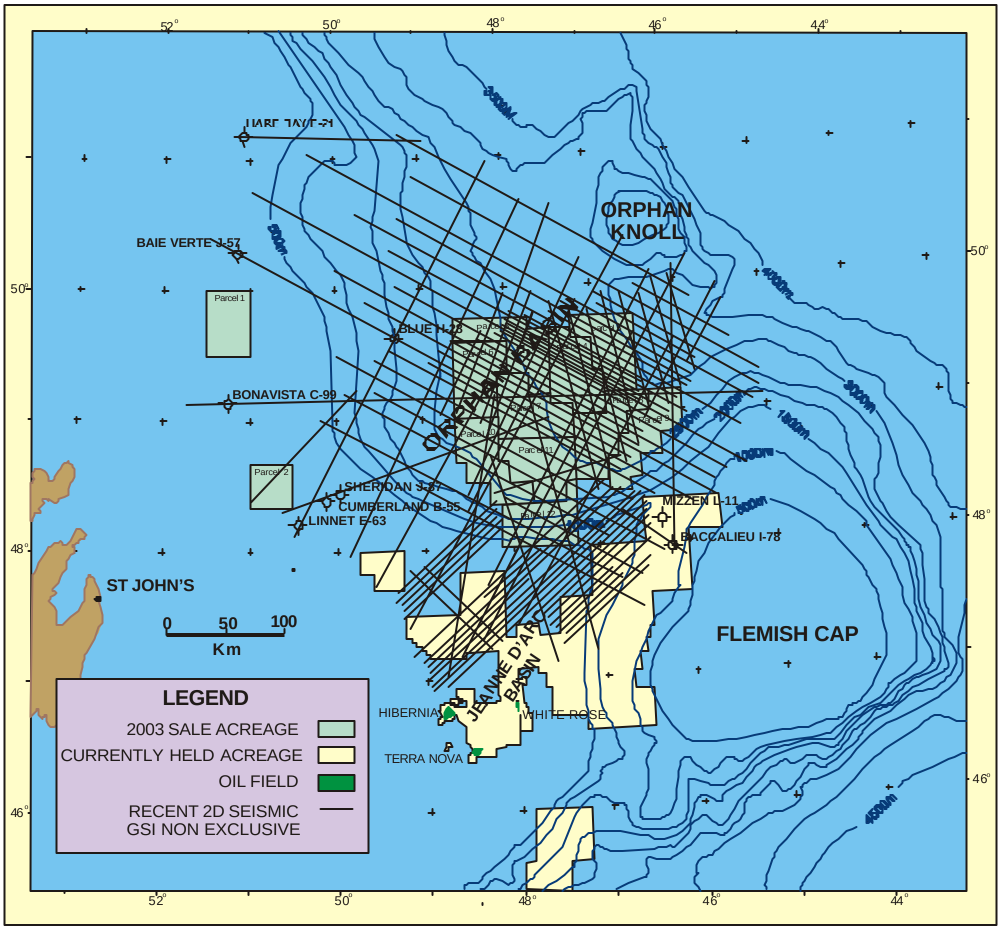


Figure 2

Land Parcel Map with new GSI Seismic Coverage

Although Exploration Permits and Licenses were held in the area throughout the 1970's and 1980's, exploration was concentrated on the shallower water western part of the basin, and much of the Orphan Basin area remains unexplored.

Seven wells, drilled in the western part of the basin between 1974 and 1985, were located on large structural closures that could be recognized on the seismic data available at the time. These features generally proved to be high basement blocks with thin Mesozoic cover, and the wells encountered Tertiary and Cretaceous sediments overlying petroleum basement. The critical Upper Jurassic section, which contains the proven source rock in the Jeanne d'Arc Basin to the south, was not definitively penetrated by any of the wells in the basin.

Recent (2000 – 2002) seismic data (Fig. 2) has revealed a large Mesozoic aged sub-basin in the eastern part of the basin, and confirmed that a thick Mesozoic section exists between the basement highs in the west. These Mesozoic sediments likely contain the Upper Jurassic and Lower Cretaceous section that is critical to the development of petroleum systems in the Jeanne d'Arc Basin, the North Sea, and other basins on the margins of the North Atlantic Ocean. The new seismic data has also revealed many large-scale structural closures that likely involve the Lower Cretaceous and Upper Jurassic section, and could contain giant-sized reserves.

The discovery of large reserves in the Jeanne d'Arc Basin drew the exploration focus to that area for the past twenty years but new geological understanding of deepwater basins and advances in deepwater development technology has brought renewed interest to the Orphan basin. Additionally it is clear that the field development techniques being developed to produce from deepwater areas around the world, together with techniques utilized in the Jeanne d'Arc Basin to the south can be applied to the Orphan Basin, which vastly improves the feasibility of developing future Orphan Basin discoveries.

Since the recently acquired seismic has become available, industry interest in the Orphan Basin has increased. After a hiatus of 18 years, 10 blocks covering most of the eastern sub-basin, and 2 blocks in the western Orphan area have been posted by the C-NOPB for the land sale scheduled to close on December 17, 2003.

This report has been prepared under contract to the Government of Newfoundland and Labrador, Department of Mines & Energy to provide relevant geologic information to interested parties.

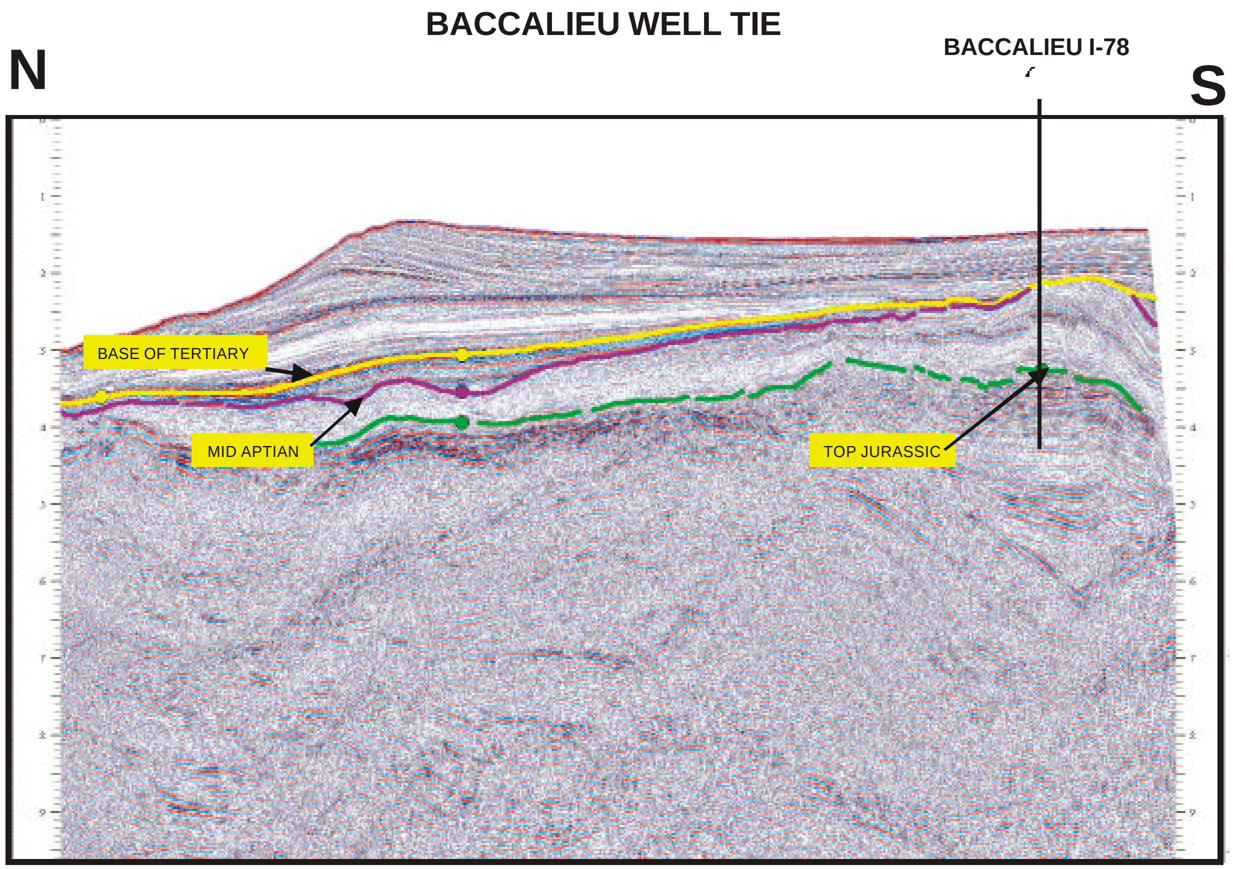
2. Data Base and Regional Correlations

Although a great deal of 2D seismic data was acquired during the 1970's and early 1980's, primarily over the western part of the Orphan Basin, it was mostly of poor quality and did not image very well below the Base of Tertiary. Recent programs in the basin by Geophysical Service Incorporated (GSI), and TGS-Nopec over the past three years (2000 – 2002) is of significantly better quality than the older data and presents a much clearer view of the Mesozoic section. This study is chiefly based on a database of over 18,000 km of good to excellent quality modern 2D seismic that has been acquired on a non-exclusive basis by GSI. This data is primarily located over the Eastern part of the basin with line spacing ranging from 3 to 12 kilometres (Fig. 2). Longer cable lengths (6 km – 8 km) and more accurate navigation (GPS) have improved data quality in the recent seismic, and achieved deeper penetration of the Mesozoic section, particularly in the deeper water areas.

The Orphan Basin is very much a virgin frontier in terms of well control. Drilling has been restricted to the western edge of the basin, with only one well (Texaco Shell et al Blue H-28) located towards the center of the Basin. The Blue well, drilled in 1979, in 1486 m of water, set a world deepwater record at the time. It penetrated a Paleozoic basement high with thin Mesozoic cover, which included porous Early Cretaceous sandstones (Figs. 11 & 21). As was the case with other wells drilled in the Basin, the thin Mesozoic section encountered provided very little information about the syn-rift rocks away from the structure.

The Baccalieu I-78 well, drilled in the Northern Flemish Pass Basin, is the closest publicly available well to the Orphan Basin to test a thick Mesozoic section. It is possible to "jump correlate" the seismic data from this well into the south-eastern part of the Orphan Basin with some degree of confidence.

For instance, although the Baccalieu well drilled through the Tertiary directly into Barremian aged section, a well defined unconformity, younger then Barremian, can be seen to the North of the Baccalieu well on a recent north-south line that runs through the Baccalieu location (Fig 3). This unconformity, shown in purple, can be correlated throughout the Eastern part of the Orphan Basin. The section above the unconformity is relatively unstructured and drapes or onlaps pre-existing highs and the margins of the basin, suggesting deposition during a period of passive subsidence. The section below has been structured, and is truncated by the unconformity on the margins of the Basin. The constraints on the age of the unconformity from the Baccalieu well, and the similarity in appearance to the Avalon Unconformity in the Jeanne d'Arc Basin strongly support a mid-Aptian age for this unconformity, which in turn supports the interpretation that Lower Cretaceous and Jurassic section is present within the Orphan Basin.



Seismic Courtesy of GSI

Figure 3
Correlation from Baccalieu I-78

Additionally, a comparison of the seismic character below the Base of Tertiary in the Orphan Basin with the seismic character of the Jurassic and Lower Cretaceous section at the Baccalieu location gives further support to the presence of a thick Lower Cretaceous and Jurassic section within the Orphan Basin (Fig. 4).

The GSI seismic data has been used to correlate major regional markers such as the Base of Tertiary and the Mid Aptian Unconformity over the entire Orphan Basin. It has also been used to identify and roughly outline potential hydrocarbon prospects and leads on which additional information is provided in Appendix "A". The seismic data across the prospects and leads presented in this report are interpreted to show major structural features and stratigraphic packages. A detailed horizon and fault interpretation of the seismic is beyond the intended scope of this report.

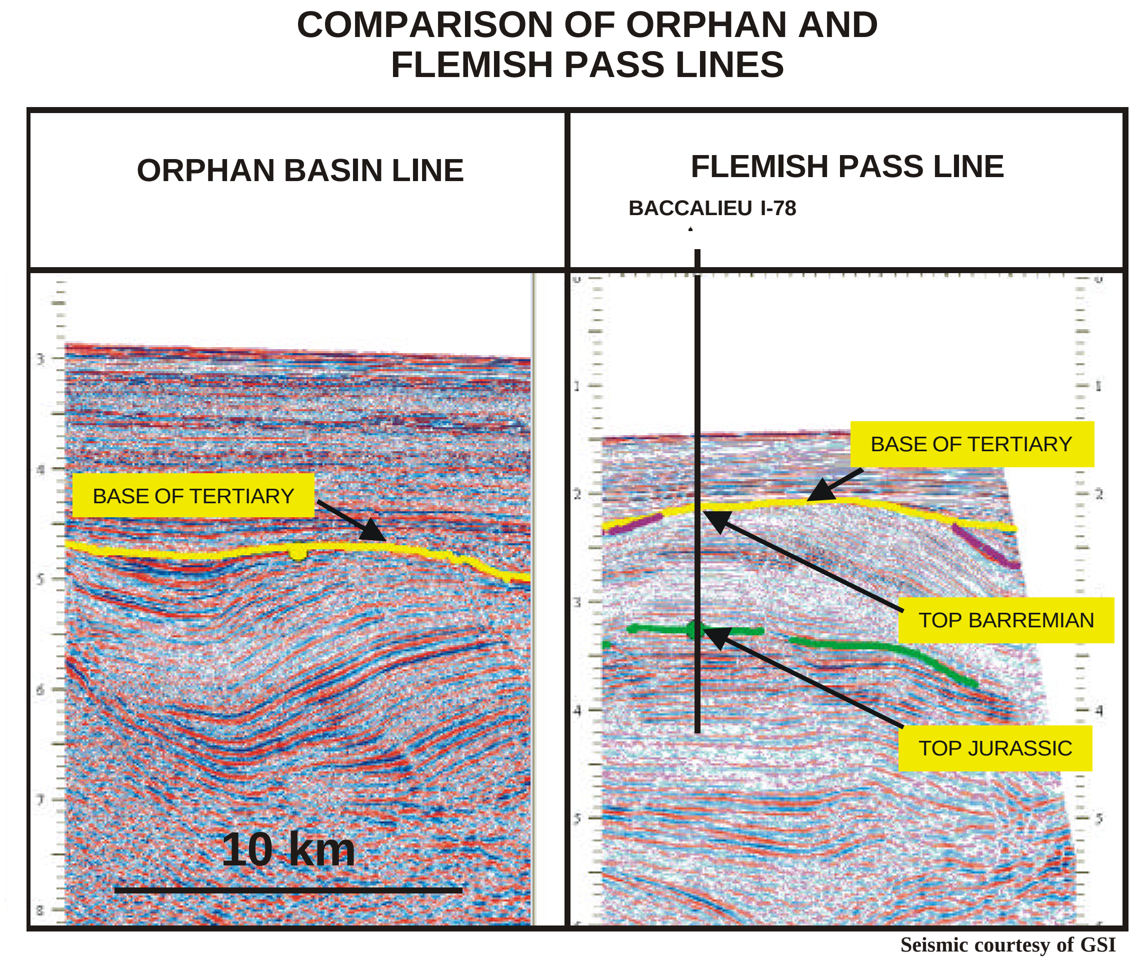


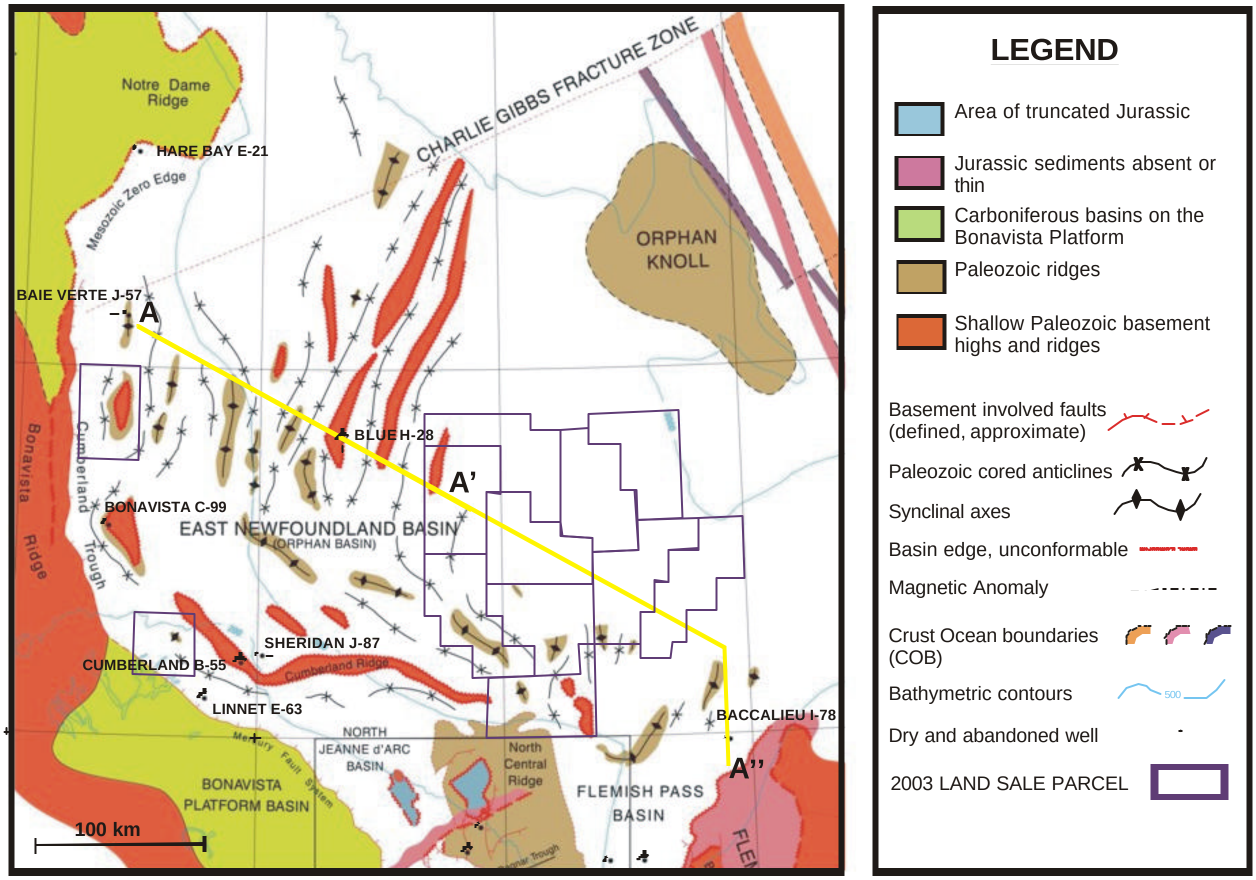
Figure 4
Comparison with Flemish Pass Mesozoic section

3. Physical Description and Naming Convention

The Orphan Basin represents an area of thinned and foundered continental crust that formed during the period from late Triassic to late Cretaceous, as a result of the opening of the North Atlantic Ocean. Stretch factors are estimated to be greater then 0.5 over most of the area (Keen and Dehler, 1993; Chian et al., 2001).

