



OFFSHORE OPPORTUNITY - 2013 LICENCE ROUND

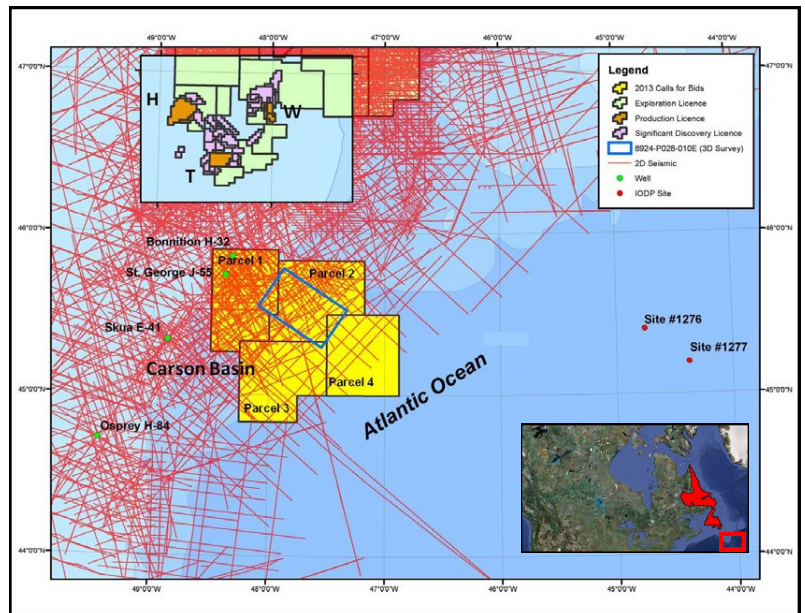
CALL FOR BIDS NL13-02, CARSON BASIN, NEWFOUNDLAND AND LABRADOR

EXECUTIVE SUMMARY

On May 16th, 2013, the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) announced a Call for Bids for four parcels in the Carson Basin, off the southeast coast of the island of Newfoundland, Eastern Canada. With substantial undiscovered resources estimated at some 6 billion barrels of oil and 60 trillion cubic feet of natural gas, the Newfoundland and Labrador offshore holds great petroleum potential. Land available in the 2013 Calls for Bids offers all explorers a variety of excellent opportunities for large discoveries. The Carson Basin is considered highly prospective for hydrocarbons, and represents part of the North Atlantic Mesozoic rift network. This network includes the Jeanne d'Arc, Flemish Pass and East Orphan basins where intense exploration and production activity has been ongoing for the past decade. Despite good seismic coverage, the area remains very much underexplored with only four wells on the shelfal part and no wells drilled in deeper water. The closing date for this Call for Bids shall be a minimum of 120 days after completion of the *Eastern Newfoundland Strategic Environmental Assessment (2013)*. The closing date will be announced in a subsequent Notice to Bidders (www.cnlopb.nl.ca/news/nr20140520.shtml).

OVERVIEW

Located on Canada's East Coast, the Province of Newfoundland and Labrador is Canada's offshore oil producing region. Over the past seventeen years the province's four producing fields - Hibernia, Terra Nova, White Rose and North Amethyst - have produced in excess of 1.5 billion barrels of oil. Hebron, expected to be the province's fifth producing field, was sanctioned late in 2012 and will utilize a gravity based structure, with first oil planned for 2017. Further development is expected in the region as a Significant Discovery Licence was awarded in 2010 to Statoil for their Mizzen discovery in the Flemish Pass Basin, estimated to contain between 100 to 200 million barrels of oil. This was followed up by additional discoveries in 2013 at Harpoon and Bay du Nord with the latter estimated at 300 to 600 million barrels recoverable. Land available in the 2013 Calls for Bids offers all explorers a variety of excellent opportunities for more discoveries.



