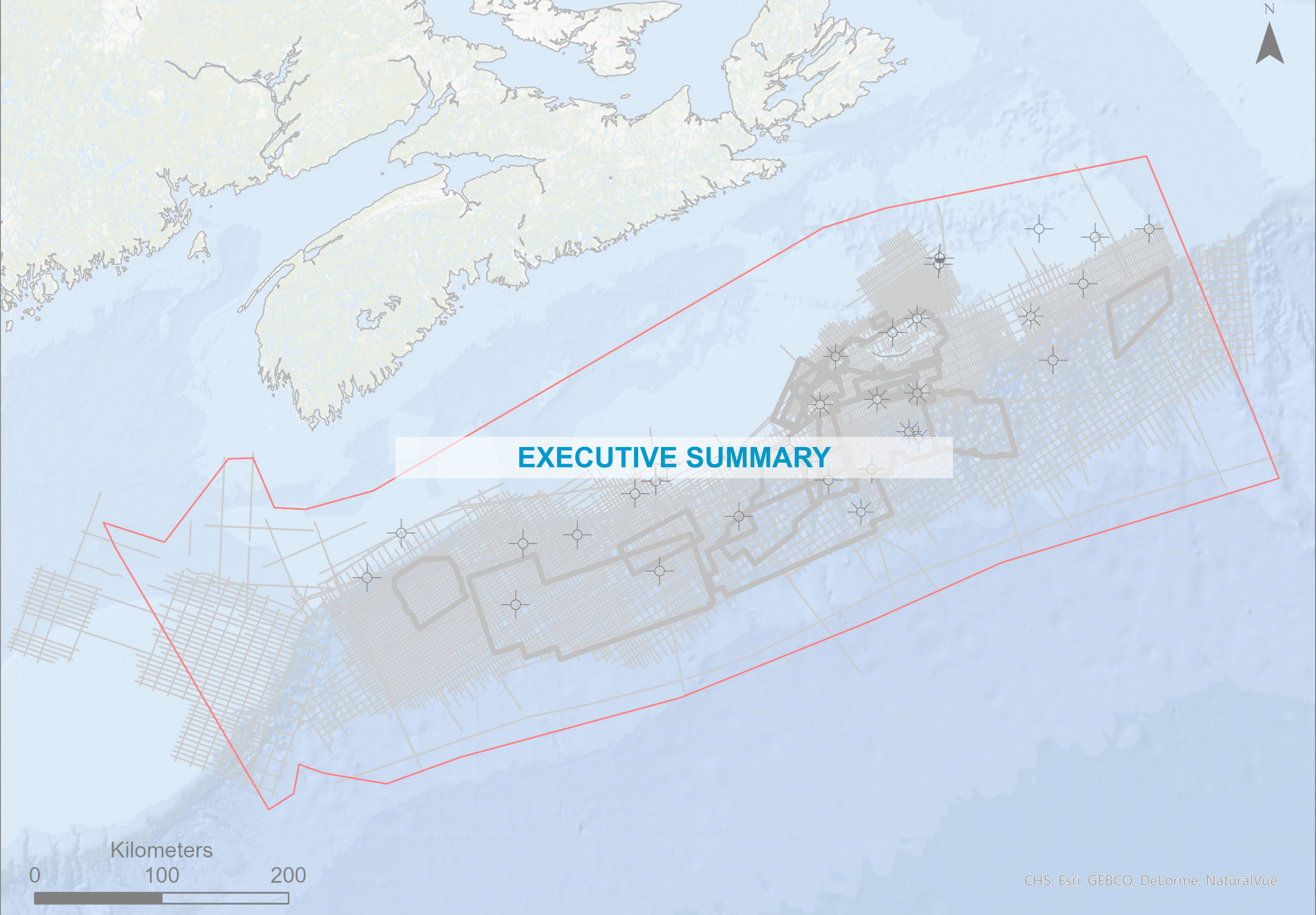
EXECUTIVE SUMMARY



Nova Scotia Deep Water Potential

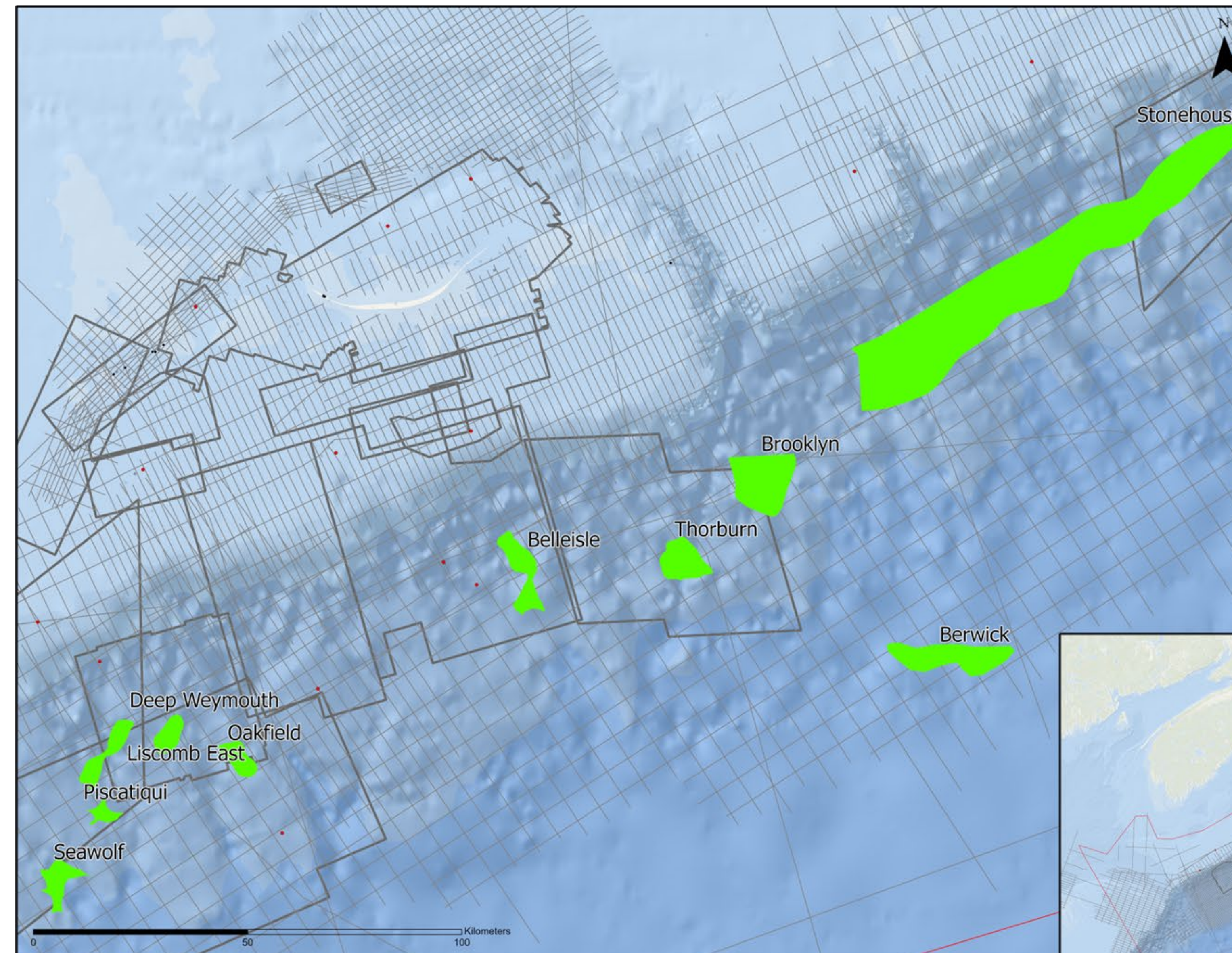
This atlas represents a collaborative and comprehensive new play fairway analysis of the deep water sub-basins, offshore Nova Scotia. It builds on legacy work published during the last decade by the Nova Scotia Department of Natural Resources and Renewables (NRR) and the Offshore Energy Research Association (OERA). Major enhancements in understanding are reported here, based on new data and new ideas.

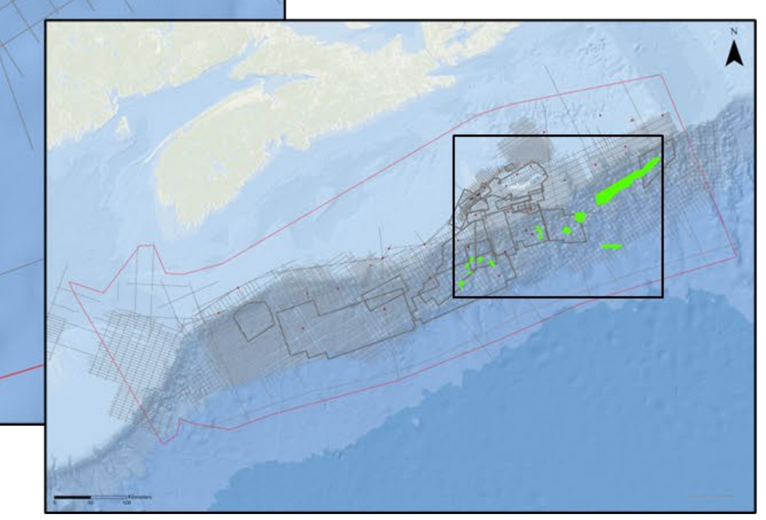
The new data component is a result of exploration work, by Shell, BP and partners, that has taken place since 2012. This exploration effort delivered two new very large, modern 3D WAZ seismic surveys and three deepwater exploration wells. These datasets have enabled a fresh perspective and improved understanding of the geological history of the area and have confirmed and extended the view that a substantial resource base exists in this province. This work has raised confidence in the likely existence of two effective source rocks across the whole of the deep water province. In addition, the application of new interpretation technology, rigorous sequence stratigraphy, and assessment of the impact of quantitative geophysics provide powerful ways of identifying reservoir distribution at lower risk.