The Orphan Basin is bounded: to the west by the Bonavista Platform; to the south by a high block separating it from the Jeanne d'Arc and Flemish Pass Basins (Cumberland Belt of Enachescu, 1987); to the east by a high basement ridge that runs between the Orphan Knoll and the Flemish Cap; and to the north by onlap of sediments onto a basement high that extends westward from the Orphan Knoll (the Orphan High) (Figs. 5 and 6). Note that Figure 5 shows the present day tectonic elements that define the Orphan Basin, whereas Figure 6 outlines the Basin during the critical time (Late Jurassic to Early Cretaceous) for the development of the petroleum system in the area. The basement underlying the syn-rift and post-rift sediments is Precambrian and Paleozoic in age and relates to the Appalachian orogeny.

ORPHAN BASIN TECTONIC ELEMENTS



GSC East Coast Basin Atlas Series

Figure 5

The western portion of this area has been referred to as the North-East Newfoundland Shelf, the East Newfoundland Basin or the West Orphan Basin in other publications. In this study the entire area is referred to as the Orphan Basin, which contains two Mesozoic aged sub-basins (the West Orphan Basin and the East Orphan Basin) separated by the Orphan High (see Figs. 6 & 7). The Orphan High is an area of relatively thick continental crust, approximately 60,000 sq. km in area, which plunges to the S.W. of the Orphan Knoll, where it has emerged at the sea floor as a bathymetric feature. Seismic indications of onlap of deep Mesozoic horizons against the Orphan High suggests that it has existed since the Late Triassic, when extensional forces initially formed the Orphan Basin. Later extensional episodes have broken it into a series of large-scale north-south trending horsts and fault blocks, 10 - 15 km wide and 200 km long, that are seen in the present day (Figs. 5 and 7).

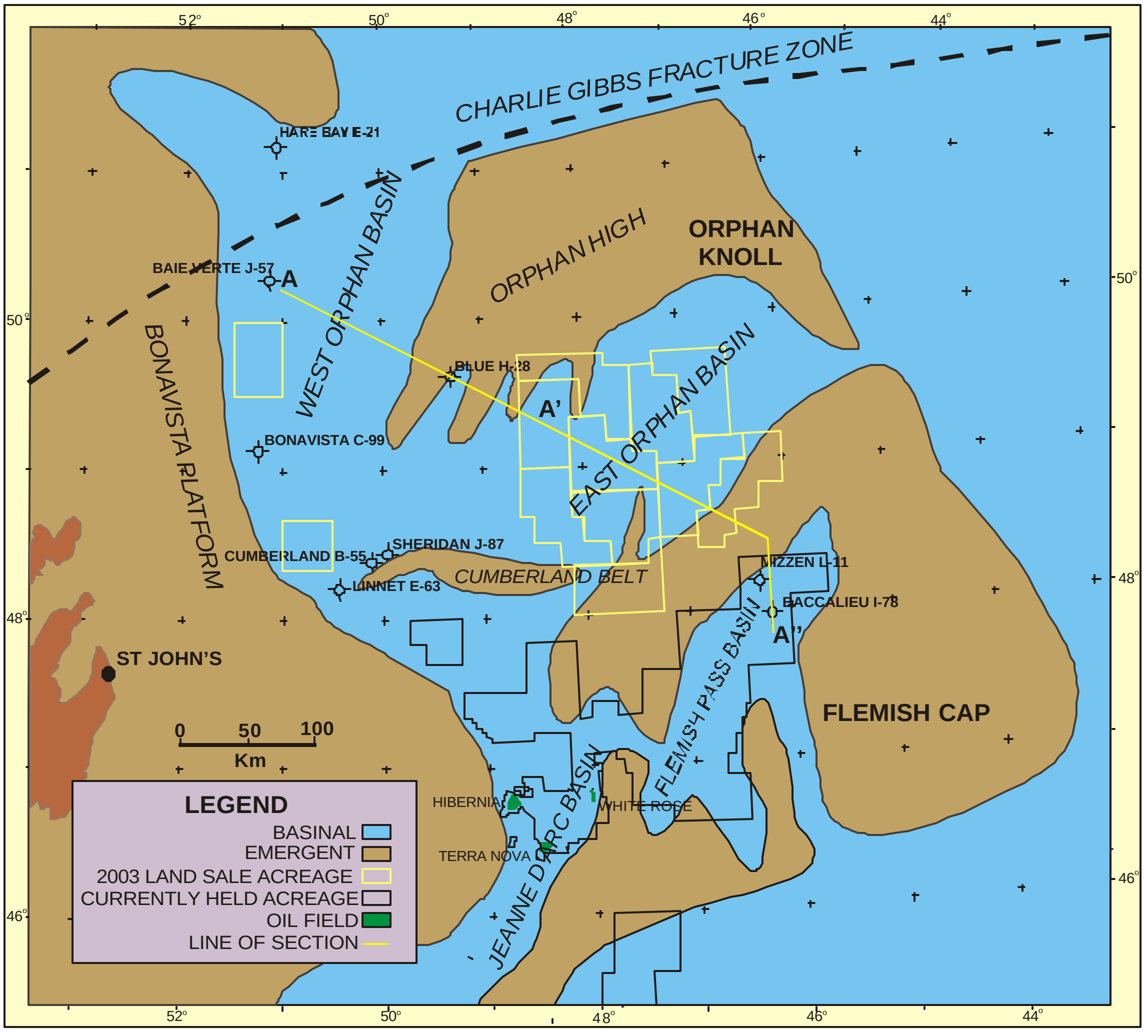


Figure 6
Grand Banks and N.E. Newfoundland Late Jurassic to Early Cretaceous (Lowstand) Basin Outlines

East Orphan Basin

The East Orphan Basin is an area of approximately 37,000 sq. km, lying between the Orphan High and the Flemish Cap. The basin is interpreted to contain over 4000 m of Upper Jurassic and Lower Cretaceous section (Fig. 7) with a Tertiary thickness ranging from 1000 to 2500 metres. In the eastern portion of the Basin, the earlier Mesozoic section is covered by up to 2000 m of Upper Cretaceous section.

Extensional tectonic episodes throughout the Late Cretaceous have structured the earlier sedimentary section into a number of large scale anticlinal and fault bounded structures. These structures are either related to basement involved tectonics, or structuring within the sedimentary section itself, and could contain significant hydrocarbon reserves.

Land sale parcels 3 – 12 are located within the East Orphan Basin.

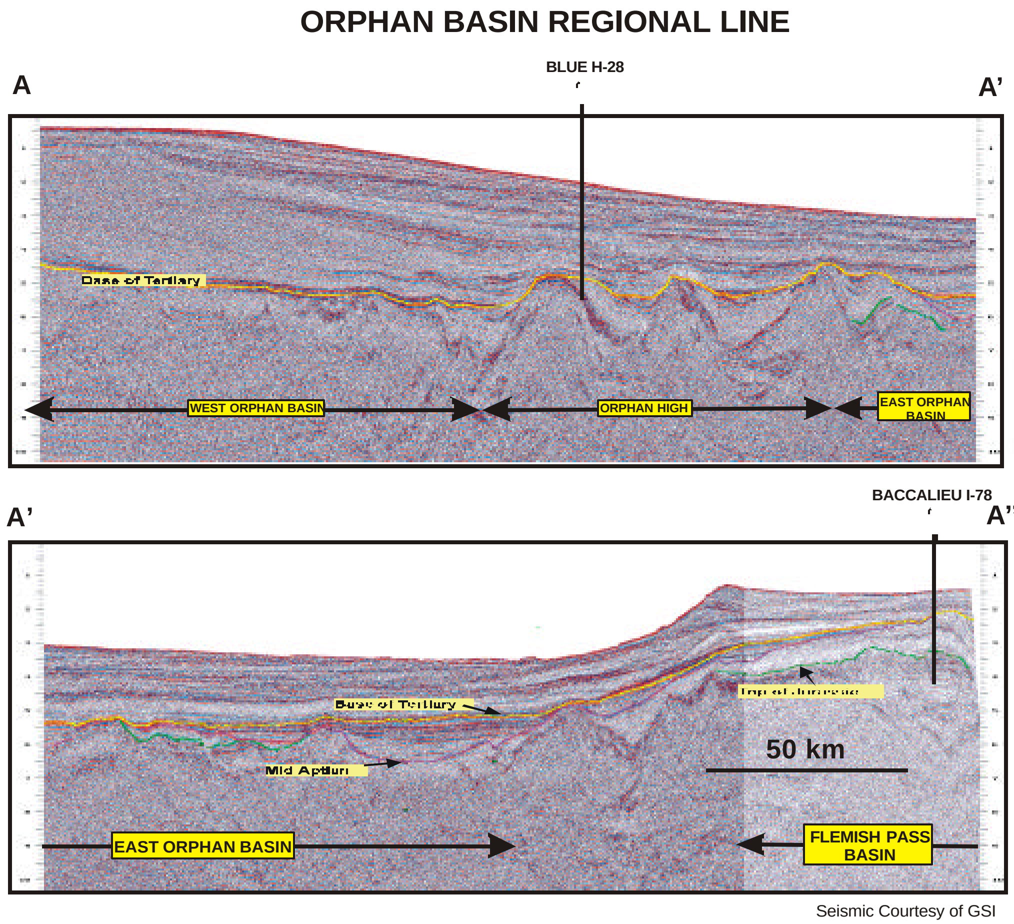


Figure 7
Regional Seismic Section across Orphan Basin

West Orphan Basin

Land sale parcels 1 and 2 are located in the West Orphan Basin which is an area of approximately 60,000 sq. km lying between the Orphan High and the Bonavista Platform (Fig. 6).

The Tertiary section over the West Orphan Basin is significantly thicker than in the East Orphan Basin, ranging from 3250 m to 4800 m in thickness. Below the Base of Tertiary seismic marker, a thick Mesozoic section can be seen onlapping the Bonavista Platform, and other basement features over much of the area (Fig. 7). This Mesozoic section contains a significant number of potential hydrocarbon traps as tilted fault blocks, or drape closures over basement highs. Additional play potential exists in the lower Tertiary where a large amplitude anomaly is seen to terminate against a fault in parcel two.

4. Exploration History and Drilling Results

Exploration of the Orphan Basin commenced in 1969, when Shell Canada Ltd. was granted a permit covering the western portion of the basin. Other major oil companies held acreage in the Orphan Basin throughout the 1970's and early 1980's, including Imperial Oil (Esso), Mobil, BP and Texaco as operators, and Petro Canada, Canterra, Beau Canada, Norcen, Columbia Gas, Home, Dome, HBOG and others as partners.

Seismic acquisition began in 1971 with the shooting of over 2000 km of non-exclusive 2D seismic by GSI and Caravel. A number of 2D seismic programs, both exclusive, and non-exclusive were shot in the basin throughout the 1970's and early 1980's, resulting in over 50,000 km of 2D seismic coverage in the area. This data was primarily concentrated in the western portion of the basin. Data quality, particularly below the Base of Tertiary unconformity was poor due to severe multiple problems, and the relatively large thickness of the Tertiary section in the western part of the basin.

Drilling began in 1974 with the Bonavista C-99 well by BP and Columbia Gas. Six other wells were drilled in the West Orphan Basin between 1975 and 1985 with the last well, Baie Verte J-57, operated by BP.

5. Drilling Results:

All of the wells were located in the West Orphan Basin, with the exception of the Blue H-28 well, which was drilled on the Orphan high. Most wells were drilled on large structural closures identified through mapping the Base of Tertiary seismic marker, which was the deepest regionally consistent marker that could be correlated on the data available at the time.

The key tops from each of the wells are summarized in Table 1 and Figure 8 is a structural cross-section through the seven wells. A geological summary and seismic section through each well is provided in section 6.

Table 1 Drilling Results Summary

WELL NAME	PARTNERS	YEAR OF SPUD	WATER DEPTH m	BASE OF TERTIARY ELEVATION m MSL	BASE OF U. CRET ELEVATION m MSL	TOP OF PALEOZOIC ELEVATION m MSL	FTD ELEVATION m MSL
Bonavista C-99	BP, Columbia Gas	1974	329	3616	3655	3655 (Granite)	3769
Cumberland B-55	Mobil, Gulf, Imperial	1975	195	3623	3677	3677	4107
Blue H-28	Texaco, Shell, Petro Canada, Home, Dome, HBOG	1979	1487	4685	4935	5266	6088
Hare Bay E-21	BP, Gulf, Chevron, Columbia Gas, Petro Canada	1979	239	3197	3378	3378	4850
Sheridan J-87	Mobil, Petro Canada, Gulf	1981	216	4480	4840	NR	5456
Linnet E-63	Mobil, Petro Canada,Gulf, PanCanadian, Norcen, Canterra, Roxy	1982	160	2515	3123	4148	4493
Baie Verte J-57	BP, Chevron, Columbia Gas, Beau Canada	1985	303	3939	4642?	4642?	4886

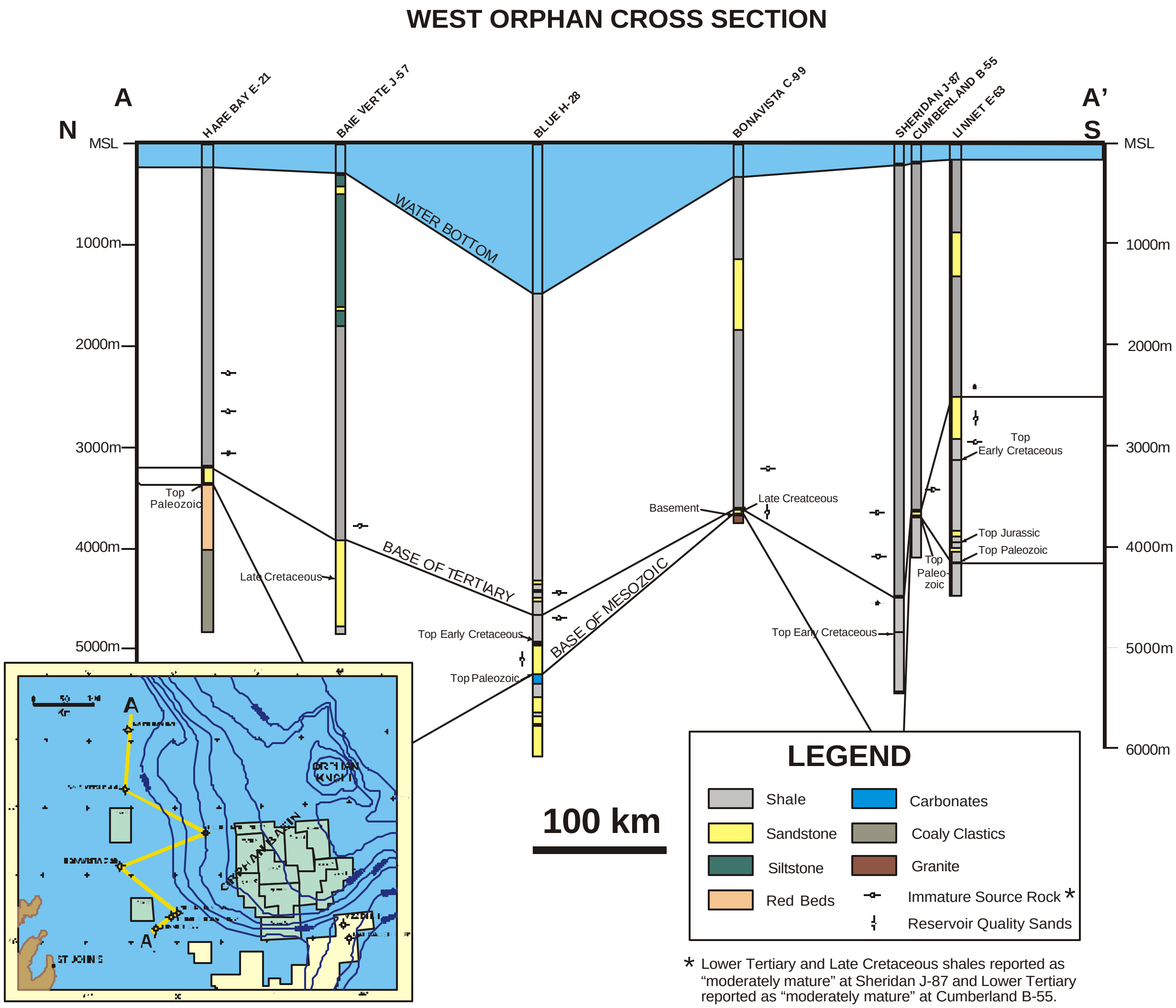


Figure 8

West Orphan Cross Section

6. Well Descriptions:

Hare Bay E-21

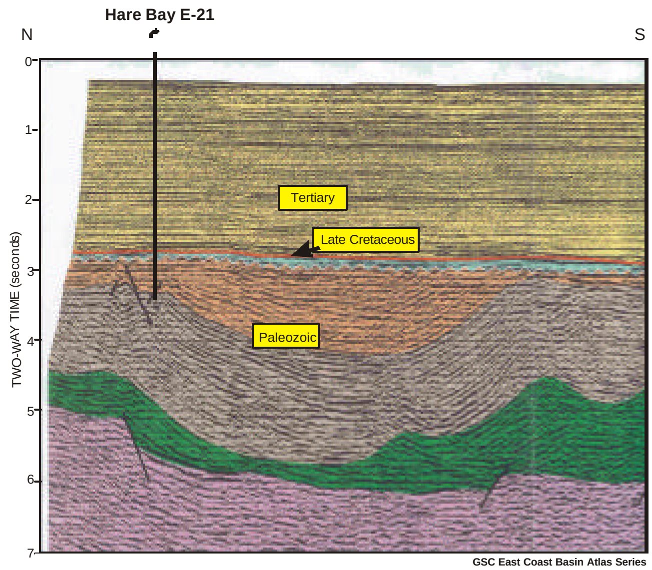


Figure 9
Hare Bay Seismic Section and Interpretation

Well name: Hare Bay E-21

Operator: BP

Partners: Gulf, Petro Canada, Chevron, and Columbia Gas

Year: 1979 (4^{th} well drilled in the basin)

Play type: Mesozoic subcrop

Water Depth: 239 metres

Tertiary
- 2958 metres thick
- Shales and mudstones
- TOCs of 1.7% to 3.5% encountered between 2150 m – 3200 m. Immature oil and gas prone kerogens
- Base of Tertiary U/C: 3197 metres MSL

Upper Cretaceous
- Top: 3197 m
- 181 metres thick
- Tightly cemented sands

Lower Cretaceous
- Not present

Paleozoic
- Top: 3378 metres MSL
- 1472 metres thick (Pennsylvanian)
- 3378 - 4030 metre interval consists of interbedded sequence of tight, well cemented red-brown sandstones and indurated shales and siltstones (redbeds)
- 4030 to 4850 (TD) metre interval consists of more grey coloured sediments with some limestone and coaly horizons

TD (Total Depth): 4850 MSL in Paleozoics

Comments:

Organic rich shales in the lower Tertiary are immature but could become very effective source rock with sufficient depth of burial.