CARSON BASIN, OFFSHORE SOUTHERN NEWFOUNDLAND, CANADA

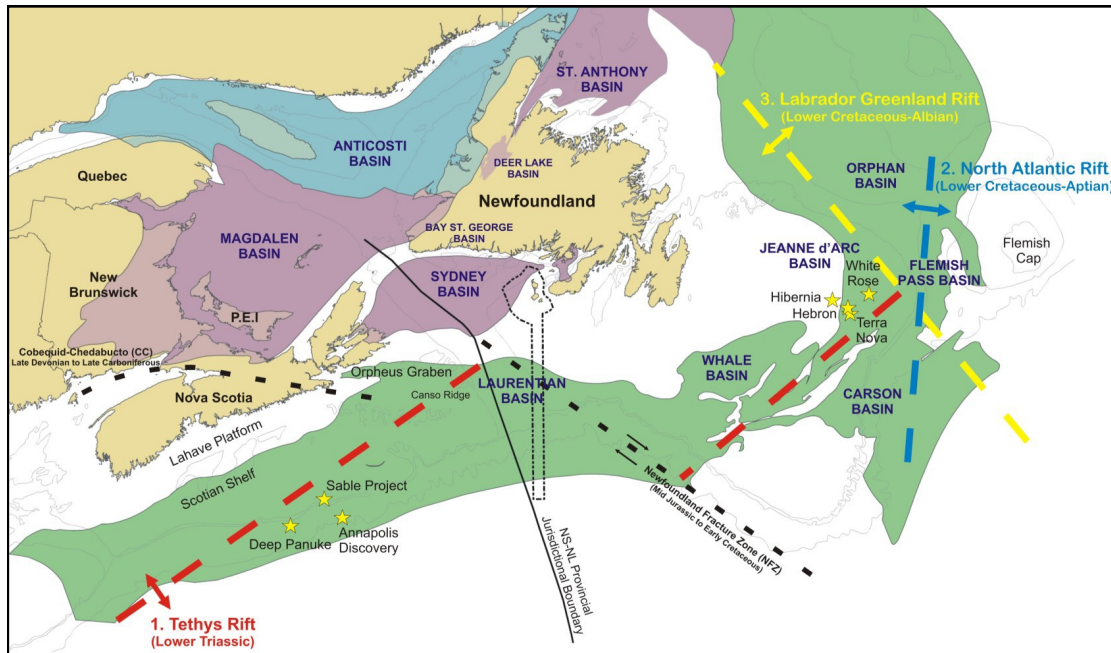
KEY ATTRIBUTES

- Call for Bids NL13-02 (Area "C") in the Carson Basin includes four large parcels totaling 1,138,399 hectares (2,813,034 acres) or 11,384 km². Parcel size ranges from 673,177 acres or 2,724 km² to 719,843 acres or 2,913 km².
- Located in shallow to deep water of the Carson Basin, southeast of the Grand Banks of Newfoundland and just south of Flemish Pass bathymetric feature. Water depth ranges from 90 to 3,700 m.
- Competitive fiscal regime with very low political risk.
- Proximity to both North American and European markets.
- Open and transparent land management and bid processing system.
- Winning bidder granted exploration rights on work commitment basis.
- The closing date will be announced in a subsequent Notice to Bidders.
- For more information, see www.cnlopb.nl.ca/pdfs/nl1302.pdf.



REGIONAL GEOLOGY OF THE ATLANTIC MARGIN

- The approximately 50,000 km² (19,305 miles²) Carson Basin is a Mesozoic extensional area developed over stretched Precambrian and Lower Paleozoic basement on the North American Continental Margin.
- Late Triassic to Early Jurassic rifting of Pangea created a chain of NE-SW oriented intracratonic basins extending from the Gulf of Mexico to the Barents Sea. Oblique and perpendicular rift branches (e.g. Bay of Fundy, Orpheus Graben, Aquitaine Basin, Viking Graben, Labrador Sea and others) were also formed during this series of tectonic events. Detached from Iberia margin in late Early Cretaceous and drifting westward during Atlantic opening, the Carson Basin was not subsequently affected by the Alpine inversion that influenced the late evolution of the European basins.
- In Eastern Canada, the Tethys rift basin chain starts with the George's Bank Basin offshore Nova Scotia, stretches through the Scotian shelf and slope basins and subbasins, including the Laurentian Basin, and continues with the deepwater Carson Basin. The system extends northeastward with the shallow-water Grand Banks basins and the intermediate to deep water Flemish Pass and Orphan basins, and likely branches into the Labrador Sea.
- The Carson Basin started as an intra-continental rift in the Late Triassic, then became an inland sea basin (confined basin) in the Jurassic and evolved into a divergent margin (unconfined basin) during Late Cretaceous and Tertiary. Since the Aptian break-up of the Grand Banks from Iberia, the lower slope and deepwater parts of the basin became directly opened to the newly born North Atlantic Ocean.
- The basin is now located on the Newfoundland non-volcanic margin occupying extended continental crust, thinned continental crust and transitional crust. During its prolonged rifting evolution, the Carson Basin had connections with basins located on the Grand Banks and on the Iberian margin. The basin extends eastwardly over transitional crust all the way to the continent-ocean boundary (COB) marked by the well-defined J(M0) magnetic alignment.



REGIONAL GEOLOGY OF THE CANADIAN ATLANTIC MARGIN, SHOWING MAJOR BASINS AND TECTONIC EVOLUTION (AFTER C-NLOPB, GSC, ENACHESCU AND FAGAN, 2006)

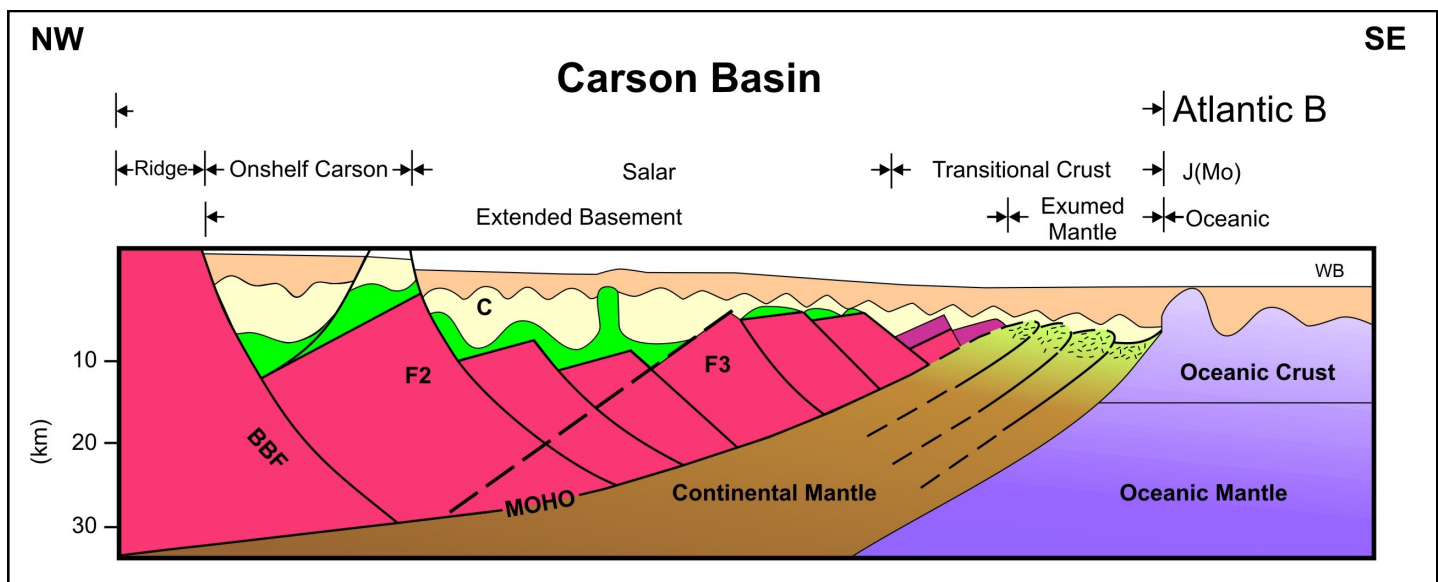
CARSON BASIN GEOLOGY

The composite Carson Basin is located a) on the continental shelf where it is known as Carson or Carson-Bonniton Basin, b) on the slope where it is known as the Salar Basin or Deepwater Carson Basin and c) on the rise and abyssal plain where Mesozoic rocks overlie a super-extended crust.