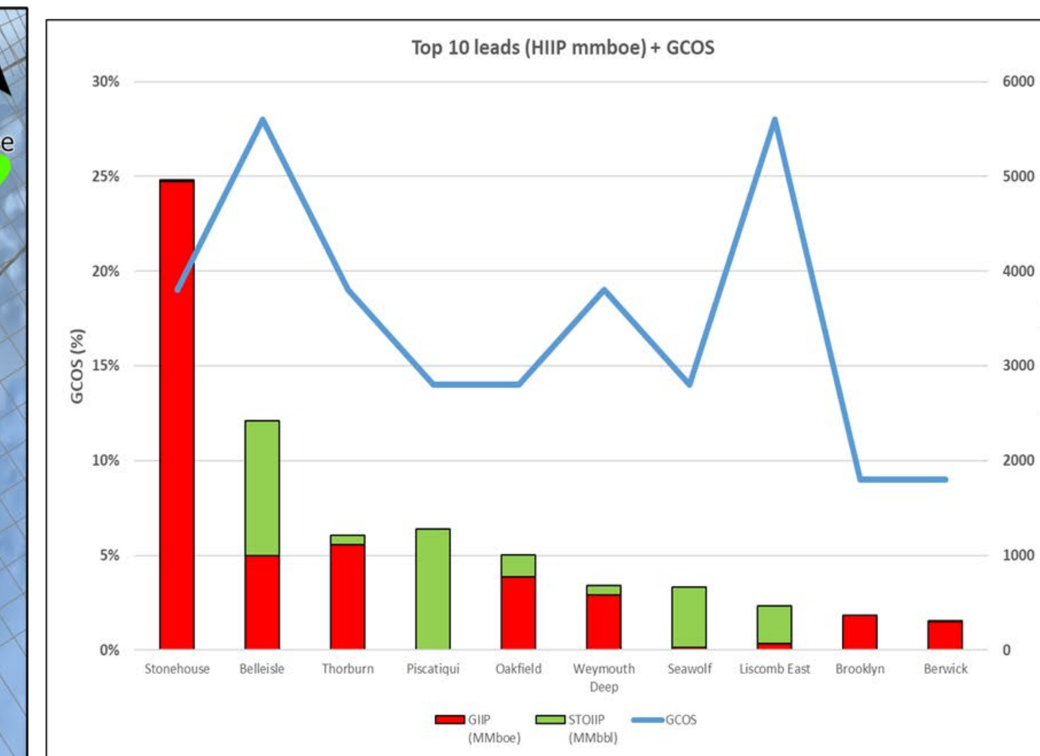
The atlas also confirms previous studies that reported a very large opportunity with a scale that could credibly form a basis for a valuable frontier exploration program. The basin is predicted to contain ~32 Bboe (in place and unrisked). This work has also identified more than 10 leads with volumes > 250 MMboe (in place) with prospect GCOS in the range 10-25%. The top 5 leads have volumes exceeding 1 Bboe in place.

These figure and the following three plates give a high level overview and summary of this atlas.

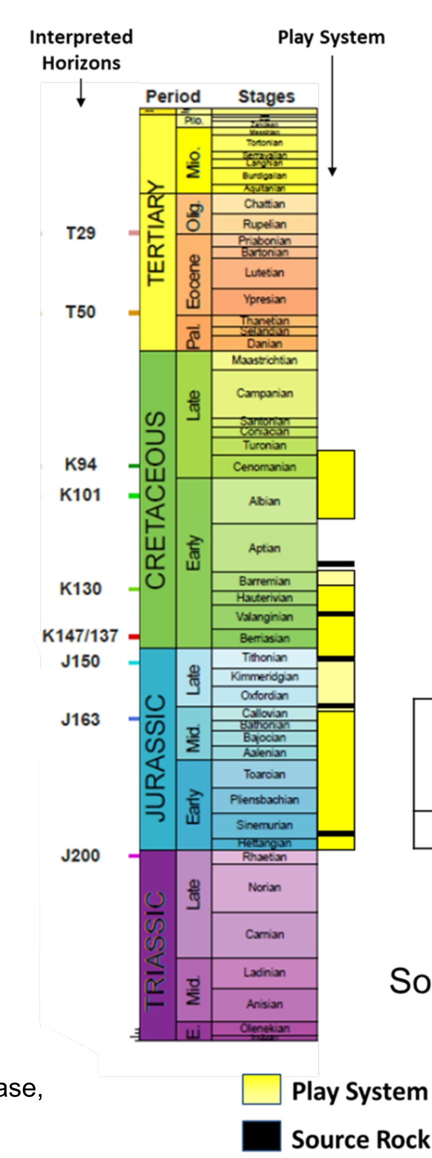
Top 10 Evaluated Leads







2011 Play Fairway Analysis



Overview

- Margin split into 6 zones
- 5 play systems considered
- 5 potential source rocks
- Volumes based on 4-way traps only