Baie Verte J-57

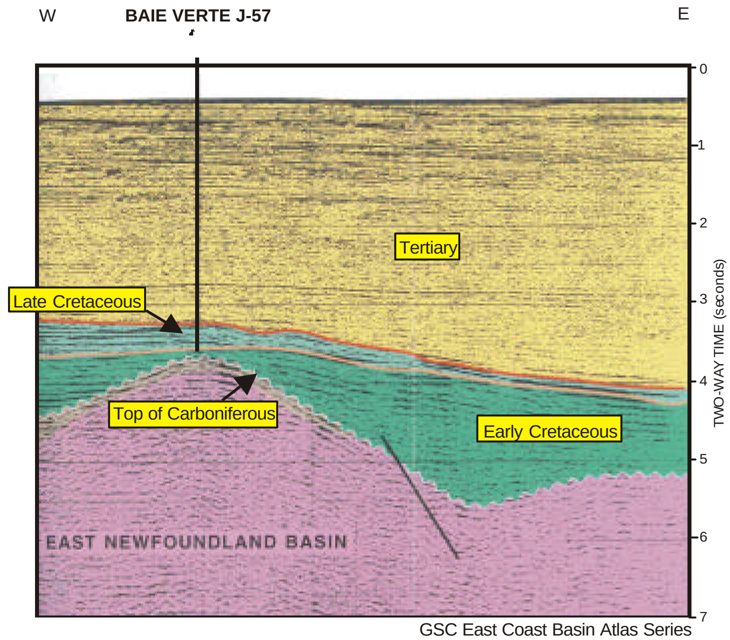


Figure 10
Baie Verte Seismic Section and Interpretation

Well name: Baie Verte J-57

Operator: BP

Partners: Chevron, Columbia Gas and Beau Canada

Year: 1985 (7th well drilled in the basin)

Play type: Basement cored anticline

Water Depth: 303 metres

Tertiary

- Thickness: 3636 metres
- Shales, mudstones, siltstones with some sands in the shallower section
- TOCs of 1.5% to 6% encountered in Lower Tertiary
- Base of Tertiary U/C: 3939 metres MSL

Upper Cretaceous

- Top: 3939 MSL (Santonian)
- 953 metres thick
- Dominantly sandstone, but described as tight, fine grained argillaceous and interpreted to have been deposited in a shallow, marginal marine or inner shelf environment

Lower Cretaceous

- Top 4892 MSL (TD)
- Albian aged mudstone

TD: 4892 MSL in Lower Cretaceous mudstone

Comments:
Organic rich shales in the Lower Tertiary are immature at this location but described by Bayliss (Geochem Labs, 1990) as having “good to excellent potential for sourcing oil liquids and associated gas, should they be buried deeper elsewhere in the basin.”

Blue H-28

Well name: Blue H-28

Operator: Texaco

Partners: Shell, Petro Canada, Home, Dome and HBOG

Year: 1979 (3rd well drilled in the basin and only deep water well)

Play type: Flank of large basement high

Water Depth: 1486 metres (world record at the time)

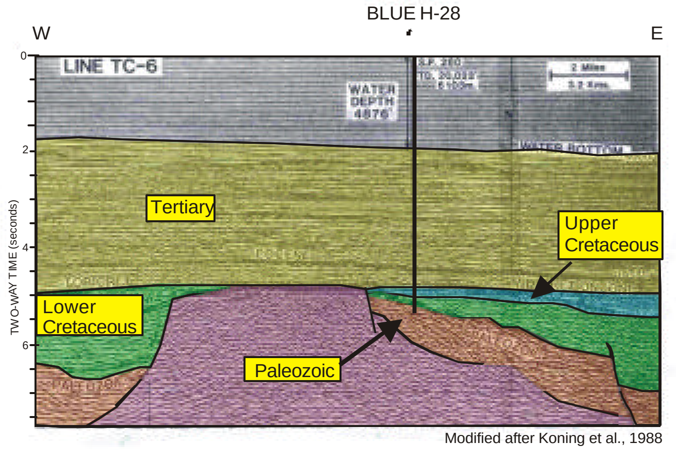


Figure 11
Blue Seismic Section and Interpretation

Tertiary
- Thickness: 3199 m MSL
- Shales, mudstones
- TOCs of 1.5% to 6% encountered in Lower Tertiary
- Base of Tertiary U/C: 4685 metres MSL

Upper Cretaceous
- Top: 4685 MSL
- 250 metres thick
- Maastrichtian aged grey shales and thin limestones

Lower Cretaceous
- Top 4935 MSL (TD)
- 225 metres thick
- Shales and sandstones
- Sandstones described as angular to sub-rounded and medium to course grained quartz with observable porosity
- Up to 19% porosity on logs (Koning 1988)

Paleozoic
- Top: 5160 m MSL
- 928 metres thick
- Top 90 metres consists of Mississippian (?) aged micritic limestones
- Underlain by fine to medium grained sandstones with shales and minor limestones to TD

TD: 6088.3 MSL in Paleozoics

Comments:
Lower Cretaceous sandstones have very good reservoir potential. TOCs in the Lower Tertiary ranged from 0.8% to 3.44%. Visual kerogen data indicate that Oligocene and younger rocks and Paleozoic rocks contain primarily terrestrial dry gas prone kerogens (Koning 1988). The Eocene and Cretaceous rocks contain higher percentages of oil-generating kerogen and if mature could yield wet gas and some crude oil as well. Analysis by Dow (1979) concluded that the oil generating kerogens in the Cretaceous and Tertiary section were oxidized, but this conclusion was "not recognized by all the partners" (Koning 1988) although there was general agreement that they were "too thin for effective hydrocarbon generation" (Koning 1988). It is possible, however, that these layers could be much thicker and un-oxidized in the "deeper" portions of the basin, away from the uplifted areas.

Bonavista C-99

Well name: Bonavista C-99

Operator: BP

Partners: Columbia Gas

Year: 1974 (1st well drilled in the basin)

Play type: Basement high

Water Depth: 329 metres

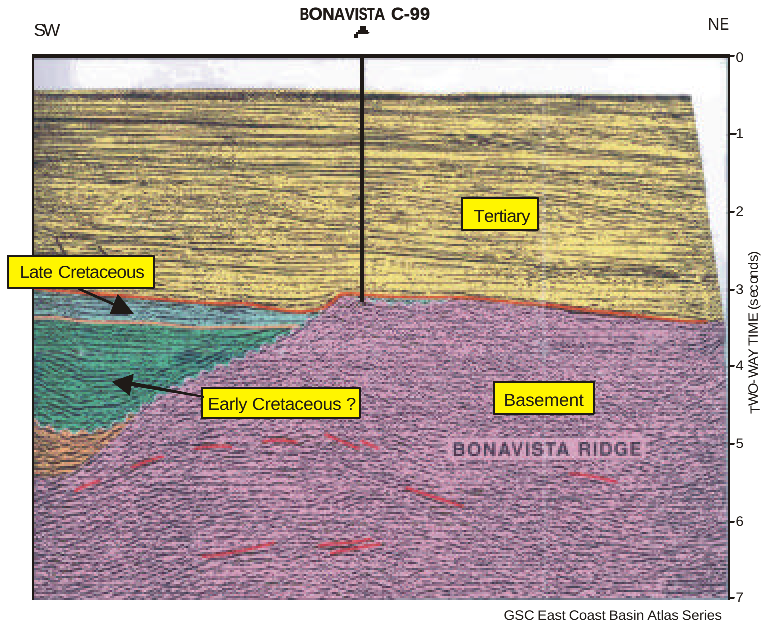


Figure 12
Bonavista Seismic Section and Interpretation

Tertiary
- 3287 metres thick
- claystones, silts and sandstones
- Base of Tertiary U/C: 3616 metres MSL

Upper Cretaceous
- Top: 3616 m MSL
- 61 metres thick
- Porous sandstones, limestones and shales

Lower Cretaceous
- Not present

Basement
- Top 3677 m MSL
- Granitic basement (dated at 146 ma) with some possible granite wash

TD: 3769 m MSL in granitic basement

Comments:
Upper Cretaceous sandstones have good reservoir potential. Organic rich shales in the lower Tertiary are immature at this location but described by Bayliss (Geochem Labs, 1990) as having "good to excellent potential for sourcing oil liquids and associated gas should they be buried deeper elsewhere in the basin."

Sheridan J-87

Well name: Sheridan J-87

Operator: Mobil

Partners: Petro Canada and Gulf

Year: 1981 (5th well drilled in the basin)

Play type: Onlap to large basement ridge

Water Depth: 215.8 metres

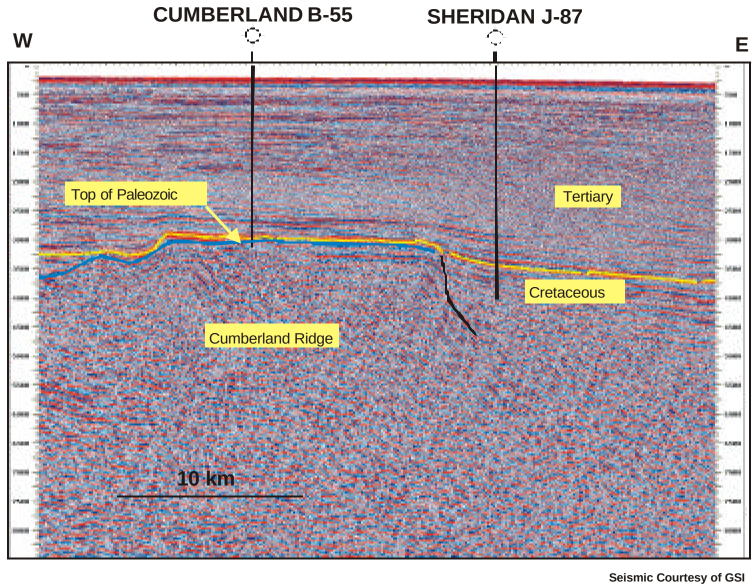


Figure 13
Sheridan Seismic Section and Interpretation

Tertiary
- 4265 metres thick
- Claystones and shales
- Base of Tertiary U/C: 4480.3 m MSL

Upper Cretaceous
- Top: 4480.3 m MSL
- 360 metres thick
- Predominantly shales with minor sandstones and silts

Lower Cretaceous
- Top: 4840 m MSL
- 617 metres penetrated
- TDed in Lower Cretaceous Hauterivian-Barremian sediments at 5457 m MSL
- Predominantly shales with minor sandstones and silts

TD: 5457 m MSL in Lower Cretaceous

Comments:
TOC content in Lower Tertiary and Late Cretaceous (3300 - 4650 m MSL) ranges from 1.5% to greater than 3%. It is described by Bayliss (1982) as ranging from a moderately mature oil, and associated gas, source in which moderate amounts of immature napthenic oil, condensate and wet gas have been formed. Deeper burial could render these shales as very good (and possibly prolific) oil and associated gas source facies (Bayliss, 1982).

Cumberland B-55

Well name: Cumberland B-55

Operator: Mobil

Partners: Gulf and Imperial

Year: 1975 (2^{nd} well drilled in the basin)

Play type: Basement high

Water Depth: 194.8 metres

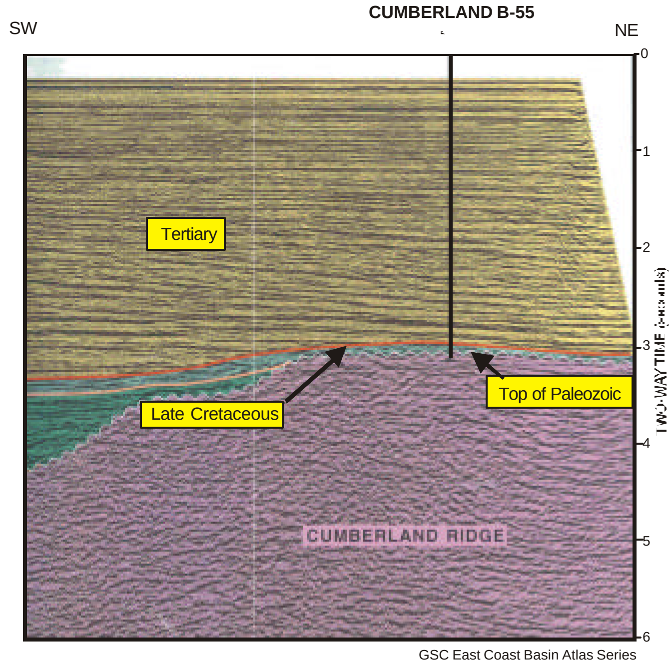


Figure 14
Cumberland Seismic Section and Interpretation

Tertiary
- 3428 metres thick
- Shales and mudstones
- Base of Tertiary U/C: 3622.5.3 metres MSL

Upper Cretaceous
- Top: 3622.3 m MSL
- 75.7 metres thick
- Shales with some marls and sandstones

Lower Cretaceous
- Not present

Paleozoic
- Top: 3698 (TD)
- 438 metres thick
- Entire section penetrated was shale

TD: 4136.5 m MSL in Paleozoic shale

Comments:
TOC content in Lower Tertiary ranges from 1% to greater than 3%, but the section is generally thermally immature and moderately mature in the deeper part of the section. Described as having good to very good potential for generating oil and associated gas if buried to sufficient depths.

Linnet E-63

Well name: Linnet E-63

Operator: Mobil

Partners: Petro Canada, Gulf, PanCanadian, Norcen, Canterra and Roxy

Year: 1982 (6th well drilled in the basin)

Play type: Tilted Paleozoic fault block and basin margin play in the Upper and Lower Cretaceous

Water Depth: 160 metres

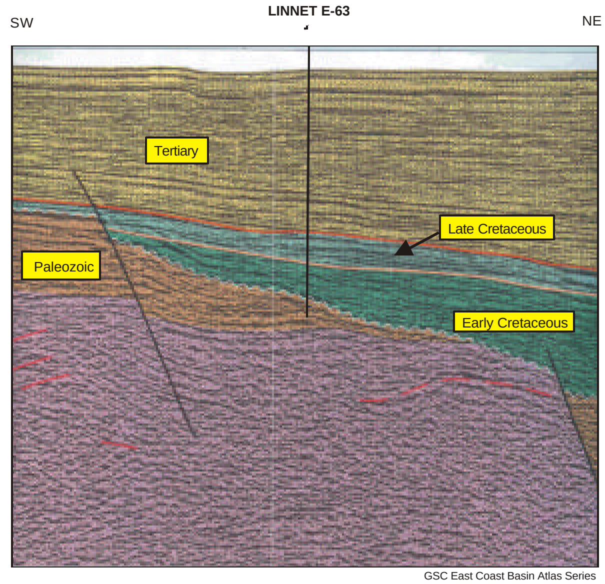


Figure 15
Linnet Seismic Section and Interpretation

Tertiary
- 2355 metres thick
- Primarily shales with sandstones in the shallower section (above 1250 m MSL)
- Base of Tertiary U/C: 2515 m MSL

Upper Cretaceous
- Top: 2515 m MSL
- 608 metres thick
- A nearly complete Maastrichtian to Cenomanian section
- Shales and marls at top overlying 350 metres of medium to course grained sandstones, with shales comprising the rest

Lower Cretaceous
- Top: 3123 m MSL
- 1025 metres thick (?) (see note on Jurassic below)
- Albian - Aptian aged shales with some thin sands near the base

Jurassic?
- 4000 - 4200 m MSL
- Mobil palynologists have dated this section as Oxfordian in age
- Shales

Paleozoic
- Top: 4148 m (?) (See note on Jurassic above)
- Thickness: had penetrated either 345 metres of Paleozoics or 148 metres (if Mobil palynologists correct) when it reached TD at 4493m MSL
- Shales
- Mississippean strata underlain by possible Ordovician and Silurian units
- Originally described as "meta-sediments" but further analysis in a comparative study of Paleozoic rocks in the Orphan Basin (Chaplin, 1982) indicates the section is only slightly metamorphosed

TD: 4493 m MSL in Paleozoic shales

Comments:

The sandstones encountered in the Upper Cretaceous may develop into excellent reservoirs in other prospects in the basin. TOCs in the Lower Tertiary and Upper Cretaceous shales ranged from 1% to 7% and are described as having excellent potential for sourcing oil should they be buried to sufficient depths.

7. Geologic History

Mesozoic sedimentary basins bordering on the North Atlantic Ocean have developed largely due to episodes of crustal extension and failed rifting related to the opening of the North Atlantic. As such, all the North Atlantic marginal basins, including the Orphan Basin share a common tectonic history. Although there may be local variations in stratigraphy and structure, the major rift events that led to the opening of the North Atlantic can be recognized in all the basins. A comparison of the stratigraphic columns for the Jeanne d'Arc Basin offshore Newfoundland, and the Porcupine Basin offshore Ireland (Fig. 16) demonstrates the common evolution of these basins.

Basins initially formed in the Orphan area during the Late Triassic in response to the rift events that ultimately led to the separation of Africa from North America (R1 in Fig. 16). These basins were likely oriented in a NE-SW direction paralleling the underlying basement fabric and consistent with orientation of the Jeanne d'Arc, Flemish Pass and central Grand Banks rifts (see Fig. 6).

Sedimentation during the synrift period, (Late Triassic to Early Jurassic) was probably continental clastics, similar to the Eurydice Formation on the Scotian Shelf and southern Grand Banks. It is likely that salt deposition occurred as well, similar to Argo salt in the Central Grand Banks and Jeanne d'Arc basin, however the absence of clearly diapiric features on the seismic data does not permit making this salt interpretation with certainty.

A period of regional thermal subsidence followed and lasted throughout the Middle Jurassic, (Enachescu, 1987 and 1988) resulting in a broad epicontinental sea developing that often extended beyond the boundaries of the initial rift basins (Sinclair, 1995) (see Fig. 17). Sediments deposited during this period would likely have been shales and carbonates similar to the Whale Formation on the Grand Banks.