- The Mesozoic-rifted Carson Basin represents the easternmost arm of the intra-cratonic network of rift basins developed on the Canadian margin during Late Triassic to Early Jurassic. The area shared a common tectonic and structural evolution through to the late Early Cretaceous with several of the Grand Banks basins (including the oil proven Jeanne d'Arc and Flemish Pass basins).
- During the Late Triassic to Early Cretaceous, the Carson Basin area was first an intra-continental rift valley followed by an internal shallow sea stage interspersed with continental episodes. The area was situated on a future divergent margin and underwent extension, transtension and subsidence within a depression situated between the Grand Banks of Newfoundland and the Iberia Peninsula.
- After the continental crust thinned considerably and transitional crust was emplaced to the east, the final rift episode became oceanic during the late Early Cretaceous (Aptian-Albian). Then the Grand Banks and Iberia separated and started drifting apart.
- Currently, the Carson Basin is separated from the Jeanne d'Arc Basin by the Morgiana Anticlinorium, from the South Jeanne d'Arc Basin by a thin basement ridge and from the Flemish Pass Basin by a series of basement highs and narrow sedimentary troughs.

CARSON BASIN GEOLOGY CONTINUED

- Basin fill includes Late Triassic to Mid Jurassic red beds, salt, limestone and dolomites, followed by a Late Jurassic to mid-Cretaceous largely clastic sequence. A predominantly shaly sequence including several basin slope and floor sandstone intervals characterize the Late Cretaceous to Quaternary cover.
- The on-shelf basin is separated from the Jeanne d'Arc Basin by a basement ridge and Morgiana Anticlinorium (Enachescu, 1987). A major down-to-ocean fault marks the basin's northwestern boundary.
- The shelf area can be divided into a northern and a southern half graben, separated by a transfer zone. The northern area contains thicker Mesozoic fill, while the southern area has suffered pronounced erosion during mid-Late Cretaceous. The Early Cretaceous sediments including sandstone reservoirs are generally preserved to the north and eroded towards the south.
- The deepwater sedimentary sequences include Triassic salt and thick Jurassic to Cretaceous successions.
- Basin fill deformation is due to extension, salt movement and detachment sliding. Inversion was a late-stage event in the region and is only a secondary mechanism for trap formation. Late Triassic to Early Jurassic Argo salt forms ridges, diapirs and complex bodies. Diapiric salt is more widespread on the slope and in deep water. In deep water, the seismic reflection and potential field data show a south-east trending, en echelon ridge and fault system interrupted by salt diapirs and volcanic mounds.
- Coarse clastics should be present within deltaic episodes during the Late Jurassic to Early Cretaceous sourced from the Precambrian basement terrains surrounding the basin. Under the slope, the prerift section drops off significantly within salt induced minibasins. Large and complex Mesozoic structural and stratigraphic features are observed under the slope and upper rise, a number of which are salt cored.



CARSON BASIN GENERALISED STRUCTURAL PROFILE (ENACHESCU, 1988 AND 2013)

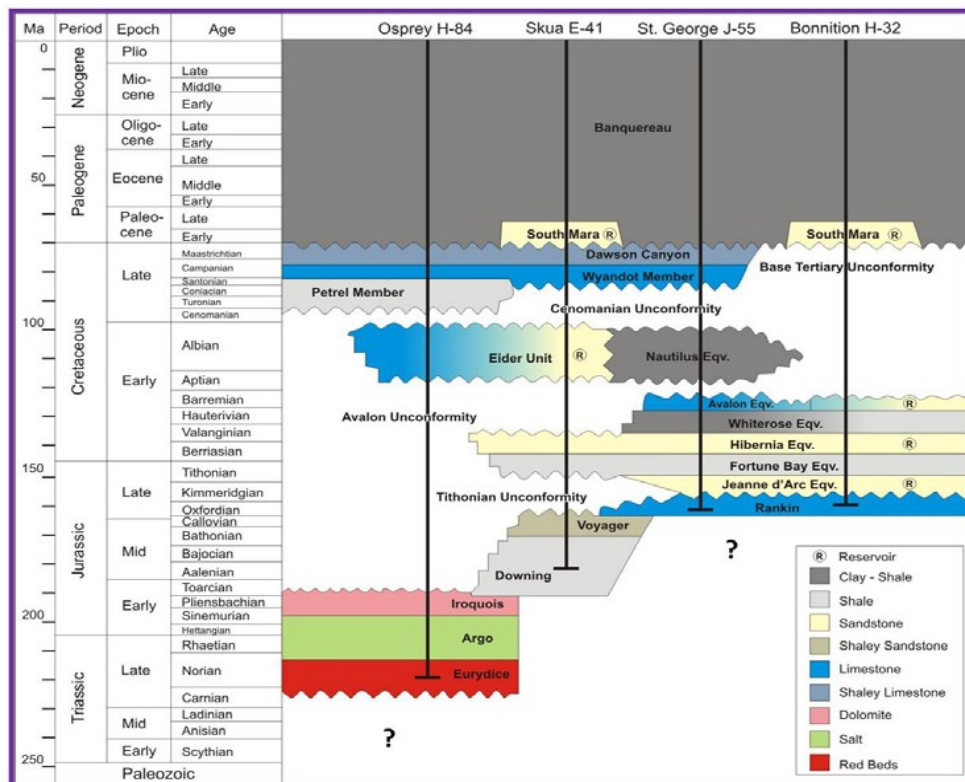
CARSON BASIN: THREE GEOLOGICAL PROVINCES