HC in Place (in place, unrisked)

Total	Total Oil (BB)	Total Gas (Tcf)	Total HC Mass (Gkg)
Deterministic*	8.1	121	3295

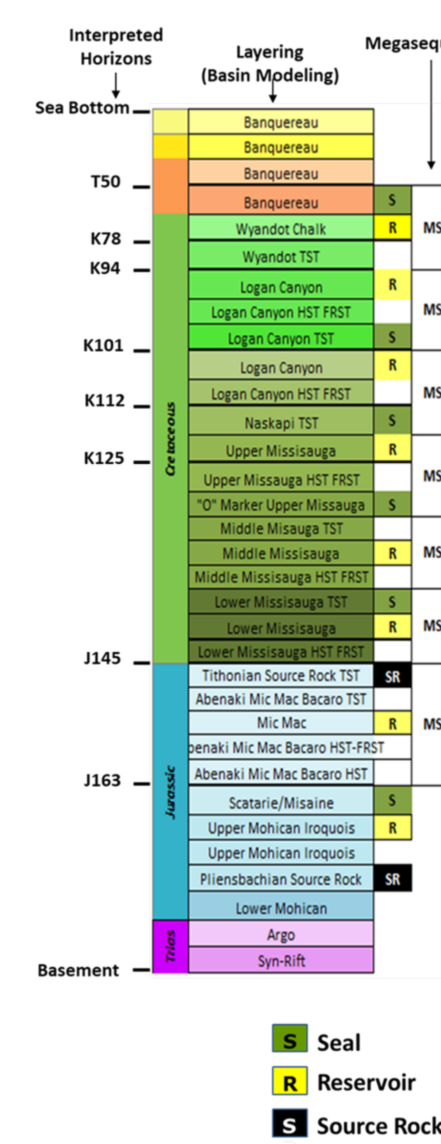
Source Rock and Reservoir Presence key uncertainties in deep water

*Deterministic calculation representing a most likely case, in reasonable agreement with known discoveries. Considerable uncertainty on source rock volumes.

Key Advancements

- 2 very large 3D WAZ seismic surveys
- 3 deepwater exploration wells
- New regional framework
- Rigorous sequence stratigraphy & reservoir distribution assessment
- Increased confidence in 2 effective source rocks across the whole of the deepwater province

2023 Scotian Basin Integration Atlas



Overview

- Margin wide sequence stratigraphic framework
- 7 megasequences
- 2 source rocks (high to moderate confidence)
- Volumes based on whole 3D petroleum model (L.M. Jurassic Reservoirs not taken into account)
- Top 10 leads worked up

YTF volumes (in place, unrisked)

Total	Total Oil (BB)	Total Gas (Tcf)	Total Oil & Gas (BOEB)
P90 Low Case	19.3	47.4	25.8
P50 Most Likely	22.6	64.6	31.5
P10 High Case	49.2	148.4	69.6

Increase in Source Rock confidence and decreased risk in Reservoir Distribution

Executive Summary

Integration Project

This integration project and deliverables intend to highlight Nova Scotia's offshore petroleum potential. The project started in March 2022 and ended in June, 2023. It was organized in three components:

1) A regional review to update Beicip-Franlab's 2011, 2015 & 2016 PFAs for all of Nova Scotia's deep water and key shelf areas, including detailed sequence stratigraphic and gross depositional environment analysis

2) Identification of Areas of Interest (AOI) for an analysis component based on a regional update of GDE and CRS maps. This was completed by a joint team of experts consisting of staff from Nova Scotia/OERA, CNSOPB and Beicip-Franlab. These AOIs were subjected to a more detailed analysis and workup by Beicip-Franlab.