Tectonism, related to the initial rifting between North America and Europe in the late Jurassic (R2), resulted in areas surrounding the rift basins occasionally becoming emergent, increasing the deposition of clastics into the basins, and restricting circulation in the seas. This environment was critical for the development of source rocks and petroleum systems in the North Sea and Grand Banks basins and would likely have done the same in the Orphan Basin.

Areas surrounding the rift basins became emergent during the remainder of the Early Cretaceous. The Paleozoic section exposed in the emergent areas would also have provided provenance for deposition of coarse clastics in the basins.

Renewed rifting during the Albian (R3), as the North Atlantic continued to open, resulted in much of the earlier Mesozoic section being structured into large potential hydrocarbon traps, as anticlines or tilted fault blocks.

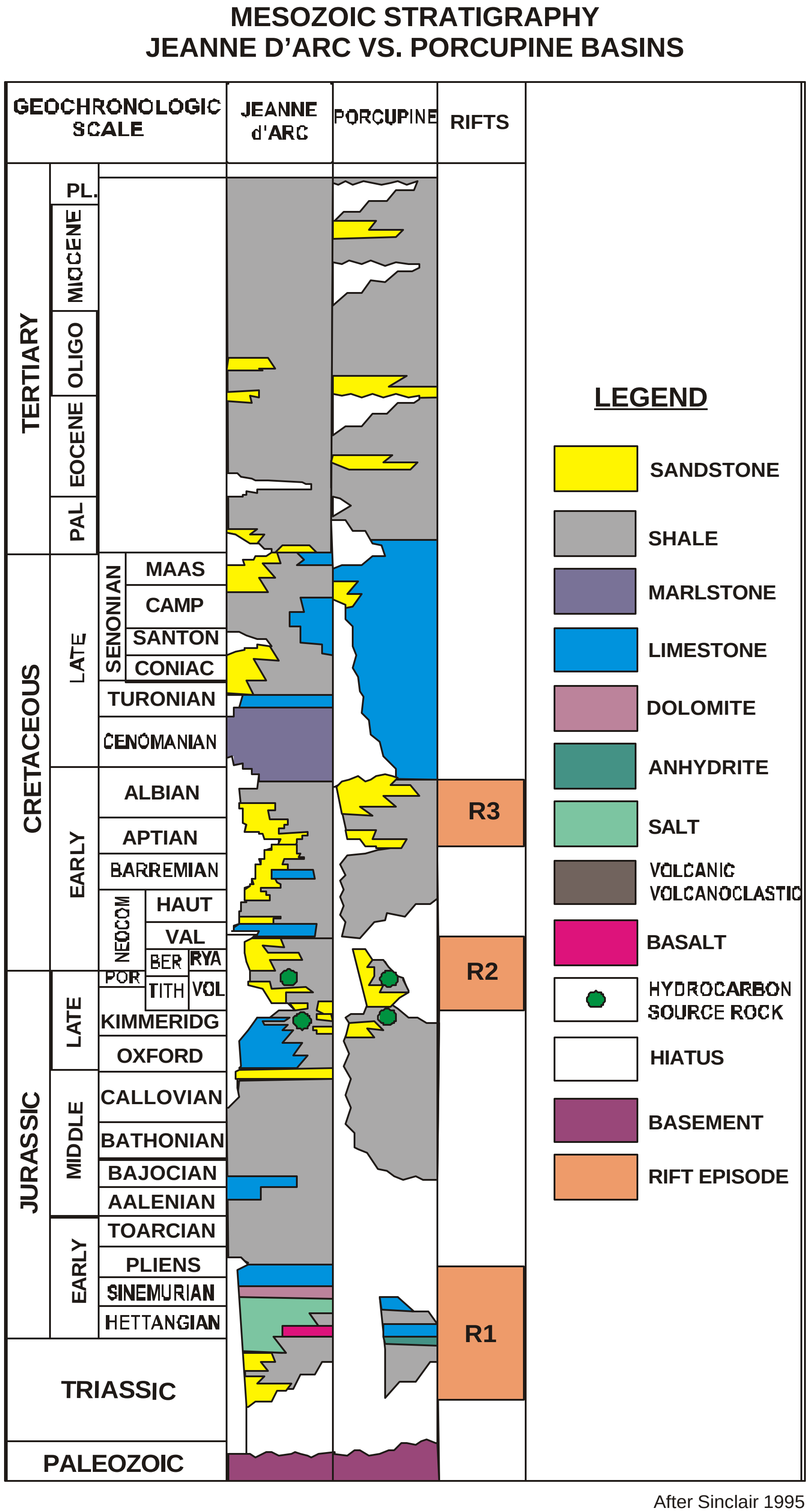
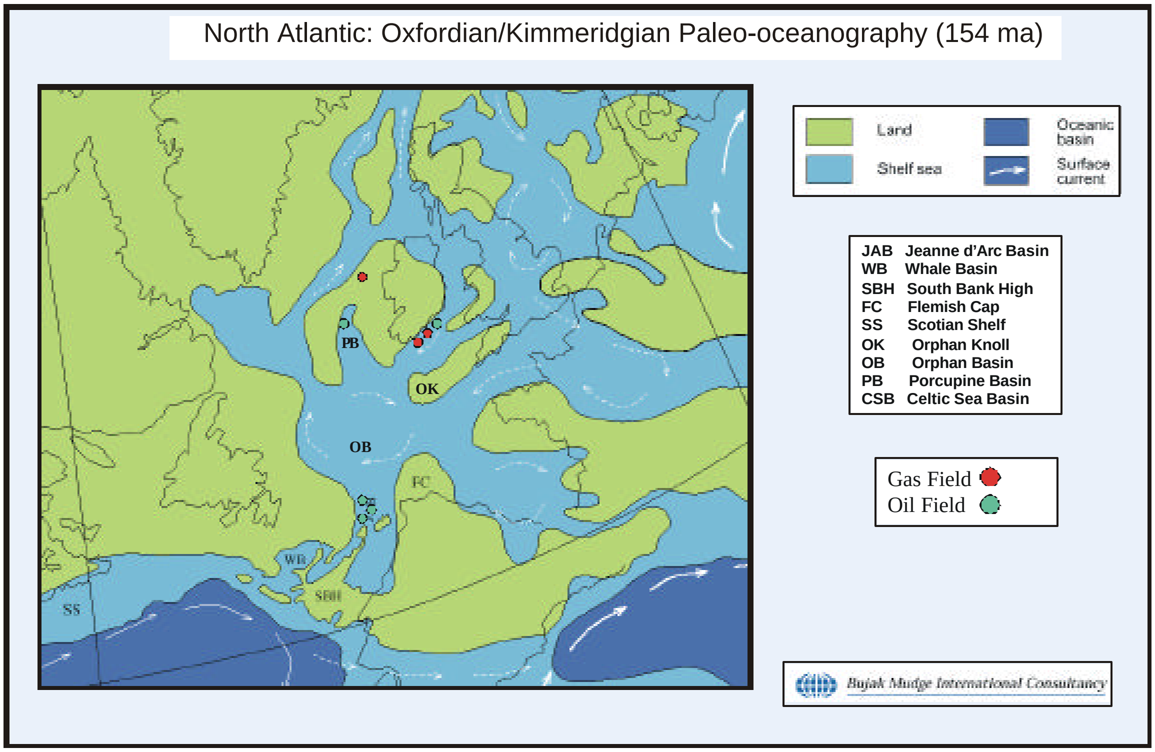


Figure 16

Comparative Stratigraphy – Jeanne d'Arc and Porcupine Basins



Courtesy of Jonathan Bujak, Bujak-Mudge

Figure 17

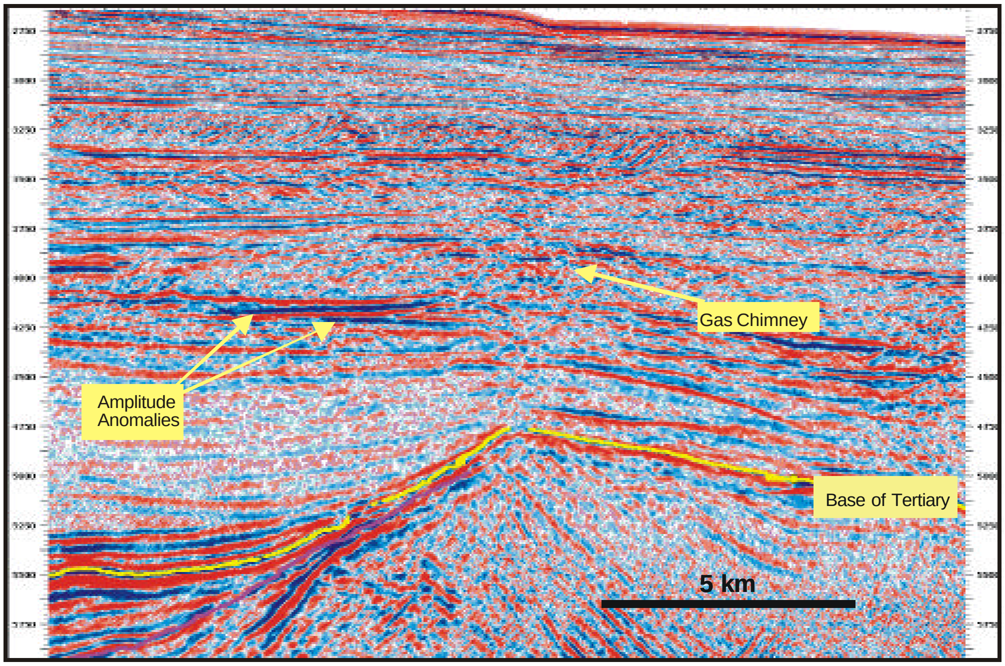
Upper Jurassic Paleoenvironment

8. Potential Source Rocks

The euxinic conditions that existed in many of the North Atlantic marginal basins during the Late Jurassic support the possibility of a good source rock in the Orphan Basin. These conditions resulted in the deposition of the Kimmeridgian aged Egret Member which has sourced the oil and gas fields of the Jeanne d'Arc Basin to the south, and the Kimmeridgian source rocks of the North sea and Porcupine Basin (see Fig. 17).

Given our current understanding of the paleogeography of the Orphan Basin and the prevalence of Upper Jurassic source rocks in the North Atlantic marginal basins, it is very likely that good oil prone source rocks are present. Geochemical analysis of wells in the West Orphan Basin have determined that "the hydrocarbon present in the sediments penetrated by the Sheridan J-87 Well and the BP Beau et al. Baie Verte J-57 well show a close similarity to the oils reservoired in the Jeanne d'Arc Basin" (Bayliss, 1990). This indicates direct evidence of the presence of Upper Jurassic source rocks in the Orphan Basin area. Other evidence for the presence of source rocks in the Orphan Basin are a number of "gas chimneys" and amplitude anomalies that can be seen on the seismic in the area (Figs. 18 and 19).

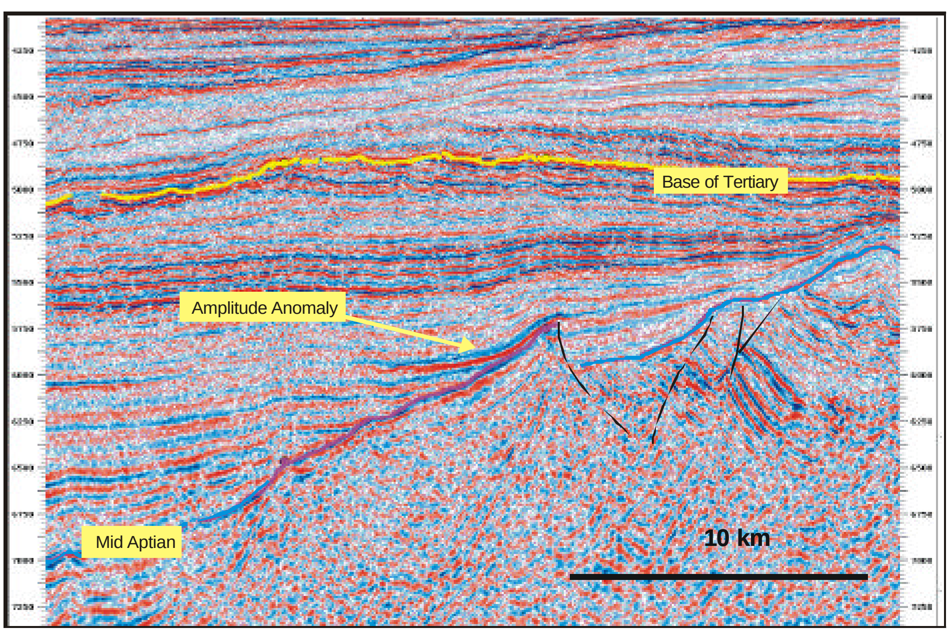
GAS CHIMNEY EXAMPLE



Seismic Courtesy of GSI

Figure 18
Gas Chimney

EAST ORPHAN DIRECT HYDROCARBON INDUCTION (DHI)



Seismic Section Courtesy of GSI

Figure 19
Onlap Amplitude Anomaly

Other potential source rocks exist in the Early Tertiary section. Geochemical analysis of the Tertiary aged shales penetrated by the wells drilled in the West Orphan area has indicated that this section contains a high proportion (2 – 6% TOC) of organic carbon that is described as "oil-prone amorphous-sapropellic kerogen" (Bayliss 1990). The Lower Tertiary and Late Cretaceous section is analyzed as being thermally immature to moderately mature in the wells. Burial depth ranging from 3100 m to 5100 m would be required to begin generation of hydrocarbons (Koning, 1988). The Tertiary section reaches a thickness of over 5000 m in much of the West Orphan Basin therefore a significant amount of oil should have been generated from these sediments.

The Late Cretaceous section penetrated in the Blue H-28 is described as containing relatively high percentages of amorphous oil generating kerogen (Dow, 1979). Dow concluded that this section had been oxidized and therefore severely diminished in its generative capacity, but this conclusion was "not recognized by all the Blue H-28 partners" (Koning, 1988). Although these potential source beds were thin and possibly oxidized at the Blue H-28 location it is possible that they could be thicker and un-oxidized in the deeper water areas of the basin during the Cretaceous. The fact that the key source rock off Labrador (Markland Shale) is of Late Cretaceous age also lends credence to the possibility of a Cretaceous source rock in the Orphan Basin.

9. Potential for Reservoir

Data from the Blue H-28 well and other wells drilled in the West Orphan area as well as DSDP 111 drilled on the Orphan Knoll, suggest that the emergent blocks surrounding the Orphan basinal areas are partly composed of Paleozoic sandstones. These blocks would therefore have provided an excellent provenance for reservoir quality sandstones to be deposited in the basin during the late Jurassic and Cretaceous (Fig. 20). The porous sandstones described in the Early Cretaceous section of the Blue H-28 well (porosities up to 19%, Koning 1988) and the Late Cretaceous section of the Linnet E-63 and Bonavista C-99 wells confirm reservoir quality sands are present in the Orphan Basin.

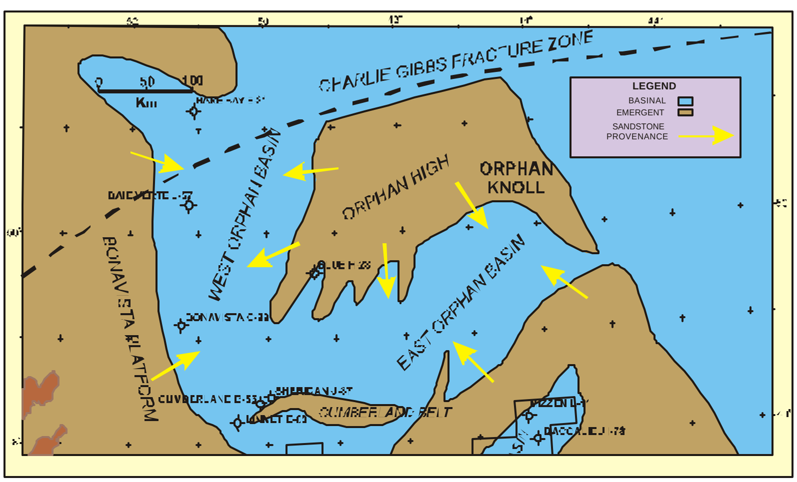


Figure 20

Provenance for Late Jurassic to Cretaceous Sands

Another reservoir target, may be in the Paleocene section where reservoir quality sandstones may have been deposited as fan sands during regressive episodes in the Early Tertiary, similar to the South Mara sands found in the Paleocene of the Jeanne d'Arc Basin, and submarine fans described in the Paleocene – Oligocene section in the Porcupine Basin (Shannon 1993). Seismic data shows many examples of Early Tertiary events onlapping the major ridges (Fig. 18 for example), with associated amplitude anomalies, suggesting that marginal marine conditions would have existed against the old highs during the Lower Tertiary.