Based on tectonic and structural setting, position on the continental margin and composition of sedimentary fill, the Carson Basin can be divided into three distinct sectors:

1. **On-shelf sector.** This sector is located on the easternmost part of the Grand Banks of Newfoundland. It is separated from the Jeanne d'Arc Basin by a basement ridge trending approximately NE-SW and from the slope part of the basin by a basement ridge capped in places by Late Triassic Argo salt. This ridge is mapped under the shelf break. Late Triassic to Quaternary successions were drilled in this sector of the basin; however Late Jurassic source rocks are missing at the well locations, probably due to non-deposition on basement highs or erosion in the proximity of the Avalon Uplift.
2. **Slope and upper rise sector.** This sector is known in the literature as the Salar Basin. This sector is separated from the on-shelf part by a basement ridge trending approximately NE-SW (forming a hinge zone) and from the deepwater basin by a tortuous fault zone and high ridge. From jump correlation of regional seismic markers, this sector seems to contain the entire Mesozoic sedimentary section including Late Triassic beds. Large and complex structures are mapped in this sector including those separated by deep penetrating faults.
3. **Deepwater sector:** This sector is located east of a fault system dividing the deepwater region into sub-regions. This Mesozoic-dominated area east of the fault zone is complexly structured. In places the Mesozoic section is thin. Tilted basement blocks, circular salt structures and transitional zone-like mounds (peridotite mounds?) intertwined with minibasins containing deformed Mesozoic layers are mapped in the deepwater sector. Some of the blocks show slight inversion probably due to transtension or isostatic rebound.

PETROLEUM GEOLOGY: OVERVIEW

- The outer shelf, slope and deepwater Carson Basin that is included in the present Call for Bids is part of Newfoundland's Mesozoic network of basins which has preserved a significant Late Jurassic-Early Cretaceous sedimentary sequence. While the inner shelf basin has suffered drastic erosion at the time of Avalon Uplift, the rest of the basin started to subside and was blanketed by a thick Late Cretaceous-Tertiary cover which helps to preserve the hydrocarbon potential synrift sequence.
- Consequently, it is anticipated that the basin will contain the identical oil prone petroleum system (anchored by Kimmeridgian Egret Member source rock) that was proven in several of the neighboring basins.
- Despite being adjacent to the prolific Jeanne d'Arc Basin, the Carson Basin remains underexplored, and undrilled on the slope and in deepwater. Several early wells drilled on the shelf were unsuccessful due to lack of charge, with source rocks eroded or nondeposited at the well locations.
- The Carson Basin's lower infill consists of a structured synrift succession of coarse and fine clastics (red beds), evaporites and various carbonates ranging in age from Late Triassic to Middle Jurassic. This is overlain by a Late Jurassic to late Late-Cretaceous (Albian) succession developed during two more rifting stages and subsequently deformed by halokinesis. Finally, the Late Cretaceous to Tertiary section contains a relatively thick, mounded on the slope and parallel-bedded succession of mainly fine clastics and thin carbonates. These were deposited during the thermal subsidence stage that started with transitional crust formation and followed by oceanic drifting and rifting accompanied by oceanic crust formation.
- The early basin fill contains the red beds sequence that may contain terrigenous source rocks.
- The Triassic Argo salt deposited in the Tethys synrift stage became mobile starting in Jurassic, creating intrusions and salt-induced structures in the overlying sediments. Prior to and during salt deposition it is expected that marine shale with high TOC were also deposited.
- A multitude of structural and combination hydrocarbon traps were formed in the basin during the extensional and minor transtensional episodes and prolonged salt halokinesis.
- Reservoir rocks are present in all stages, although good quality clastic and carbonate reservoirs can be localized to deltaic and littoral environments. Quality sandstone reservoirs were encountered on the shelf in several wells located near the NW boundary of the basin.
- While not drilled yet, oil prone source rocks should be present in several Late Jurassic intervals identified on seismic reflection data. The potential for other source rocks is recognized in the Paleozoic, Early Jurassic, Early and Late Cretaceous and Early Tertiary sequences. High TOC "black shale" intervals were cored during ODP Leg 210, holes 1276A and 1277.
- Thus far, the only proven petroleum system on the Grand Banks and environs is anchored by the Egret Member of the Rankin Formation feeding hydrocarbons into Late Jurassic to Tertiary sandstones. This system is expected to be present in the intermediate and deep water Carson Basin. The Egret Member is a Type II- marls and calcareous shale, lime and mudstone with high organic carbon content from marine plankton and secondary terrestrial organics. The Egret Member has 2-9% (average 4%) TOC and 100-600 Hydrogen Index and is generally mature when buried deeper than 2800-3000 m.