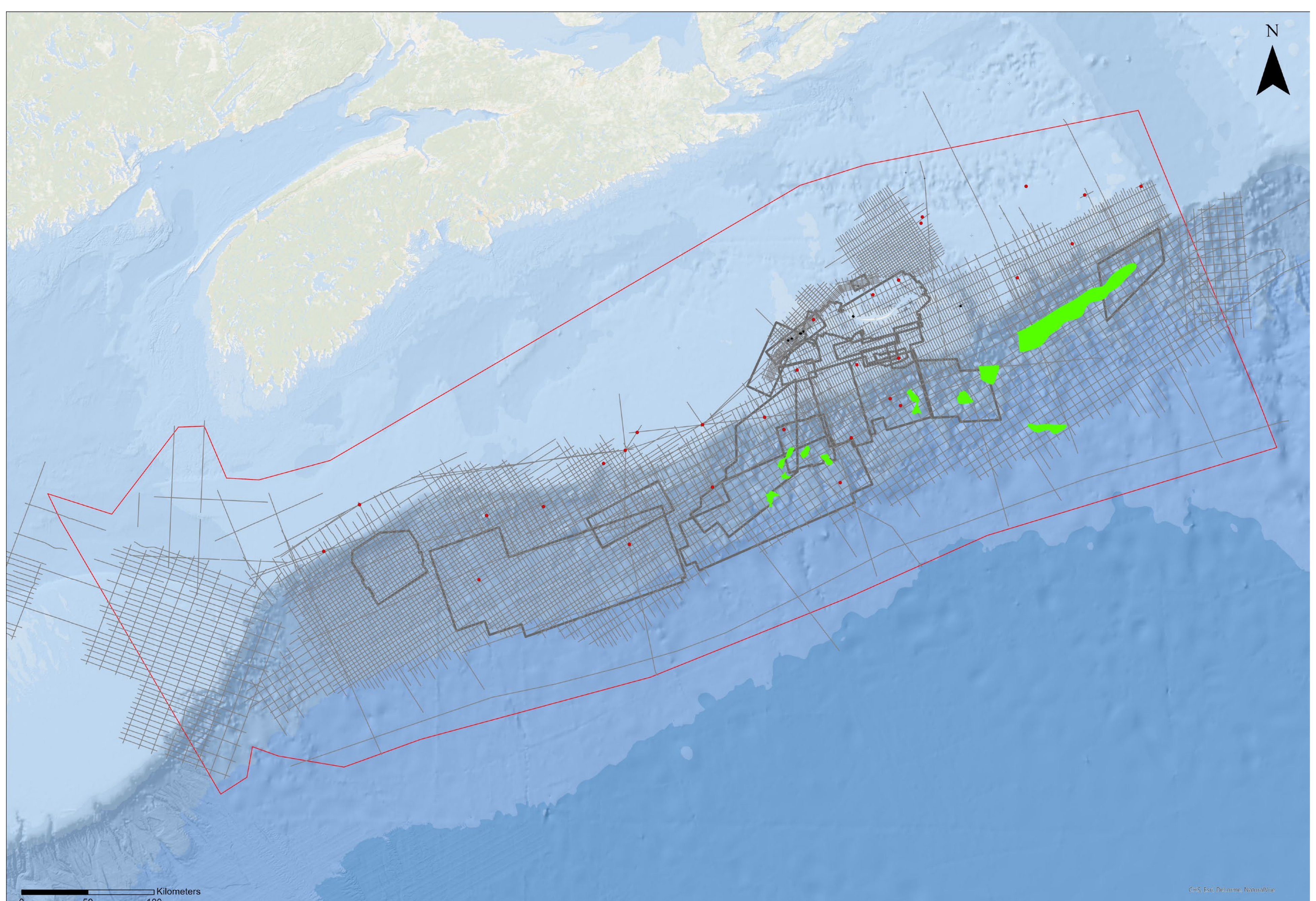
3) A detailed evaluation of the top 10 leads identified and the creation of an atlas synthesis of (1) and (2), similar to previous PFA studies. Publication of the Atlas is accompanied by digital layers of the component inputs and outputsThe principal objective of this integration project was to take lessons learned and work done in the decade since the 2011 Play Fairway Analysis was published and create an updated review of Nova Scotia's potential for the petroleum exploration community.

The Atlas was prepared by Beicip-Franlab with significant inputs and collaboration from:

- Stratum Reservoir (source rock distribution, quality and uncertainty);
- CNSOPB (seismic interpretation and sediment delivery to the deep water);
- NRR (seismic attribute analysis for reservoir potential; Jurassic petroleum system assessment and AVO analysis); and
- Other international researchers currently contributing to the PaGeo research program as well as technical advisors such as Matt Luheshi, Janice Weston, Andrew Macrae, Andrew Bishop, Bill Richards , Martin Fowler

The CNSOPB provided the framework seismic grids, covering the area enclosed by the red line.

The area studied is covered by approximately 79 000km of 2D seismic and 42 300km² of 3D as shown in the figure hereafter.