10. Bibliography

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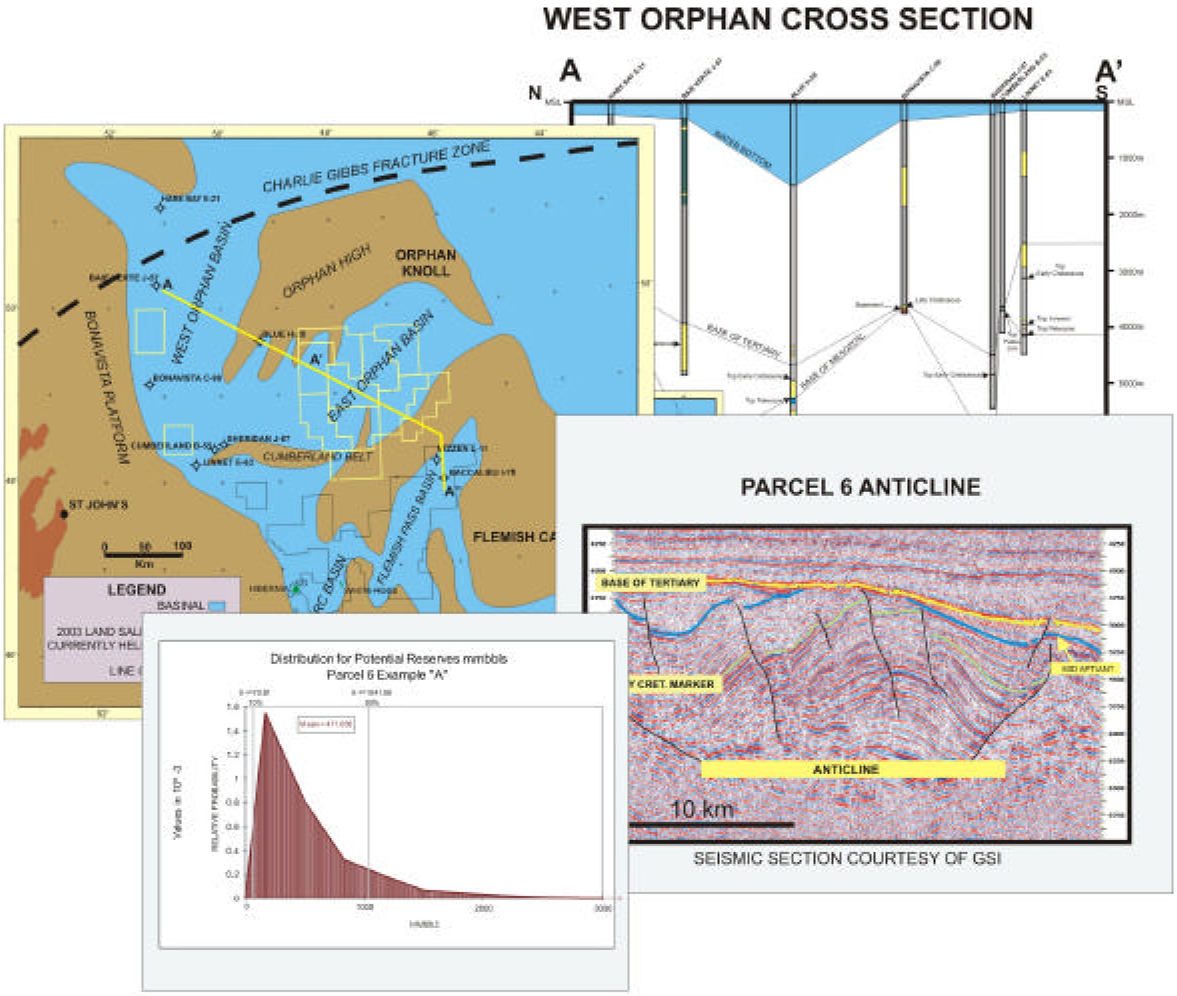
APPENDIX "A"

PARCEL DESCRIPTIONS AND EXAMPLE LEADS AND PROSPECTS

C-NOPB CALL FOR BIDS NF 03-1

DECEMBER 17,2003

ORPHAN BASIN OFFSHORE NEWFOUNDLAND



REPORT PREPARED FOR
DEPARTMENT OF MINES AND ENERGY
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

AUGUST, 2003

G&G
EXPLORATION
CONSULTING LTD.

ORPHAN BASIN
2003 LAND SALE
PARCEL AND PROSPECT DESCRIPTIONS

The following section describes hydrocarbon plays and resource potential for parcels, 1 – 12, posted by the C-NOPB for the land sale set for December 17, 2003. Leads and potential prospects have been seismically identified and assessed for each of the parcels. The description of the hydrocarbon potential for each parcel does not include an exhaustive list of every prospect on the parcels, but contains preliminary interpretations of examples of the play types and representative prospect sizes. Detailed horizon and fault interpretations were beyond the scope of this report.

Seismic interpretation and illustration of potential prospects are based on the non-exclusive 2D seismic data acquired by the Canadian contractor, GSI in 2000, 2001, and 2002, and described in section 2. Several 1980's vintage lines were also used for the parcels located in the West Orphan Basin, where new data is scarce. Direct and jump correlation ties to the Baccalieu I-78 well in the northern Flemish Pass Basin have been used to interpret ages of seismic horizons in the East Orphan Basin. Velocity control from the Baccalieu well, together with stacking velocity data has also been used to estimate horizon depths and reservoir thickness for potential prospects. Publicly released data from seven wells that have been drilled in the basin were used to define hydrocarbon source and reservoir presence in the area.

Estimates of Potential Reserves

Probabilistic estimates of the ranges of reserve sizes for the representative potential prospects were made using Palisades **@RISK ™** software.

Regional paleogeographic studies and analogy to adjacent basins suggests that the Orphan Basin will likely be an oil prone basin (Bayliss, 1990). Considering that oil development will be economically feasible before gas development, volumetric assessments are performed only for potential oil bearing prospects. A trap fill factor has been applied to account for the portion of the reservoir that may be filled with gas.

Other assumptions used for volumetric calculations are:

Area:

The range of areas of potential prospects is based on contour mapping of seismic horizons correlated over the prospect. The P90 or "90% probability of greater than" value is the area within one of the highest or best controlled closing contours. The P10 or "10% probability of greater than" value is the area of the lowest or largest mapped closing contour. Potential prospects that are well controlled by a relatively dense grid of seismic will have narrower ranges of possible area then those with little control constraining the size. These P90 and P10 values were fitted to a lognormal probability distribution to use as an input curve. (A TRIGEN or P90, Most Likely (ML), P10 triangular probability distribution was used to describe the ranges of the rest of the reservoir parameters). The area indicated on the Prospect Outline Maps (Prospect Summary illustrations) is the P10 area.

Thickness:

The thickness parameter describes the range of thickness of the total section that may be under closure, estimated from measuring the time interval on the seismic and converting to depth. An average interval velocity of 3500 m/sec was used for the Early Cretaceous to Jurassic sedimentary section. This is a good estimation of average velocity for Jeanne d'Arc clastic sequences of that age. Recognizing that there are limits to the depths at which porosity may be expected, all effective reservoirs considered are shallower then 4500 m.

% Sand:

The % Sand parameter describes the proportion of the total formation thickness under closure that may be sandstones. 30% was used as an upper limit, since seal risk becomes a large factor if there is greater then 30% sand in the section. Nominal values of 10% and 20% are used for the P10 and ML values.

Net to Gross:

Net to Gross is the portion of the sandstones in the section that would be considered reservoir quality sandstones. P90, ML, and P10 values of 30%, 70% and 90% respectively, are used based on data from the producing fields in the Jeanne d'Arc Basin.

Trap Fill

Trap Fill defines the portion of the available reservoir pore space that would be filled with oil. Considering the potential for part of the reservoir volume to be filled with gas, a wide range of 20%, 50% and 80%, as P90, ML, and P10 values are used in most cases. For the very large closures, where source adequacy and abundance becomes an issue, values were reduced to 10%, 30%, and 50%, respectively.

Porosity

Porosity is affected by burial depth. P90, ML and P10 values of 15%, 17% and 21% respectively are used to describe the porosity range for potential prospects where the likely burial depth to the target is less then 3500 m. For likely burial depths greater then 3500 m, a range of 14%, 16% and 18% are used.

Oil Saturation

P90, ML, and P10 values of 80%, 85% and 90% are used for Oil Saturation (1-Sw), consistent with data from the oil fields in the Jeanne d'Arc Basin.

Shrinkage

Shrinkage is defined as the inverse of the Formation Volume Factor (1/FVF). Based on published data from the Terra Nova and White Rose fields in the Jeanne d'Arc Basin, P90, ML, and P10 shrinkage values of 70%, 73% and 77% are used.

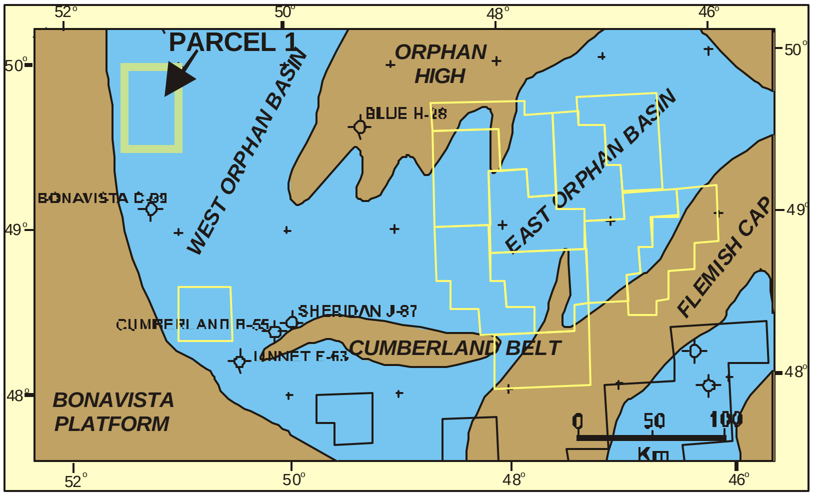
Recovery Factor

Nominal P90, ML and P10 values of 20%, 30% and 40% RF are applied.

Interval of Possible Reservoir

In each example a vertical bar is added (I) to identify the interval believed to contain potential reservoir rocks in the prospect being analyzed.

PARCEL 1

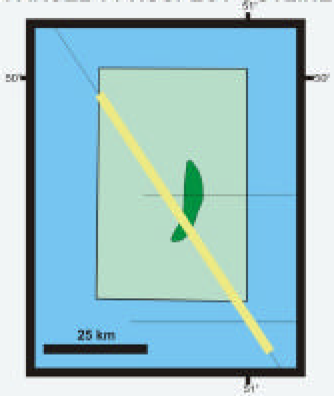


Parcel 1 Location

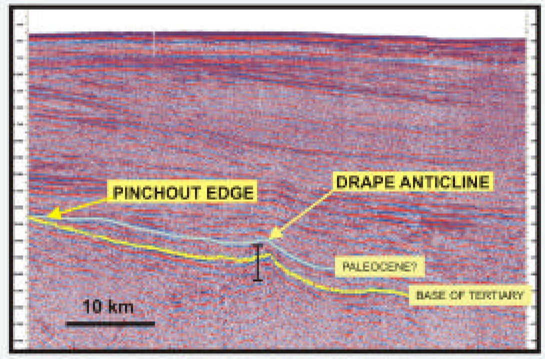
Location:	West Orphan Basin.
Area:	200,240 ha.
Water Depth:	Between 200 and 400 m.
Seismic Control:	Two lines 1980’s vintage.
Possible Reservoirs:	Paleocene (South Mara equiv.) sandstones. Late Cretaceous (Otter Bay) sandstones.
Possible Source Rocks:	Late Jurassic (Egret equiv.) shales. Early Tertiary high TOC shales.
Play Types:	Drape closures in Late Cretaceous or Paleocene sandstones over pre-existing structural highs. Onlap pinchout traps against the Bonavista Platform on the west of the parcel.
Prospect Analyzed Here:	Drape closure lead.
Comments:	Tertiary thickness increases to over 5000 m east of the block suggesting that the Early Tertiary section would be thermally mature in that area. Bonavista Platform is potential reservoir provenance in close proximity to block.

PROSPECT SUMMARY - PARCEL 1 EXAMPLE

PARCEL 1 PROSPECT OUTLINE



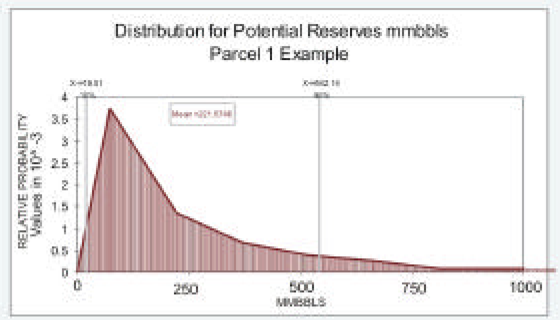
PARCEL 1 LEADS



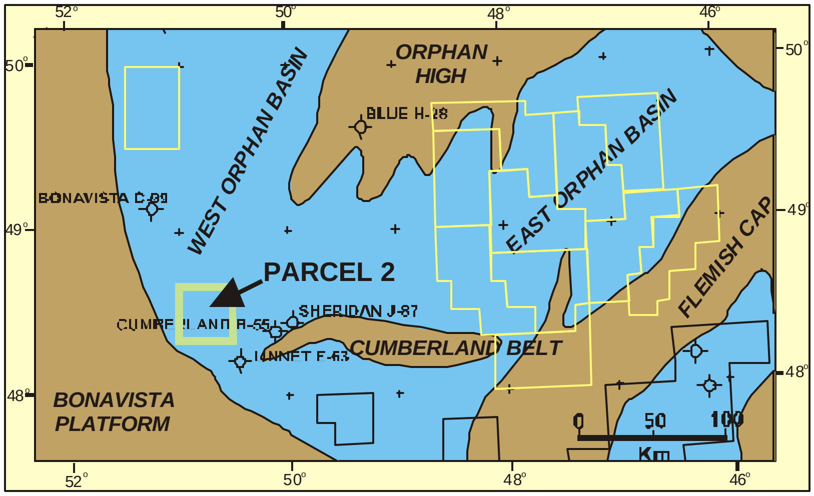
SEISMIC SECTION COURTESY OF GSI

Prospect 1

	MEAN	P90	ML	P10	Input	standdev	Dist Type
INPUT RANGES					Mean		
Area Sq Km	21.4	5		60	32.5	44.8	trdgnml
Thickness m	800.0	640	800	960			trigen
%Sand	20.0%	10%	20%	30%			trigen
Net to gross	61.4%	30%	70%	90%			trigen
Trap fill	50.2%	20%	50%	80%			trigen
Porosity	17.9%	15%	17%	21%			trigen
Oil sat	85.0%	80%	85%	90%			trigen
Shrinkage	73.4%	70%	73%	77%			trigen
Recov	30.0%	20%	30%	40%			trigen
	MEAN	P90	P50	P10			
OUTPUT POTENTIAL							
mmm3	35.3	3.1	19.4	86.3			
mmbbls	221.4	19.5	121.9	542.1			



PARCEL 2

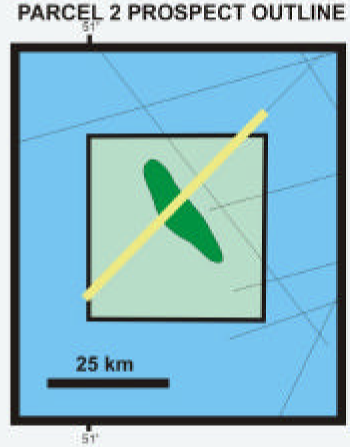


Parcel 2 Location

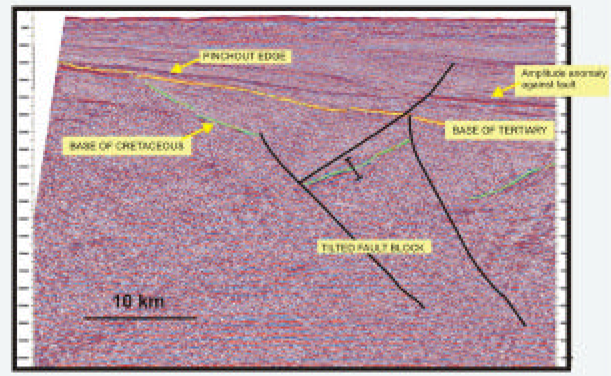
Location:	West Orphan Basin.
Area:	136,860 ha.
Water Depth:	Average 200 m.
Seismic Control:	One recent (2000) and one 1980’s vintage seismic line.
Possible Reservoirs:	Paleocene (South Mara equiv.) sandstones. Late Cretaceous (Otter Bay) sandstones.
Possible Source Rocks:	Late Jurassic (Egret equiv.) shales. Early Tertiary high TOC shales.
Play Types:	Tilted fault blocks involving Cretaceous section on flanks of Bonavista Platform. Onlap pinchout traps against the Bonavista Platform on the west of the parcel. Bright spot against fault in Lower Tertiary
Prospect Analyzed Here:	Tilted fault block with Upper Jurassic sands.
Comments:	Tertiary thickness increases to over 5000 m east of the block suggesting that the Early Tertiary section would be thermally mature in that area. Bonavista Platform is potential reservoir provenance in close proximity to block.

PROSPECT SUMMARY - PARCEL 2 EXAMPLE

PARCEL 2 PROSPECT OUTLINE



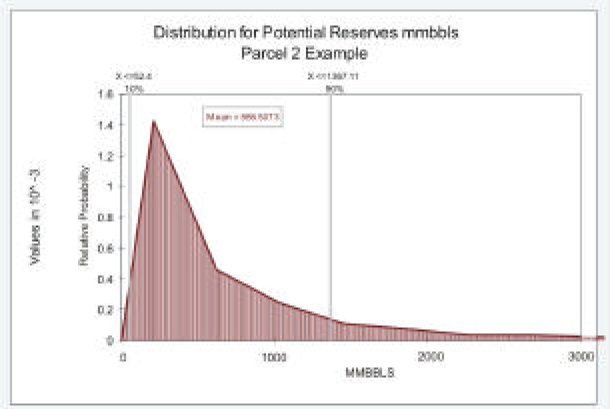
PARCEL 2 TILTED FAULT BLOCK



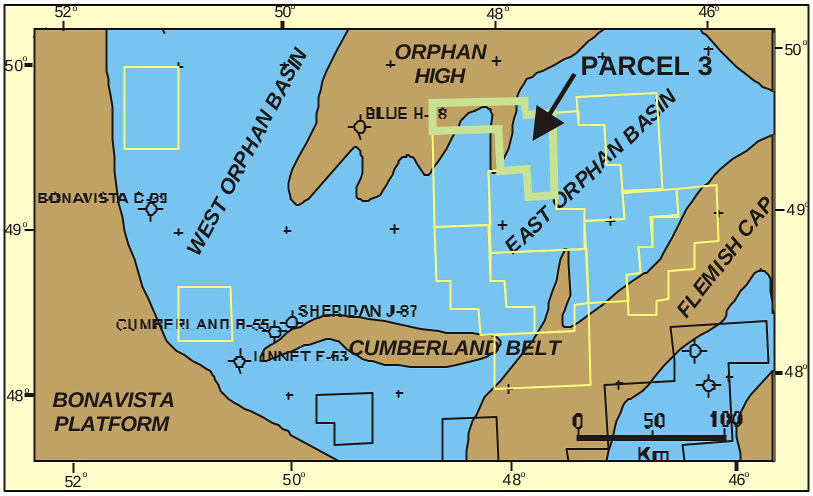
SEISMIC SECTION COURTESY OF GSI

Prospect 2

	MEAN	P90	ML	P10	Input	standdev	Dist Type
INPUT RANGES					Mean		
Area Sq Km	45.6	10		150	67.7	96.9	trdgnrml
Thickness m	1000.0	800	1000	1200			trigen
% Sand	20.0%	10%	20%	30%			trigen
Net to gross	61.4%	30%	70%	90%			trigen
Trap fill	50.2%	20%	50%	80%			trigen
Porosity	17.9%	15%	17%	21%			trigen
Oil sat	85.0%	80%	85%	90%			trigen
Shrinkage	73.4%	70%	73%	77%			trigen
Recov	30.0%	20%	30%	40%			trigen
	MEAN	P90	P50	P10			
OUTPUT POTENTIAL							
mm m3	93.9	8.3	49.1	217.7			
mmbbls	589.5	52.4	308.6	1367.1			



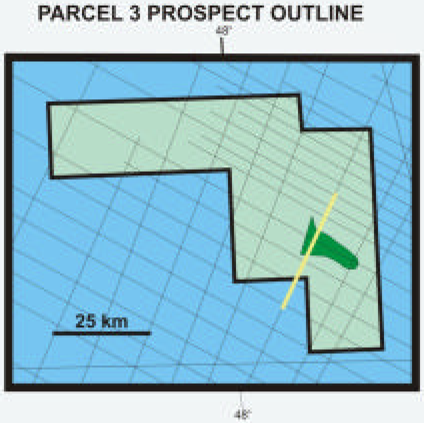
PARCEL 3

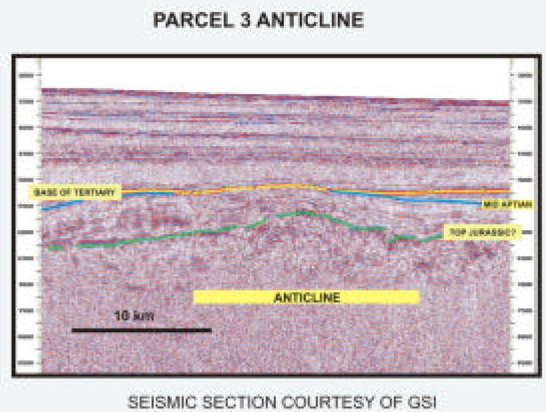


Parcel 3 Location

Location:	N.W. margin of East Orphan Basin.
Area:	268,190 ha.
Water Depth:	2400 m to 2600 m.
Seismic Control:	Modern 2D seismic (GSI), 3 km to 6 km line spacing.
Possible Reservoirs:	Late Jurassic to Early Cretaceous sands.
Possible Source Rocks:	Late Jurassic (Egret equiv.) shales.
Play Types:	Anticlines and fault dependant closures.
Prospect Analyzed Here:	Faulted anticline.
Comments:	Thick (> 1500 m) Mesozoic section to south of Parcel 3 likely contains Late Jurassic source rocks. Orphan High is potential reservoir provenance in close proximity to block.