CHRONOSTRATIGRAPHY OF WELLS DRILLED TO DATE (ALL SHELFAL) IN THE CARSON BASIN (AFTER GRANT ET AL., 1988; SOLVASON, 2006)

PETROLEUM GEOLOGY: SOURCE ROCKS

- Part of the network of Late Triassic–Early Jurassic chain of the basins stretching across Pangea from Nova Scotia to the Norwegian Sea, the Carson Basin had a common rift evolution as other North Atlantic petroliferous basins. The basin has experienced an early lacustrine age similar to other Atlantic margin basins (e.g. Scotian Basin) and an interior sea stage period similar to the Jeanne d'Arc and Flemish Pass basins, when significant thickness of oil potential source rocks were deposited in the basin.
- The most significant source rock in the basin is most likely to be the Egret Member of the Rankin Formation of Kimmeridgian age or its equivalent. This unit is the prolific source rock interval that sourced all the current oil fields of the Jeanne d'Arc Basin.
- The Egret source rock is a marine-derived organic shale with up to 9% (average 4.5%) Total Organic Carbon (TOC). Over 25 exploration wells have penetrated the Egret Member source in the Grand Banks and environs. The Egret shale, deposited in a semi-silled epeiric basin, is the best marine source rock within the North American Atlantic rift system.
- The predominant kerogen in the Egret Member unit is marine Type II and therefore oil-prone. Several wells in the Flemish Pass–Central Ridge area have also encountered Egret sections containing Type I-II kerogens. Other source rock intervals have been intersected in the Tithonian and Oxfordian shale successions.
- Another possible source rock is the Albian shale (Nautilus Formation) that showed rich marine organic content when drilled by IODP Leg 210, Sites 1276 and 1277, just east of the Flemish Cap. This interval may be mature in the deeper troughs of the Carson Basin.
- In some areas a Paleozoic source rock (similar to Paleozoic sources in the adjacent Maritimes Basin) may also be a contributor to gas generation. Tertiary shales show some high TOC intervals, however they are yet unproven as source rocks.

PETROLEUM GEOLOGY: RESERVOIRS AND SEALS

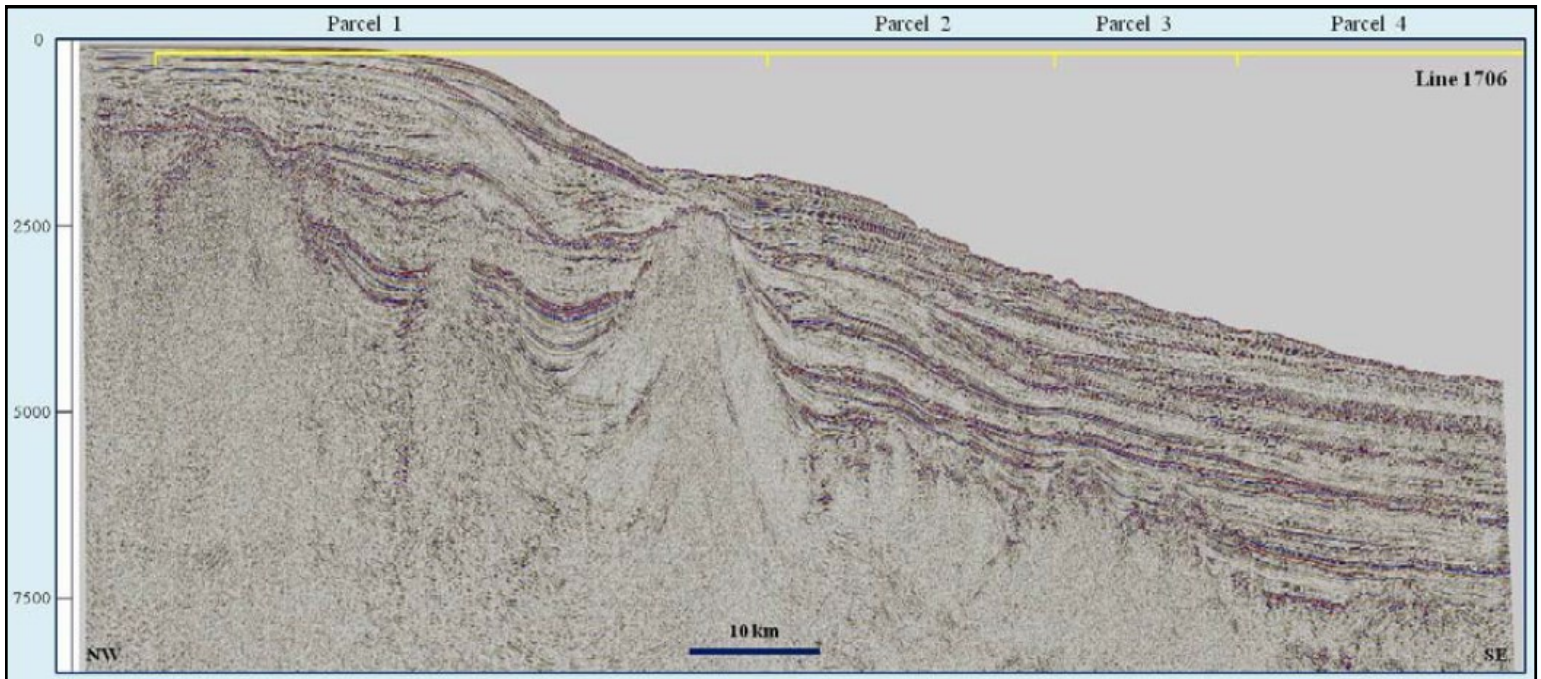
- Reservoir rocks in the Carson Basin are predominantly high-porosity/high-permeability sandstones of Late Jurassic to late Early Cretaceous age draping basin highs or present in salt withdrawal mini-basins. Turbidite sands and basin floor fans should also be present on the Carson Basin's continental slope and rise.
- Good porous sandstone intervals were encountered by the wells drilled on the shelf. The Bonniton H-32 and St. George J-35 wells intersected Late Jurassic to Early Cretaceous sandstones.
- The targets in the area of interest are equivalents of these sandstones, deposited as valley fill, deltaic and shoreline sandstone trapped in tilted blocks, rollover and salt anticlines and turbidites, slope and basin floor fans, minibasins, channels etc., situated either between salt swells or deformed by later salt movements.
- The Early Tertiary sequence has a real and effectively untested potential for large oil and gas pools, especially in the deep water area. Secondary migration would be required to fill Late Cretaceous and Early Tertiary turbidite traps.