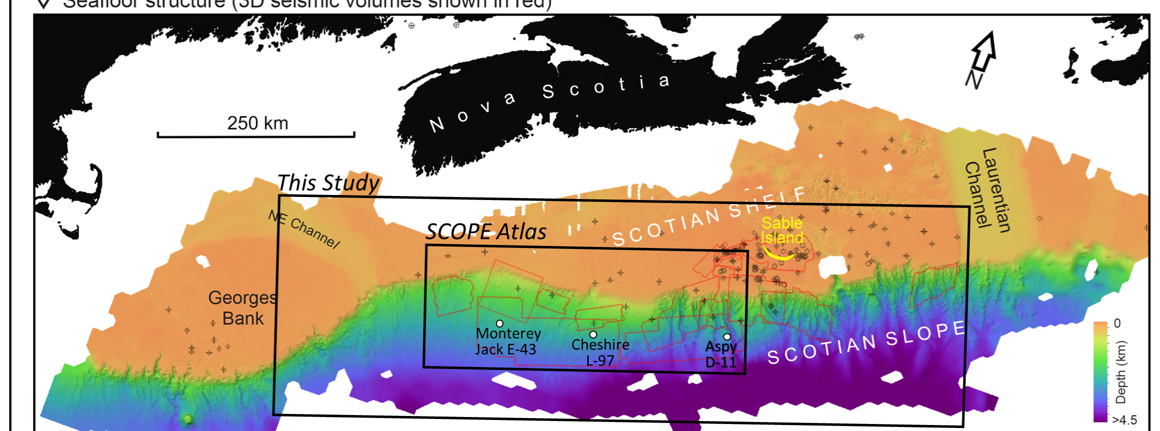


New Scotian Basin Architecture, Source Rocks & Advanced Geophysics

New Regional Framework

A broad spectrum of reflection seismic data-sets collected over the past five decades provides extensive coverage across the Scotian Basin. Notably, renewed exploration interest since 2012 resulted in the acquisition of two large wide-azimuth 3D reflection seismic volumes on the central to western Scotian Slope (Shelburne 3D and Tangier 3D), and the drilling of three wildcat exploration wells (Cheshire L-97/L-97A, Monterey Jack E-43/E-43A, and Aspy D-11/D-11A). These modern seismic surveys, coupled with seven older 3D seismic volumes, provided more than 29 000 km2 of near-continuous 3D seismic coverage for the SCOPE Atlas published in 2020 (Deptuck and Kendell 2020). The atlas presented an updated view of the seismic stratigraphy of the Shelburne and western Sable Subbasins, with new well control enabling, for the first time, high-confidence correlation of post-Bajocian strata across wide areas of the continental slope.

▽ Seafloor structure (3D seismic volumes shown in red)