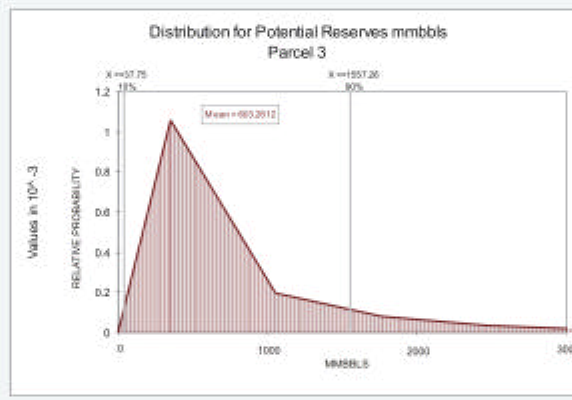
PROSPECT SUMMARY - PARCEL 3 EXAMPLE



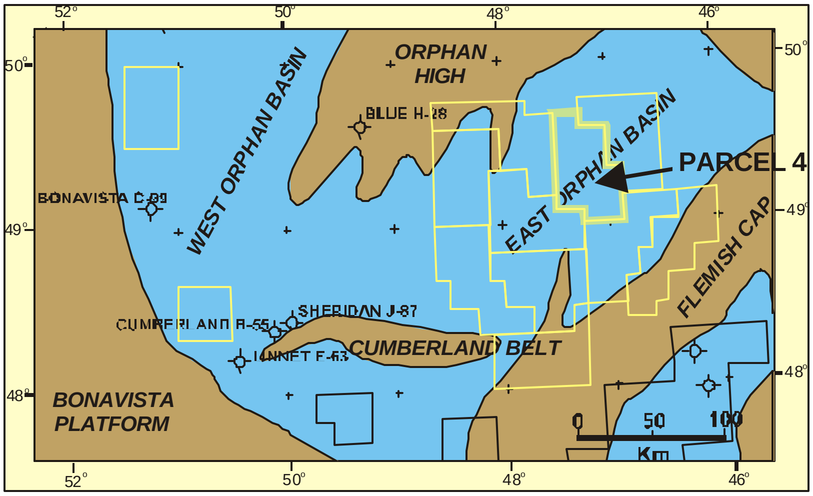


Prospect 3

	MEAN	P90	ML	P10	Input	standdev	Dist Type
INPUT RANGES					mean		
Area Sq Km	20.8	3		70	30.8	57.6	trnlgnrml
Thickness m	2250.0	1800	2250	2700			trigen
% Sand	20.0%	10%	20%	30%			trigen
Net to gross	61.4%	30%	70%	90%			trigen
Trap fill	50.2%	20%	50%	80%			trigen
Porosity	17.9%	15%	17%	21%			trigen
Oil sat	85.0%	80%	85%	90%			trigen
Shrinkage	73.4%	70%	73%	77%			trigen
Recov	30.0%	20%	30%	40%			trigen
	MEAN	P90	P50	P10			
OUTPUT POTENTIAL							
mm m3	96.3	6.0	43.0	248.0			
mmbbls	604.8	37.7	269.8	1557.2			



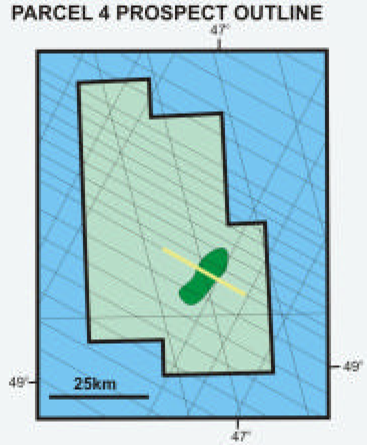
PARCEL 4

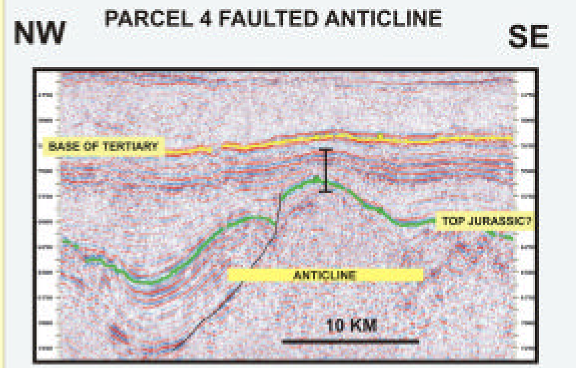


Parcel 4 Location

Location:	Centre of East Orphan Basin.
Area:	269,375 ha.
Water Depth:	2500 m to 2750 m.
Seismic Control:	Modern 2D seismic (GSI), 3 km line spacing.
Possible Reservoirs:	Late Jurassic to Lower and Upper Cretaceous sands.
Possible Source Rocks:	Late Jurassic (Egret equiv.) shales.
Play Types:	Anticlines and fault dependant closures.
Prospect Analyzed Here:	Faulted anticline.
Comments:	Thick Mesozoic section on Parcel 4 likely contains Late Jurassic source rocks. Seismically reflective Cretaceous section good candidate for reservoir sands.

PROSPECT SUMMARY - PARCEL 4 EXAMPLE

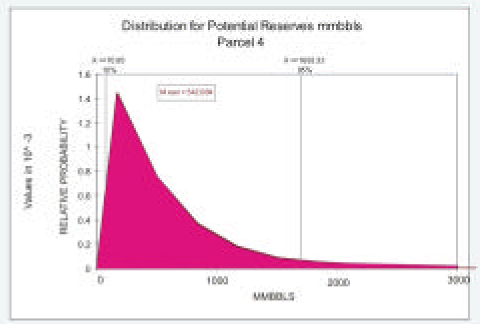




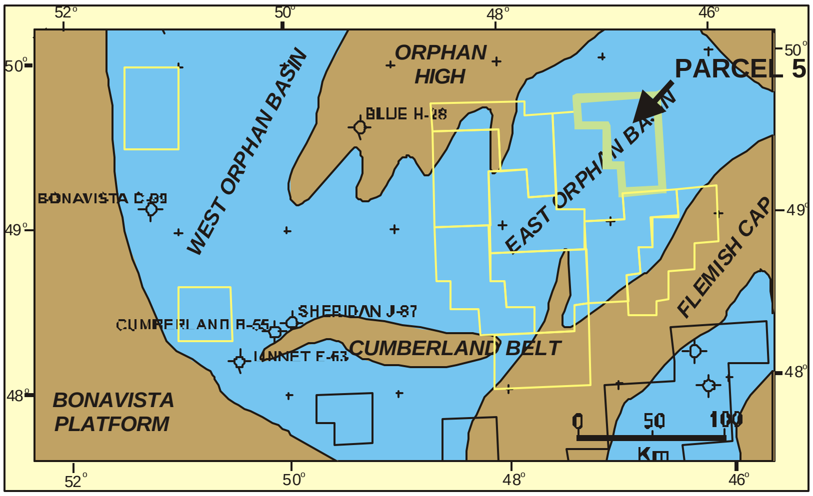
SEISMIC SECTION COURTESY OF GSI

Prospect 4

	MEAN	P90	ML	P10	Input	standdev	Dist Type
INPUT RANGES					Mean		
Area Sq Km	41.4	16		85	46.5	33.1	trclgnml
Thickness m	1000.0	800	1000	1200			trigen
% Sand	20.0%	10%	20%	30%			trigen
Net to gross	61.4%	30%	70%	90%			trigen
Trap fill	50.2%	20%	50%	80%			trigen
Porosity	17.9%	15%	17%	21%			trigen
Oil sat	85.0%	80%	85%	90%			trigen
Shrinkage	73.4%	70%	73%	77%			trigen
Recov	30.0%	20%	30%	40%			trigen
	MEAN	P90	P50	P10			
OUTPUT POTENTIAL							
mm m3	85.2	11.3	55.0	191.2			
mmbbls	535.0	71.0	345.7	1201.0			



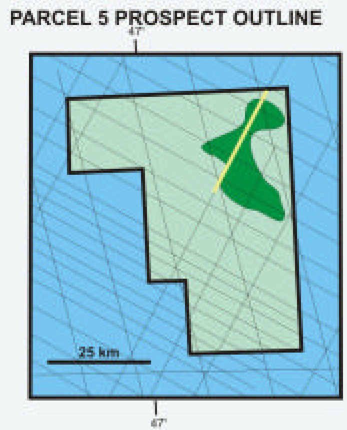
PARCEL 5

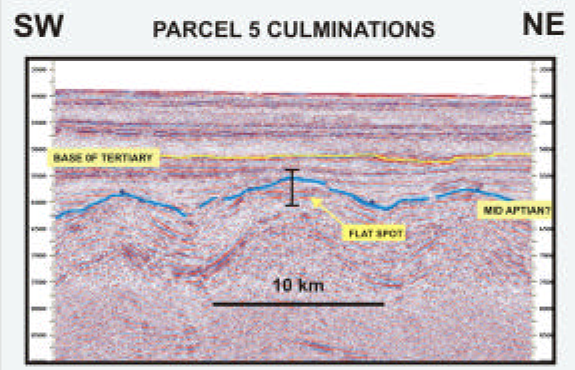


Parcel 5 Location

Location:	Centre of East Orphan Basin.
Area:	251,585 ha.
Water Depth:	2750 m to 3050 m.
Seismic Control:	Modern 2D seismic (GSI), 3 km to 6 km line spacing.
Possible Reservoirs:	Late Jurassic to Lower and Upper Cretaceous sands.
Possible Source Rocks:	Late Jurassic (Egret equiv.) shales.
Play Types:	Anticlines and fault dependant closures.
Prospect Analyzed Here:	Large closure involving three anticlinal culminations.
Comments:	Flat seismic reflector at the crest of the centre culmination may indicate a gas/oil or gas/water contact.

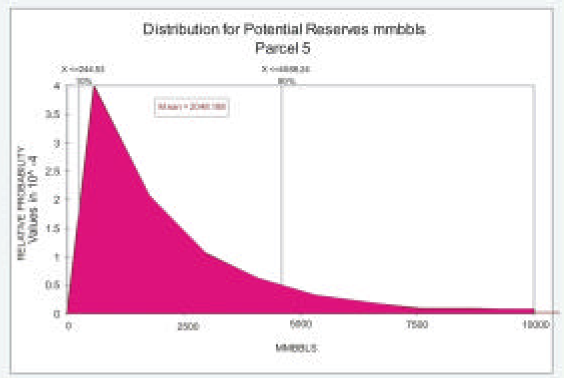
PROSPECT SUMMARY - PARCEL 5 EXAMPLE



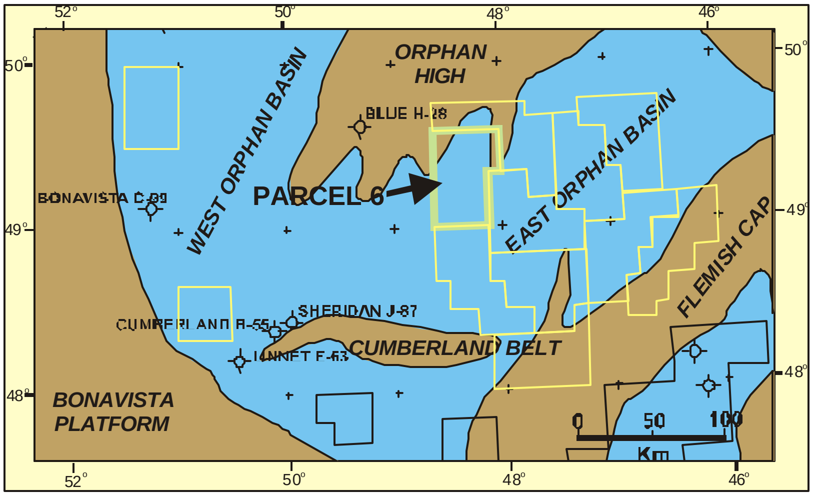


Prospect 5

	MEAN	P90	ML	P10	Input mean	standdev	Dist Type
INPUT RANGES							
Area Sq Km	106.0	35		270	133.5	125.7	trdgnrml
Thickness m	1500.0	1200	1500	1800			trigen
% Sand	20.0%	10%	20%	30%			trigen
Net to gross	61.4%	30%	70%	90%			trigen
Trap fill	50.2%	20%	50%	80%			trigen
Porosity	17.9%	15%	17%	21%			trigen
Oil sat	85.0%	80%	85%	90%			trigen
Shrinkage	73.4%	70%	73%	77%			trigen
Recov	30.0%	20%	30%	40%			trigen
	MEAN	P90	P50	P10			
OUTPUT POTENTIAL							
mm m3	327.5	38.9	208.7	730.6			
mmbbls	2056.9	244.5	1310.4	4588.2			



PARCEL 6



Parcel 6 Location

Location: N.W. margin of East Orphan Basin.

Area: 260,935 ha.

Water Depth: 2150 m to 2400 m.

Seismic Control: Modern 2D seismic (GSI), 6 km line spacing.

Possible Reservoirs: Late Jurassic to Early Cretaceous sands.

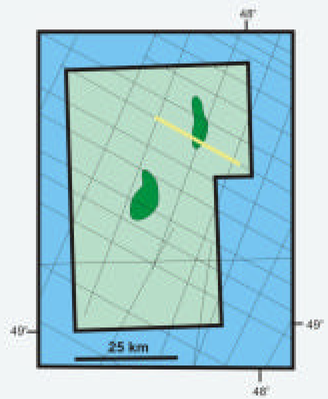
Possible Source Rocks: Late Jurassic (Egret equiv.) shales.

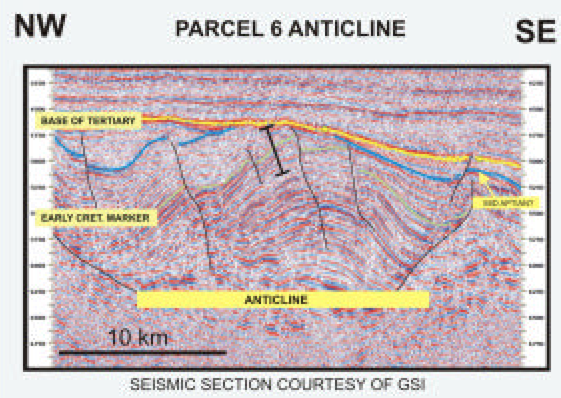
Play Types: Anticlines and fault dependant closures.

Prospect Analyzed Here: Two separate anticlines.

Comments: Well imaged, high relief anticlines involve very thick (> 4000 m) section of likely Late Jurassic to Early Cretaceous within closure. Orphan High is potential reservoir provenance in close proximity to block.