SEISMIC AND WELL DATA

- Good to excellent 2D marine seismic grids are available for all parcels. However the deepest parts of the easternmost parcels have reduced coverage.
- Excellent modern seismic coverage exists over several extensional and salt induced structures located on the slope and straddling the Call for Bids parcels (see next page).
- Seismic data quality is good to excellent in most of the parcels but deteriorates around salt features and due to the presence of multiples in steep slope areas.
- Seismic mapping is possible using high quality regional seismic markers such as carbonate intervals within clastics and several widespread unconformities. Good local markers and detachment surfaces within the postrift sedimentary wedge can also be easily mapped. Main and secondary faults are readily traceable, and salt walls/welds are relatively well imaged.
- Seismic ties to on shelf wells and to the nearest oil discoveries (Hibernia, Terra Nova, Hebron and White Rose) are possible using the long regional lines covering the shelf and deep water.

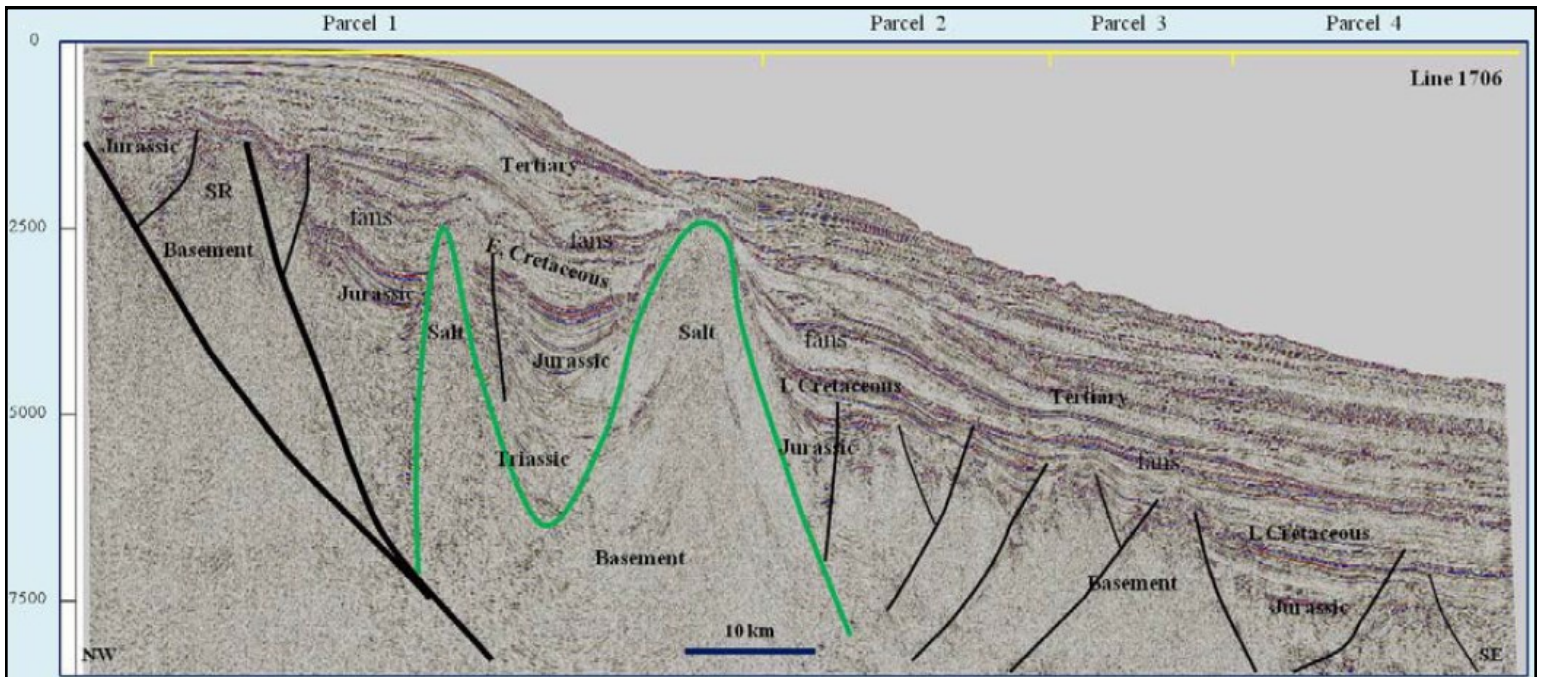
Well	Drilled	WD (m)	Status	Location	TD (m)	Postrift Unc (m)	TD in	Reservoir Interval (m)	Source rock
Osprey H-84	1973	61	Abandoned	Grand Banks shelf	3474	1056	Eurydice Fm		Not present
Bonniton H-32	1973	102	Abandoned	Grand Banks shelf	3048	1291	Rankin Fm	S. Mara Mbr 1268-1291 Hibernia eq. 1458-1640 Jeanne d'Arc eq. 1725-2054	Not present
Skua E-41	1974	83	Abandoned	Grand Banks shelf	3339	1341	Downing Fm	S. Mara Mbr 1077-1117m Eider 1319-1341 Hibernia eq. 1341-1370	Not present
St. George J-55	1986	104	Abandoned	Grand Banks shelf	4100	1840	Rankin Fm	Hibernia eq. 2385-3006 Jeanne d'Arc eq. 3287-3714	Not present

SUMMARY OF WELL RESULTS, CARSON BASIN (ENACHESCU, 2013)