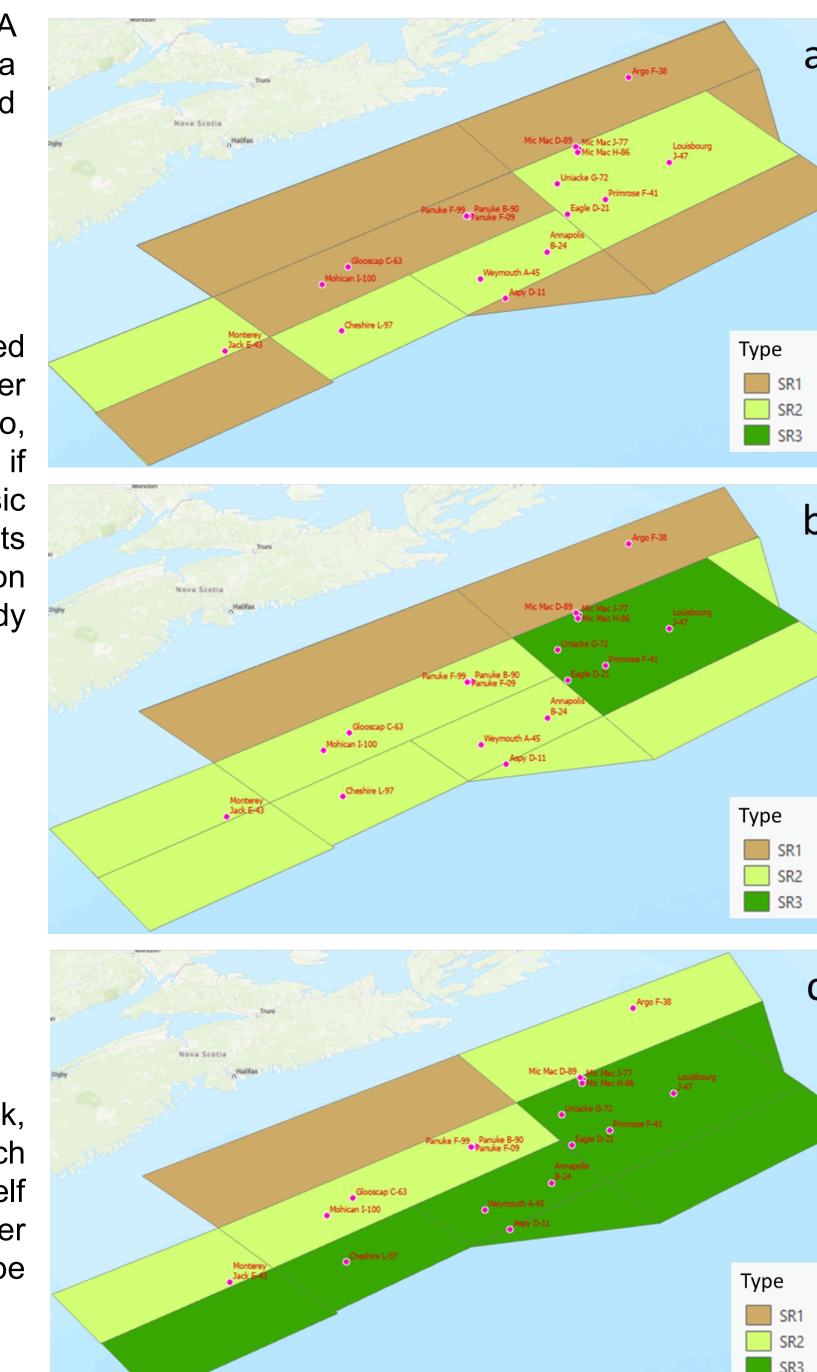


Modified from Deptuck & Kendell, 2020

In this study, the framework markers presented in the SCOPE Atlas were expanded into surrounding areas, using all available data. Direct ties to Monterey Jack E-43 and Cheshire L-97 made it possible to correlate the seismic stratigraphic framework onto the slope seaward of the salt basin, where the absence of salt diapirs enabled seismic markers to be correlated towards the northeast. This provided an additional constraint on the age of seismic markers for areas like the eastern Scotian Slope where there is very little well calibration, and where correlations across the shelf (where more well control is available), are hindered by densely spaced listric faults and poor seismic imaging.

Jurassic Source Rock Synthesis

The majority of the hydrocarbons discovered on the Scotian Shelf are gas often associated with light oils/condensates, with signatures indicative of Nova Scotia's proven Tithonian aged Source Rock (e.g. Powel, 1982; Beicip et al., 2011; Fowler, 2020). Other source rocks on the margin have also been considered, namely the Lower Jurassic. Over the last two decades, many studies have been commissioned to help de-risk the presence and effectiveness of a Lower Jurassic Source Rock. Despite there being no direct evidence for the occurrence of Lower Jurassic Marine sediments offshore Nova Scotia, these studies show credible indirect evidence in support of its existence. A synthesis of these studies was conducted to draw together all of the evidence and provide a critical review of Lower Jurassic hydrocarbon charge potential in offshore, Nova Scotia and compile scenarios for source rock presence (Bishop, 2022).



Lower Jurassic Source Rock Presence Maps

Following the synthesis, modeling of source rock presence along the margin was completed (P10 to P90). With no direct evidence, indirect indications such as the potential Lower Jurassic facies and oil geochemistry were relied upon to address source rock risk. Also, based on maturity grounds, some of the hydrocarbon observations are difficult to explain if only relying on an Upper Jurassic source, and thus are most likely due to a Lower Jurassic source. The confidence rating was highest at the location of the Mic Mac J-77 well with its carbonate oil. Risking is based on the premise of one Lower Jurassic source rock horizon occurring (however probably distributed through several Lower Jurassic stages). This study concluded that this would most likely be Sinemurian or Pliensbachian (Bishop, 2022).

Three potential source rock end-members considered were:

SR1 - Type IV (non source), mean TOC of 1.5% and HI of 150, ~100m thick

SR2 – Type III/II, TOC of 3.0% and HI of 300, ~50m thick

SR3 - Type II marine, mean TOC of 4.0% and HI of 500, ~ 30m thick

Key Conclusions

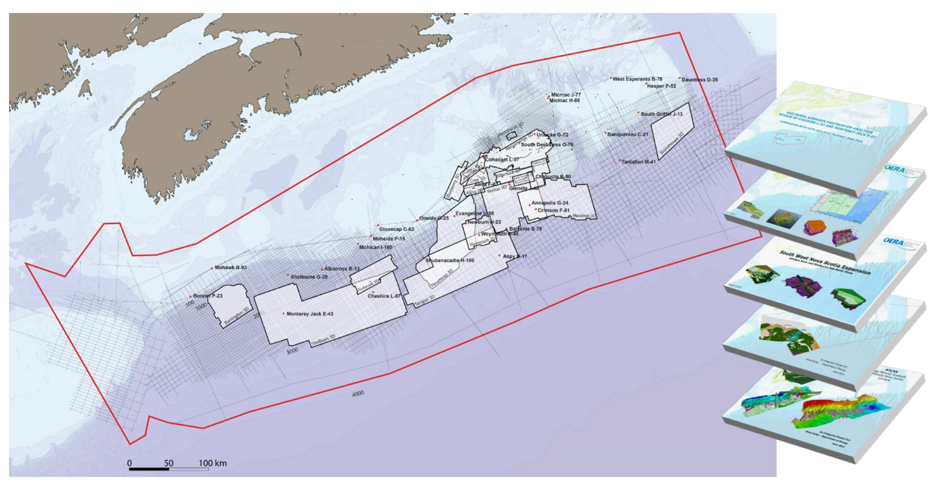
Despite absence of direct evidence of both Lower Jurassic marine facies and source rock, Bishop concluded that there is a ***considerable amount of circumstantial evidence*** which suggests that such a source rock may exist. Some hydrocarbon occurrences on the shelf and slope, such as that of the Mic Mac J-77 oil, are difficult to account for unless a Lower Jurassic source rock is inferred. Optimum source rock conditions would naturally be expected in distal basin locations, for which data is currently unavailable (Bishop, 2022).