PROSPECT SUMMARY - PARCEL 6 EXAMPLE “A”

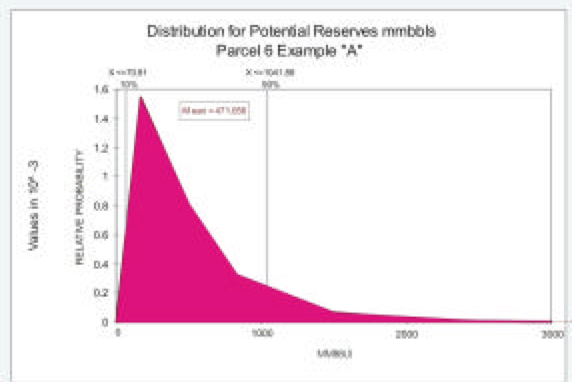




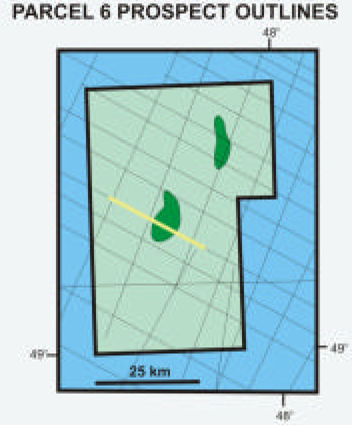
SEISMIC SECTION COURTESY OF GSI

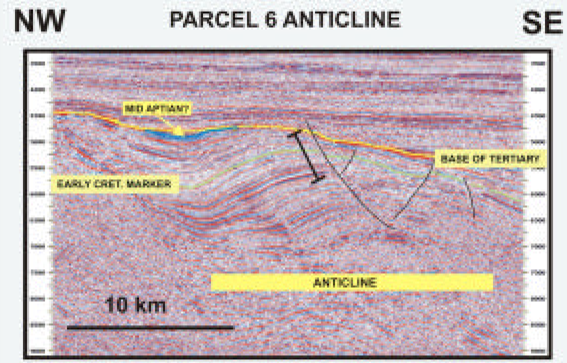
Prospect 6a

	MEAN	P90	ML	P10	Input Mean	standdev	Dist Type
INPUT RANGES							
Area Sq Km	16.5	8		30	17.6	9.7	trclgnrml
Thickness m	2200.0	1750	2200	2650			trigen
% Sand	20.0%	10%	20%	30%			trigen
Net to gross	61.4%	30%	70%	90%			trigen
Trap fill	50.2%	20%	50%	80%			trigen
Porosity	17.9%	15%	17%	21%			trigen
Oil sat	85.0%	80%	85%	90%			trigen
Shrinkage	73.4%	70%	73%	77%			trigen
Recov	30.0%	20%	30%	40%			trigen
	MEAN	P90	P50	P10			
OUTPUT POTENTIAL							
mm m3	74.9	11.3	51.5	165.9			
mmbbls	470.5	70.8	323.2	1041.9			



PROSPECT SUMMARY - PARCEL 6 EXAMPLE "B"

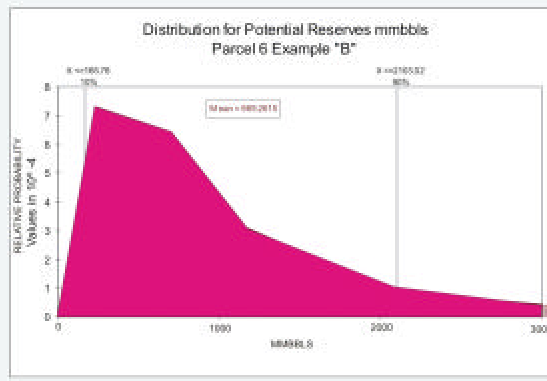




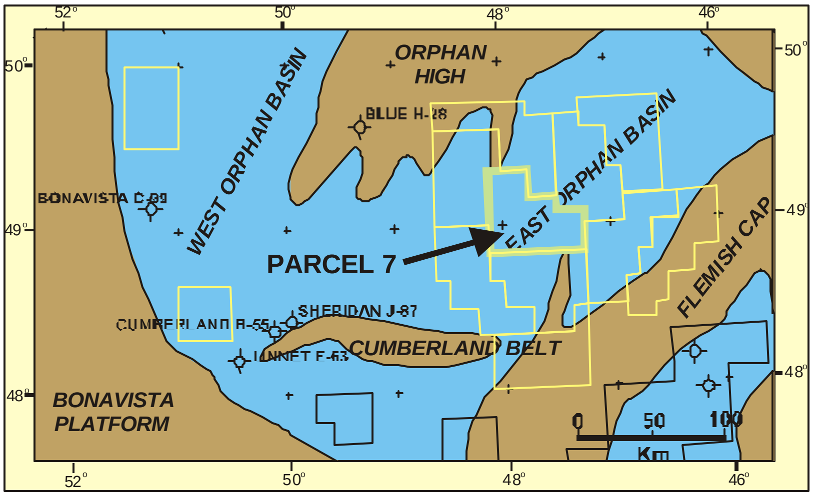
SEISMIC SECTION COURTESY OF GSI

Prospect 6b

	MEAN	P90	ML	P10	Input	standdev	Dist Type
INPUT RANGES			MODE		mean		
Area Sq Km	29.9	17		50	31.7	13.9	trclgnml
Thickness m	2500.0	2000	2500	3000			trigen
% Sand	20.0%	10%	20%	30%			trigen
Net to gross	61.4%	30%	70%	90%			trigen
Trap fill	50.2%	20%	50%	80%			trigen
Porosity	17.9%	15%	17%	21%			trigen
Oil sat	85.0%	80%	85%	90%			trigen
Shrinkage	73.4%	70%	73%	77%			trigen
Recov	30.0%	20%	30%	40%			trigen
	MEAN	P90	P50	P10			
OUTPUT POTENTIAL							
mm m3	154.2	26.4	107.8	334.9			
mmbbls	968.4	165.8	676.7	2103.0			



PARCEL 7

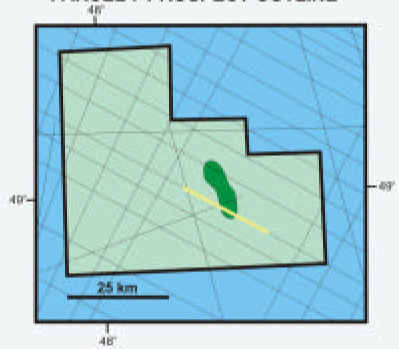


Parcel 7 Location

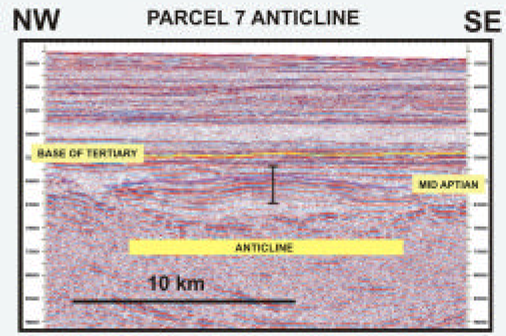
Location:	Centre of East Orphan Basin.
Area:	270,825 ha.
Water Depth:	2250 m to 2600 m.
Seismic Control:	Modern 2D seismic (GSI), 6 km line spacing.
Possible Reservoirs:	Late Jurassic to Upper and Lower Cretaceous sands.
Possible Source Rocks:	Late Jurassic (Egret equiv.) shales.
Play Types:	Anticlines and fault dependent closures.
Prospect Analyzed Here:	Anticline.

PROSPECT SUMMARY - PARCEL 7 EXAMPLE

PARCEL 7 PROSPECT OUTLINE



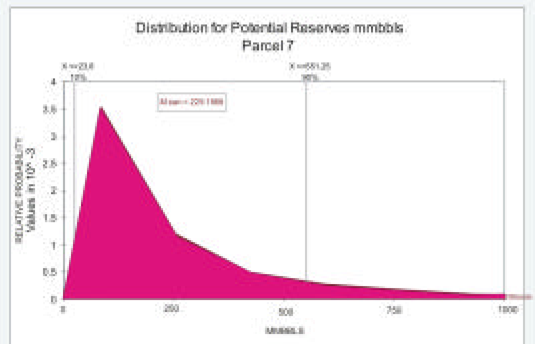
PARCEL 7 ANTICLINE



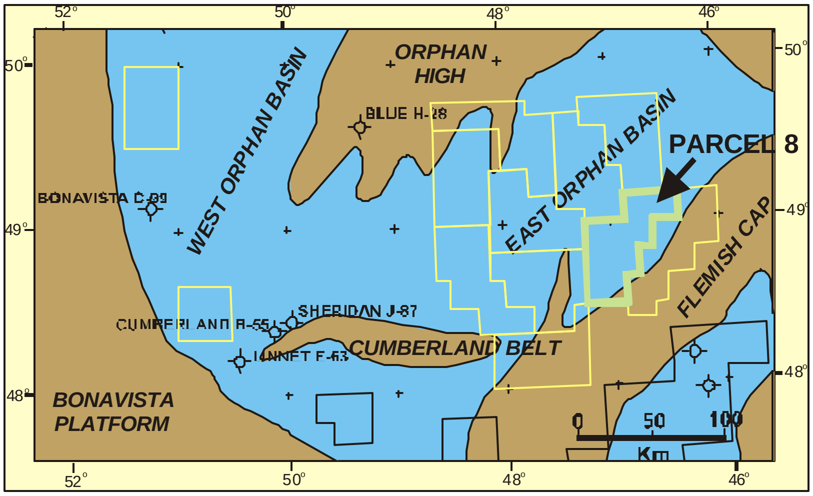
SEISMIC SECTION COURTESY OF GSI

Prospect 7

	MEAN	P90	ML	P10	Input	standdev	Dist Type
INPUT RANGES			MODE		Mean		
Area Sq Km	21.0	6		53	25.6	26.4	trlgnrml
Thickness m	828.5	650	850	1000			trigen
% Sand	20.0%	10%	20%	30%			trigen
Net to gross	61.4%	30%	70%	90%			trigen
Trap fill	50.2%	20%	50%	80%			trigen
Porosity	17.9%	15%	17%	21%			trigen
Oil sat	85.0%	80%	85%	90%			trigen
Shrinkage	73.4%	70%	73%	77%			trigen
Recov	30.0%	20%	30%	40%			trigen
	MEAN	P90	P50	P10			
OUTPUT POTENTIAL							
mm m3	35.8	3.8	20.8	87.8			
mmbbls	224.8	23.8	130.6	551.2			



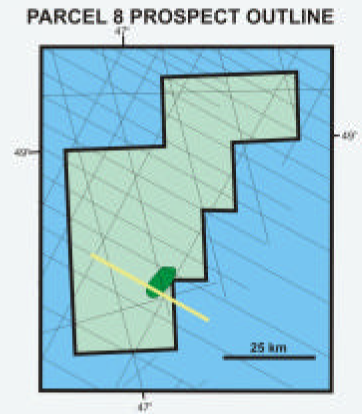
PARCEL 8

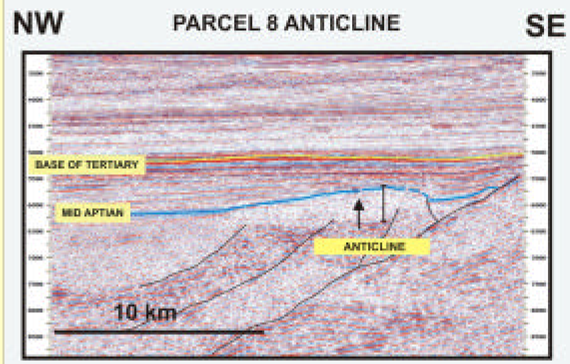


Parcel 8 Location

Location:	South-east margin of East Orphan Basin.
Area:	271,830 ha.
Water Depth:	2250 m to 2900 m.
Seismic Control:	Modern 2D seismic (GSI), 6 km line spacing.
Possible Reservoirs:	Late Jurassic to Early Cretaceous sands.
Possible Source Rocks:	Late Jurassic (Egret equiv.) shales.
Play Types:	Anticlines and fault dependant closures.
Prospect Analyzed Here:	Rollover anticline on flank of Flemish Cap.
Comments:	Flemish Cap is potential reservoir provenance in close proximity to block.

PROSPECT SUMMARY - PARCEL 8 EXAMPLE

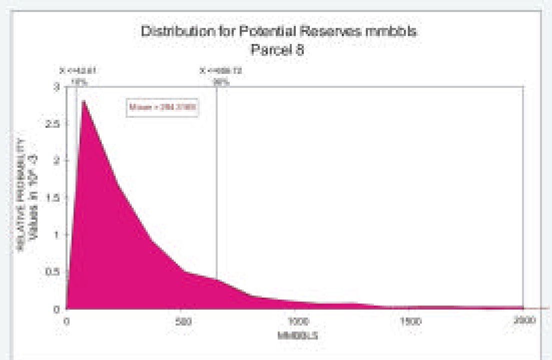




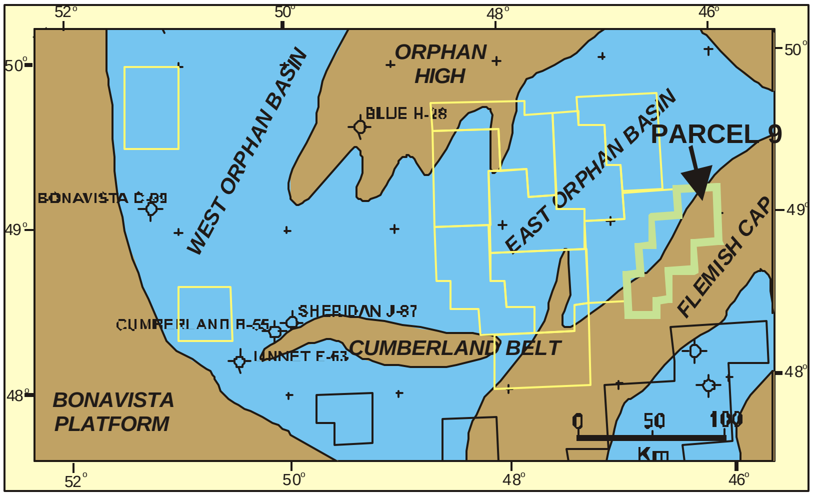
SEISMIC SECTION COURTESY OF GSI

Prospect 8

	MEAN	P90	ML	P10	Input	standdev	Dist Type
INPUT RANGES			MODE		mean		
Area Sq Km	21.2	9		40	22.5	14.3	trolgnml
Thickness m	1185.5	950	1250	1400			trigen
% Sand	20.0%	10%	20%	30%			trigen
Net to gross	61.4%	30%	70%	90%			trigen
Trap fill	50.2%	20%	50%	80%			trigen
Porosity	16.0%	14%	16%	18%			trigen
Oil sat	85.0%	80%	85%	90%			trigen
Shrinkage	73.4%	70%	73%	77%			trigen
Recov	30.0%	20%	30%	40%			trigen
	MEAN	**P90**	**P50**	**P10**			
OUTPUT POTENTIAL							
mm m3	**46.3**	**6.8**	**30.0**	**104.6**			
mmbbls	**290.8**	**42.6**	**188.1**	**656.7**			



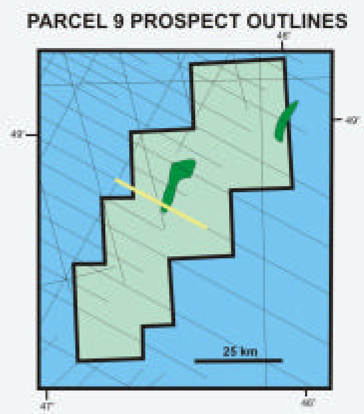
PARCEL 9

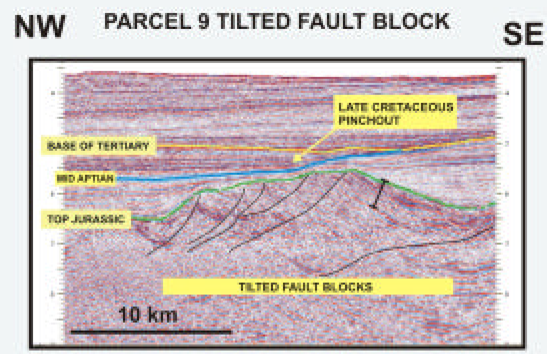


Parcel 9 Location

Location:	North-west flank of Flemish Cap.
Area:	272,040 ha.
Water Depth:	2300 m to 3000 m.
Seismic Control:	Modern 2D seismic (GSI), 6 km line spacing.
Possible Reservoirs:	Jurassic and Early and Late Cretaceous sands, Paleocene (South Mara equiv.) sandstones.
Possible Source Rocks:	Late Jurassic (Egret equiv.) shales.
Play Types:	Tilted fault blocks and anticlines involving Mesozoic section, onlap pinchout of Early Tertiary section.
Prospects Analyzed Here:	Tilted fault block involving Jurassic section on flank of Flemish Cap, anticline involving Early Cretaceous and Late Jurassic section
Comments:	Flemish Cap is potential reservoir provenance in close proximity to block.

PROSPECT SUMMARY - PARCEL 9 EXAMPLE "A"

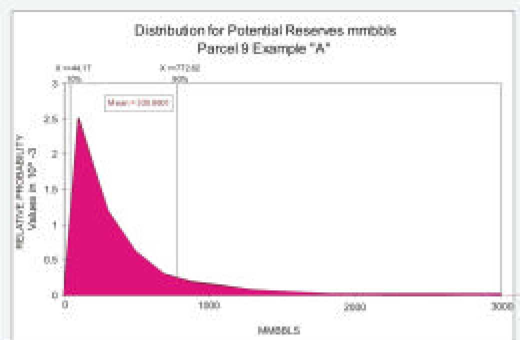




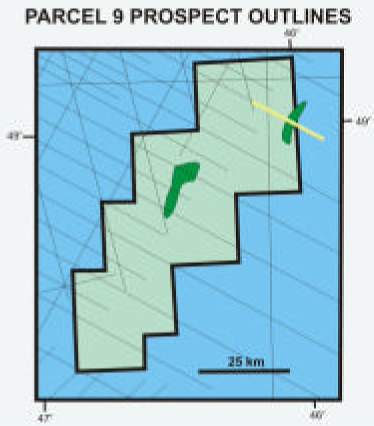
SEISMIC SECTION COURTESY OF GSI

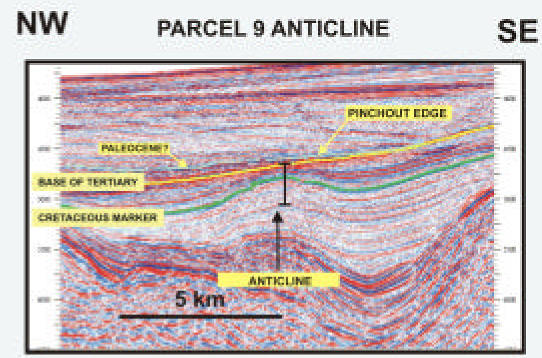
Prospect 9A

	MEAN	P90	ML	P10	mean	standdev	Dist Type
INPUT RANGES			MODE				
Area Sq Km	21.8	8		49	25.5	20.5	trclgnml
Thickness m	1171.5	950	1150	1400			trigen
% Sand	20.0%	10%	20%	30%			trigen
Net to gross	61.4%	30%	70%	90%			trigen
Trap fill	50.2%	20%	50%	80%			trigen
Porosity	17.9%	15%	17%	21%			trigen
Oil sat	85.0%	80%	85%	90%			trigen
Shrinkage	73.4%	70%	73%	77%			trigen
Recov	30.0%	20%	30%	40%			trigen
	MEAN	P90	P50	P10			
OUTPUT POTENTIAL							
mm m3	52.6	7.0	32.1	123.0			
mmbbls	330.4	44.1	201.6	772.6			



PROSPECT SUMMARY - PARCEL 9 EXAMPLE “B”