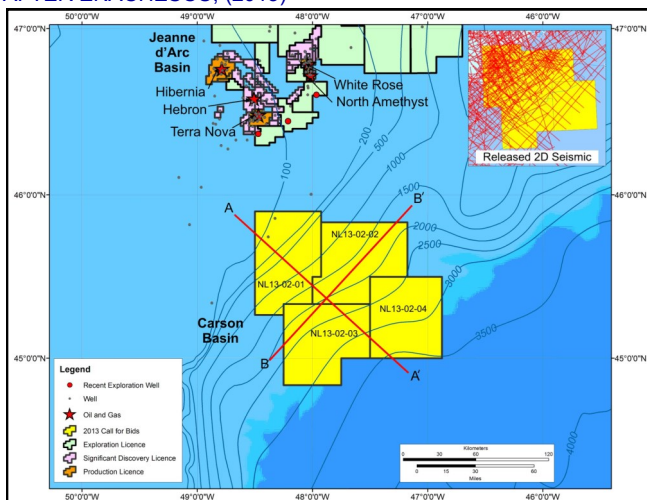
AFTER ENACHESCU, (2013)

SEISMIC LINES SOURCE: C-NLOPB



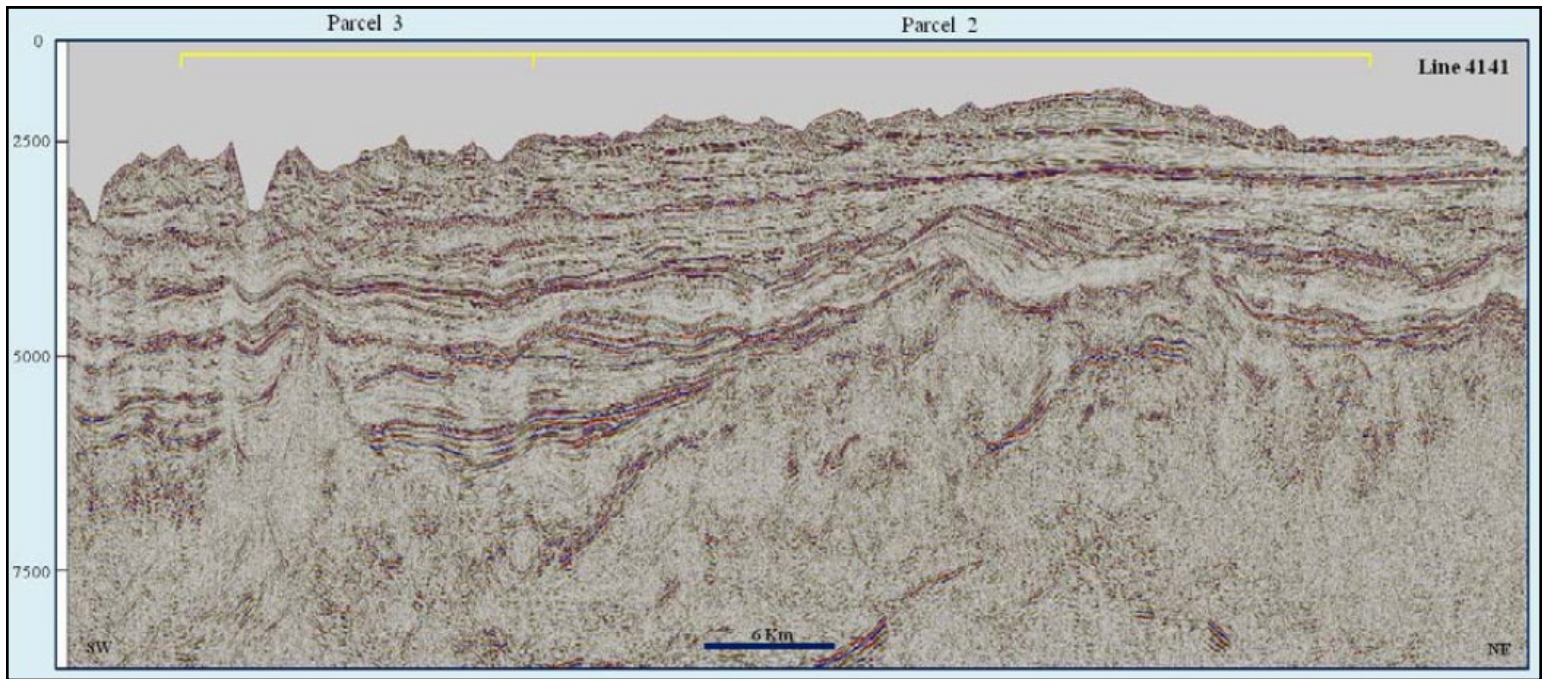
AFTER ENACHESCU, (2013)