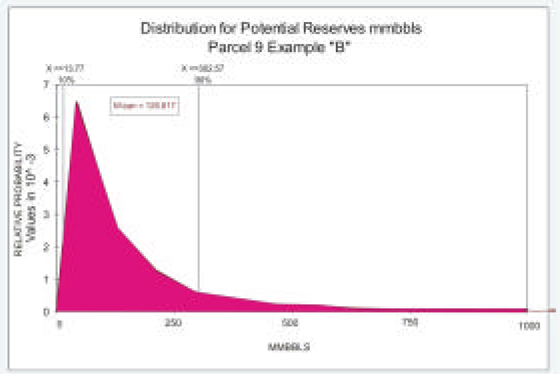




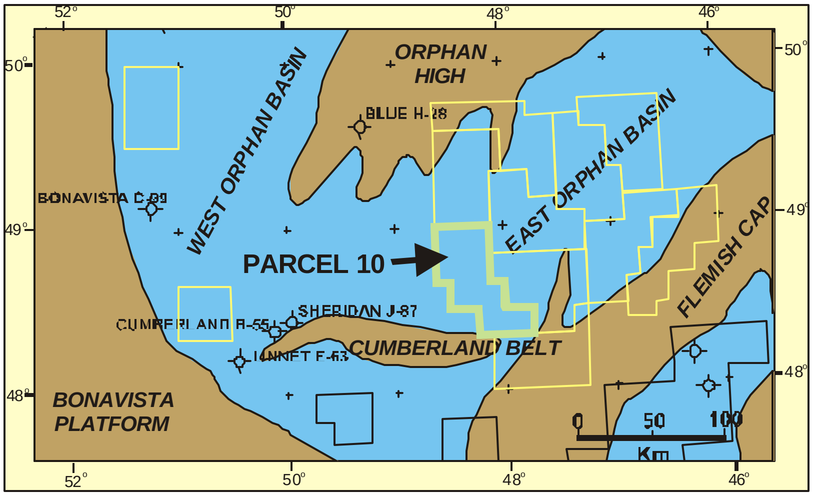
SEISMIC SECTION COURTESY OF GSI

Prospect 9B

	MEAN	P90	ML	P10	mean	standdev	Dist Type
INPUT RANGES			MODE				
Area Sq Km	9.2	2.6		24	11.5	12.2	trclgnml
Thickness m	1078.5	850	1100	1300			trigen
% Sand	20.0%	10%	20%	30%			trigen
Net to gross	61.4%	30%	70%	90%			trigen
Trap fill	50.2%	20%	50%	80%			trigen
Porosity	17.9%	15%	17%	21%			trigen
Oil sat	85.0%	80%	85%	90%			trigen
Shrinkage	73.4%	70%	73%	77%			trigen
Recov	30.0%	20%	30%	40%			trigen
	MEAN	P90	P50	P10			
OUTPUT POTENTIAL							
mm m3	20.4	2.2	12.0	48.2			
mmbbls	128.0	13.8	75.1	302.6			



PARCEL 10

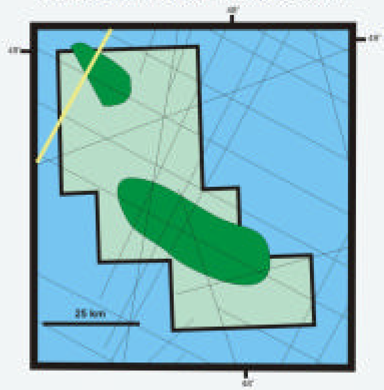


Parcel 10 Location

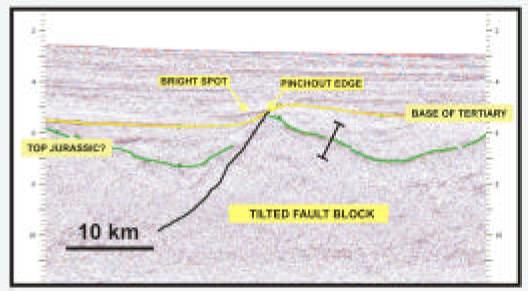
Location:	South-west end of East Orphan Basin
Area:	272,840 ha.
Water Depth:	1650 m to 2200 m
Seismic Control:	Modern 2D seismic (GSI), 6 km to 12 km line spacing.
Possible Reservoirs:	Jurassic and Early Cretaceous sandstones for structural play, Paleocene (South Mara equiv.) and Late Cretaceous (Otter Bay equiv.) sandstones for pinchout play
Possible Source Rocks:	Late Jurassic (Egret equiv.) shales.
Play Types:	Tilted fault blocks involving Mesozoic section, onlap pinchout of Early Tertiary and Late Cretaceous section against high blocks.
Prospects Analyzed Here:	Large tilted fault blocks involving Jurassic and Early Cretaceous section
Comments:	DHI's and gas chimneys on seismic over potential prospects indicate generation and migration of hydrocarbons in this area

PROSPECT SUMMARY - PARCEL 10 EXAMPLE "A"

PARCEL 10 PROSPECT OUTLINE



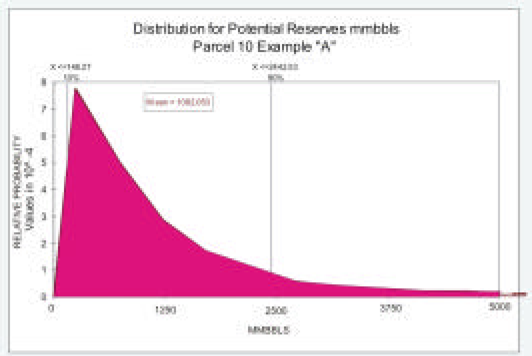
SW **PARCEL 10 TILTED FAULT BLOCK** NE



SEISMIC SECTION COURTESY OF GSI

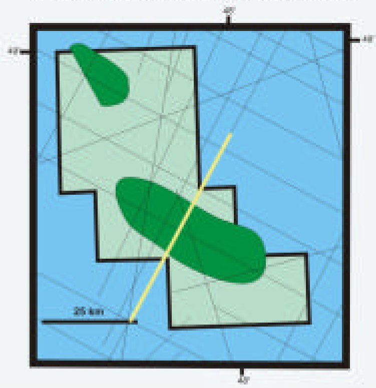
Prospect 10 A

	MEAN	P90	ML	P10	Input	standdev	Dist Type
INPUT RANGES			MODE		Mean		
Area Sq Km	74.3	33		138	78.9	47.7	trclgnml
Thickness m	1107.6	750	1000	1500			trigen
% Sand	20.0%	10%	20%	30%			trigen
Net to gross	61.4%	30%	70%	90%			trigen
Trap fill	50.2%	20%	50%	80%			trigen
Porosity	17.9%	15%	17%	21%			trigen
Oil sat	85.0%	80%	85%	90%			trigen
Shrinkage	73.4%	70%	73%	77%			trigen
Recov	30.0%	20%	30%	40%			trigen
	MEAN	P90	P50	P10			
OUTPUT POTENTIAL							
mm m3	169.5	23.6	109.8	388.9			
mmbbls	1064.4	148.3	689.4	2442.5			

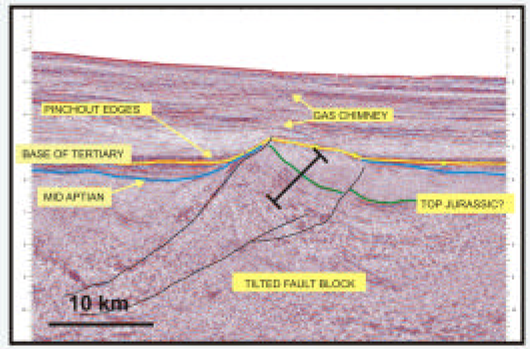


PROSPECT SUMMARY - PARCEL 10 EXAMPLE "B"

PARCEL 10 PROSPECT OUTLINE



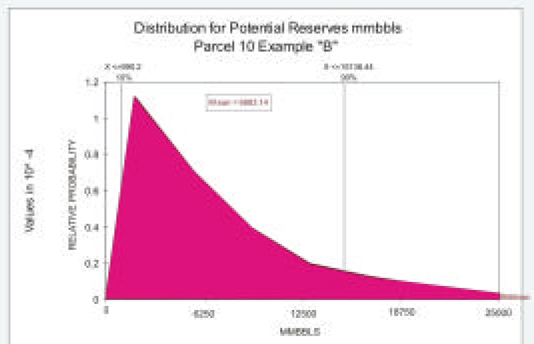
SW PARCEL 10 TILTED FAULT BLOCK NE



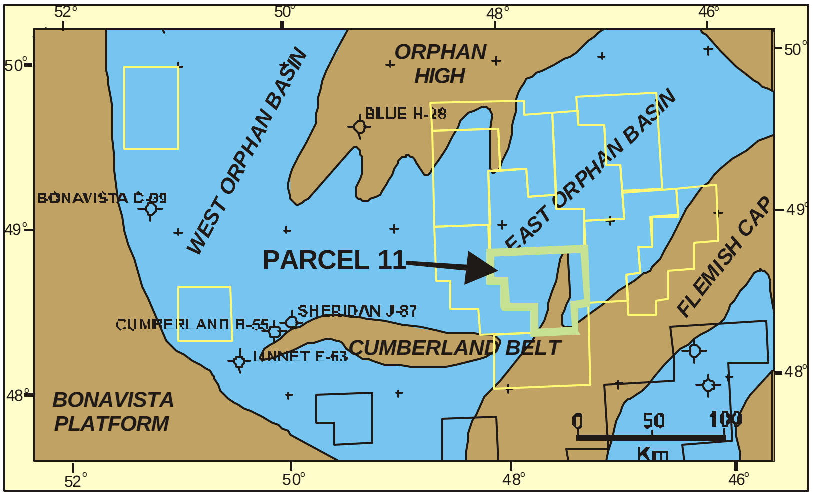
SEISMIC SECTION COURTESY OF GSI

Prospect 10B

	MEAN	P90	ML	P10	mean	standdev	Dist Type
INPUT RANGES			MODE				
Area Sq Km	342.5	186		593	368	175	trnlgnrml
Thickness m	2500.0	2000	2500	3000			trigen
% Sand	20.0%	10%	20%	30%			trigen
Net to gross	61.4%	30%	70%	90%			trigen
Trap fill	30.5%	10%	30%	50%			trigen
Porosity	17.9%	15%	17%	21%			trigen
Oil sat	85.0%	80%	85%	90%			trigen
Shrinkage	73.4%	70%	73%	77%			trigen
Recov	30.0%	20%	30%	40%			trigen
	MEAN	P90	P50	P10			
OUTPUT POTENTIAL							
mm m3	1071.5	157.7	748.0	2410.3			
mmbbls	6728.9	990.2	4697.3	15136.4			



PARCEL 11

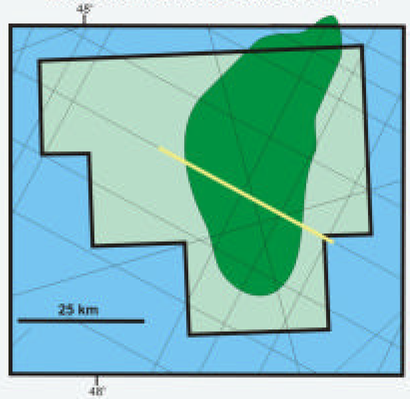


Parcel 11 Location

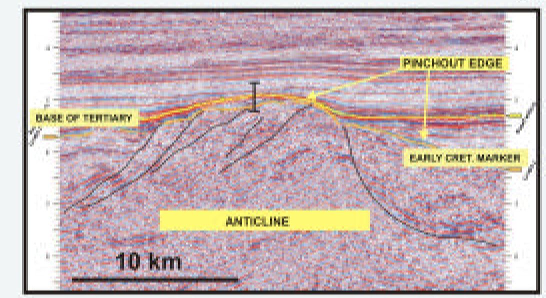
Location:	Southern margin of East Orphan Basin
Area:	273,060 ha.
Water Depth:	1800 m to 2800 m
Seismic Control:	Modern 2D seismic (GSI), 6 km to 12 km line spacing.
Possible Reservoirs:	Jurassic and Early Cretaceous sandstones, or possible porosity in Paleozoic section for structural play; Paleocene (South Mara equiv.) and Late Cretaceous (Otter Bay equiv.) sandstones for pinchout play
Possible Source Rocks:	Late Jurassic (Egret equiv.) shales.
Play Types:	Horst block involving Mesozoic and Paleozoic section. Onlap pinchout of Early Tertiary and Late Cretaceous section against high block.
Prospect Analyzed Here:	Large horst block forming anticlinal structure possibly involving Jurassic, Early Cretaceous and Paleozoic section
Comments:	Very large horst is dominant structure on Parcel. Closure well defined as anticline on Base of Tertiary marker. Although it is possible that the Jurassic section could be contained in this feature, the highly structural nature of the package below the Early Cretaceous marker increases the risk that the feature could be covered by a Paleozoic section. Nevertheless, plays could still exist in the relatively undeformed Upper Cretaceous and Lower Tertiary sections, which drape over this very large feature.

PROSPECT SUMMARY - PARCEL 11 EXAMPLE

PARCEL 11 PROSPECT OUTLINE



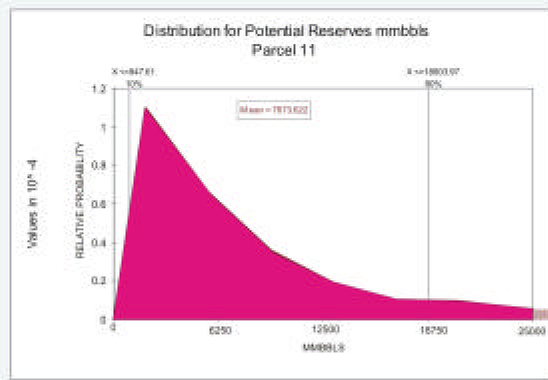
PARCEL 11 ANTICLINE



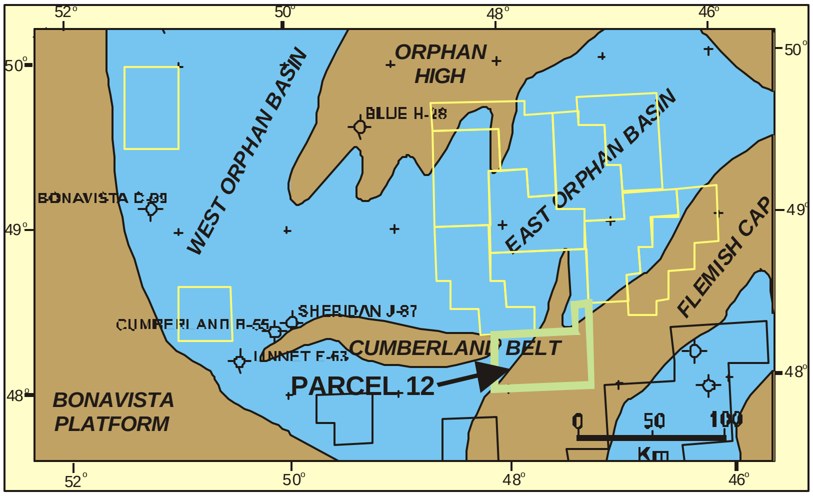
SEISMIC SECTION COURTESY OF GSI

Prospect 11

	MEAN	P90	ML	P10	Input	standdev	Dist Type
INPUT RANGES			MODE		mean		
Area Sq Km	480.0	202		1000	545.7	377	trolgnrmal
Thickness m	2000.0	1500	2000	2500			trigen
% Sand	20.0%	10%	20%	30%			trigen
Net to gross	61.4%	30%	70%	90%			trigen
Trap fill	30.5%	10%	30%	50%			trigen
Porosity	17.9%	15%	17%	21%			trigen
Oil sat	85.0%	80%	85%	90%			trigen
Shrinkage	73.4%	70%	73%	77%			trigen
Recov	30.0%	20%	30%	40%			trigen
	MEAN	P90	P50	P10			
OUTPUT POTENTIAL							
mm m3	1201.2	150.9	769.7	2994.3			
mmbbls	7543.8	947.6	4833.5	18804.0			



PARCEL 12

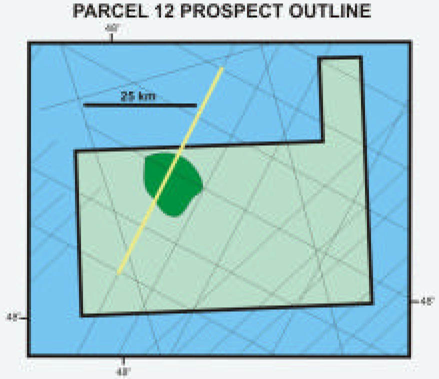


Parcel 12 Location

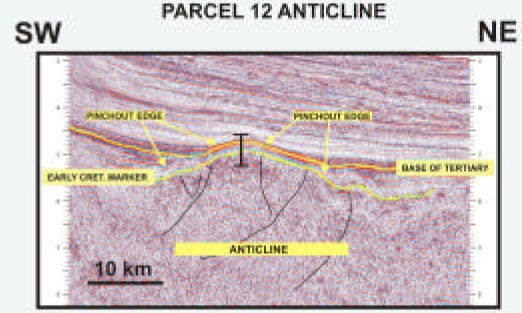
Location:	Southern margin of East Orphan Basin
Area:	258,180 ha.
Water Depth:	350 m to 2250 m
Seismic Control:	Modern 2D seismic (GSI), 9 km to 12 km line spacing. Rapidly shallowing water bottom in south of Parcel has reduced seismic quality.
Possible Reservoirs:	Jurassic and Early Cretaceous sandstones, or possible porosity in Paleozoic section for structural play; Paleocene (South Mara equiv.) and Late Cretaceous (Otter Bay equiv.) sandstones for pinchout play.
Possible Source Rocks:	Late Jurassic (Egret equiv.) shales.
Play Types:	Fault blocks and anticlines involving Mesozoic and Paleozoic section. Onlap pinchout of Early Tertiary and Late Cretaceous section against high blocks.
Prospect Analyzed Here:	Large anticline involving Jurassic and Early Cretaceous and Paleozoic section.
Comments:	The highly structured character of the core of this feature suggests the possibility of Paleozoic sediments instead of Jurassic. The possibility remains for relatively unstructured Late Cretaceous and Lower Tertiary sediments draping over the feature. Onlap of Late Cretaceous and Early Tertiary section against structure may provide additional traps.

PROSPECT SUMMARY - PARCEL 12 EXAMPLE

PARCEL 12 PROSPECT OUTLINE



PARCEL 12 ANTICLINE



SEISMIC SECTION COURTESY OF GSI

Prospect 12

	MEAN	P90	ML	P10	Input	standdev	Dist Type
INPUT RANGES			MODE		Mean		
Area Sq Km	76.0	39		130	79.3	39.3	trdgnrml
Thickness	1000.0	500	1000	1500			trigen
% Sand	20.0%	10%	20%	30%			trigen
Net to gross	61.4%	30%	70%	90%			trigen
Trap fill	50.2%	20%	50%	80%			trigen
Porosity	16.0%	14%	16%	18%			trigen
Oil sat	85.0%	80%	85%	90%			trigen
Shrinkage	73.4%	70%	73%	77%			trigen
Recov	30.0%	20%	30%	40%			trigen
	MEAN	P90	P50	P10			
OUTPUT POTENTIAL							
mm m3	140.1	19.6	91.8	315.8			
mmbbls	880.1	122.8	576.7	1983.5