SEISMIC LINES SOURCE: C-NLOPB



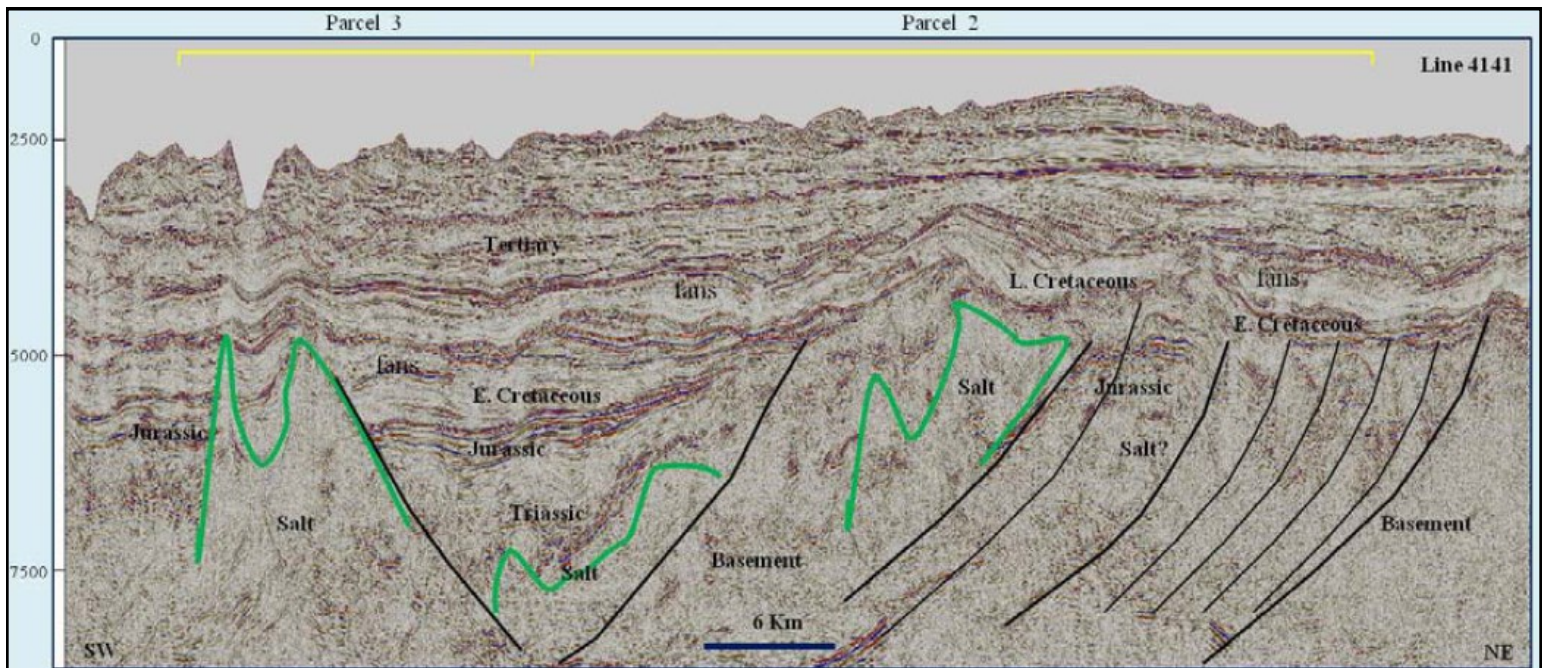
SEISMIC EXAMPLES

- Uninterpreted and interpreted seismic lines from the Carson Basin. Dip line A-A' (shown above) and strike line B-B' (facing page) illustrate structural style and quality of public domain 2D seismic data in the Carson Basin.
 - ⇒ Rotated basement blocks and deeply rooted salt diapirs, creating structural, stratigraphic and combination traps.
 - ⇒ Drape anticlines containing several Late Cretaceous and Tertiary successions separated by unconformities.
 - ⇒ Presence of a thick Late Jurassic sequence located within inter-salt basins that may contain high-TOC, mature source intervals.
 - ⇒ Petroleum leads are 5-10 km wide and, if closed in strike direction, could contain significant volumes of hydrocarbons.



AFTER ENACHESCU, (2013)

SEISMIC LINES SOURCE: C-NLOPB



AFTER ENACHESCU, (2013)

SEISMIC LINES SOURCE: C-NLOPB

CARSON BASIN PLAY SUMMARY

- The Carson Basin represents a vastly underexplored high-risk, high reward petroleum play on the Newfoundland Atlantic Margin in immediate proximity to proven prolific hydrocarbon regions, the giant oil accumulations of the Jeanne d'Arc Basin and the emerging, recently proven significant discoveries at Mizzen, Harpoon and Bay du Nord in the Flemish Pass Basin.
- Main play risk is considered to be charge, notably source rock presence and maturity.
- Multiple play types are conceptualized in the Carson Basin, including large structural fault-bounded closures, salt-induced anticlines, mini-basin traps, Cretaceous fans, Tertiary lowstand submarine fans and channel complexes, salt wall stratigraphic traps and deep sub-salt plays. These will likely be sourced by a world-class Late Jurassic source rock
- Conventional plays that are expected to be successful in the Carson Basin, with analogies to the adjacent Jeanne d'Arc Basin, will likely be Late Jurassic Jeanne d'Arc equivalent sandstone, Early Cretaceous Hibernia equivalent sandstone and late Early Cretaceous Avalon and Ben Nevis equivalent sandstones.
- Late Cretaceous and Early Tertiary lowstand clastics are expected to have significant play potential on the basin's slope and upper rise.

ADDITIONAL INFORMATION AND CONTACTS

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MANDATE AND ROLES

The C-NLOPB is mandated to apply the provisions of the Atlantic Accord and the Atlantic Accord Implementation Acts to all activities of operators in the Newfoundland and Labrador Offshore Area. Their role is to facilitate the exploration for and development of the hydrocarbon resources, including effective management of land tenure, in a manner that conforms to the statutory provisions set out in the Acts.

As Offshore Regulator and administrator for the Call For Bids, the C-NLOPB are the primary contact for participation in this resource opportunity. They operate a registry to record exploration, significant discovery and production licences and information related to these interests for public review. They are also the curators of all geoscientific data pertaining to the Newfoundland and Labrador Offshore Area. The C-NLOPB has no active role in promotion of the Province's hydrocarbon resources.

The Government of Newfoundland and Labrador, Department of Natural Resources, is responsible for providing marketing and promotional services to foster the exploration, development and production of the Province's hydrocarbon resources internationally as well as promoting the maximization of fiscal and industrial benefits through the negotiation, development, administration and monitoring of petroleum project agreements and legislation.

Additional information related to the Calls for Bids NL13-02 is included in the report: Enachescu (2013), available here: www.nr.gov.nl.ca/nr/invest/PetExOpCarsonNL1302.pdf