Geological and Geophysical review and update : from Sequence Stratigraphy to Object Based Depositional Environment mapping

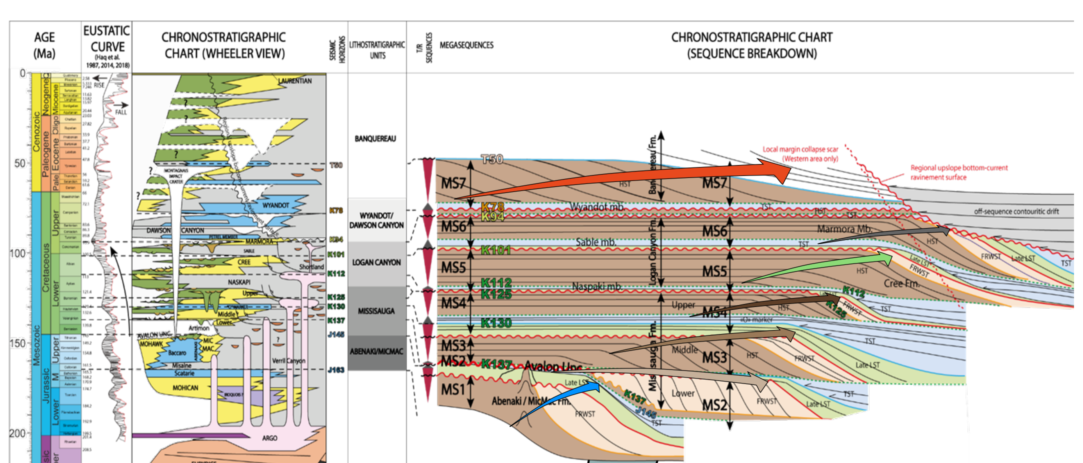
The combined use of seismic sequence stratigraphy and seismic geomorphology analysis was based on a huge seismic and well dataset (including sixteen 3D surveys, seven 2D surveys and 130 exploration wells covering over 200000 km²) as well as the review of previous literature led to a new vision of the Scotian Margin depositional systems throughout the whole Mesozoic to Cenozoic:

- The detailed **sequence stratigraphic analysis** based on the combined use of well stacking pattern and seismic stratal geometry analysis led to the identification of **seven megasequences** with regional expression throughout the whole margin.
- This stratigraphic analysis led to the update of the **chronostratigraphic chart**, which highlights both long term and short term prograding/retrograding trends, reflecting both eustatic and tectonic control of the depositional profile.
- The **seismic geomorphological analysis** was conducted at the same time as the seismic stratigraphy, with the help of innovative semi-automated methods of **3D seismic scanning** (PaleoScan™). This analysis led to the mapping of the seismic geobodies with unprecedented precision, from the shelf to the basin and in a constrained stratigraphic framework.
- Then, the design of new **object-based Gross Depositional Environment maps** at key reservoir prone intervals validates the genetic links between forced regressive deltaic environments and slope to basin turbidites.
- Finally, those GDE maps provide strong **added value** for 3D petroleum system modeling, reservoir CRS mapping, and lead & prospect assessment.

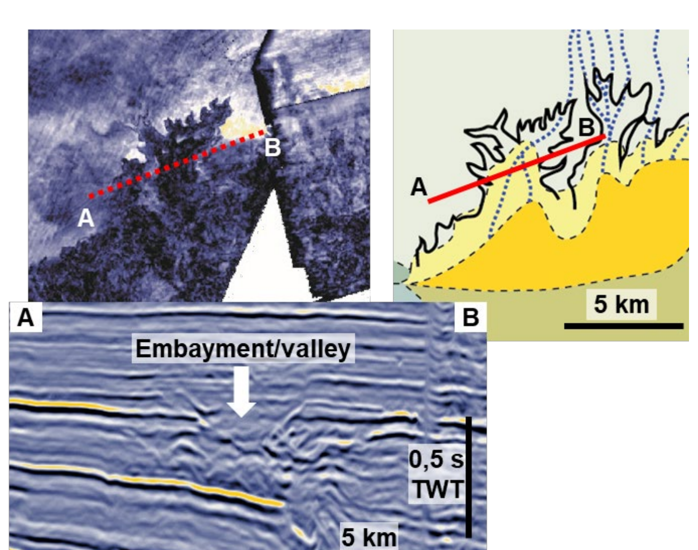
Well/seismic dataset and previous literature review



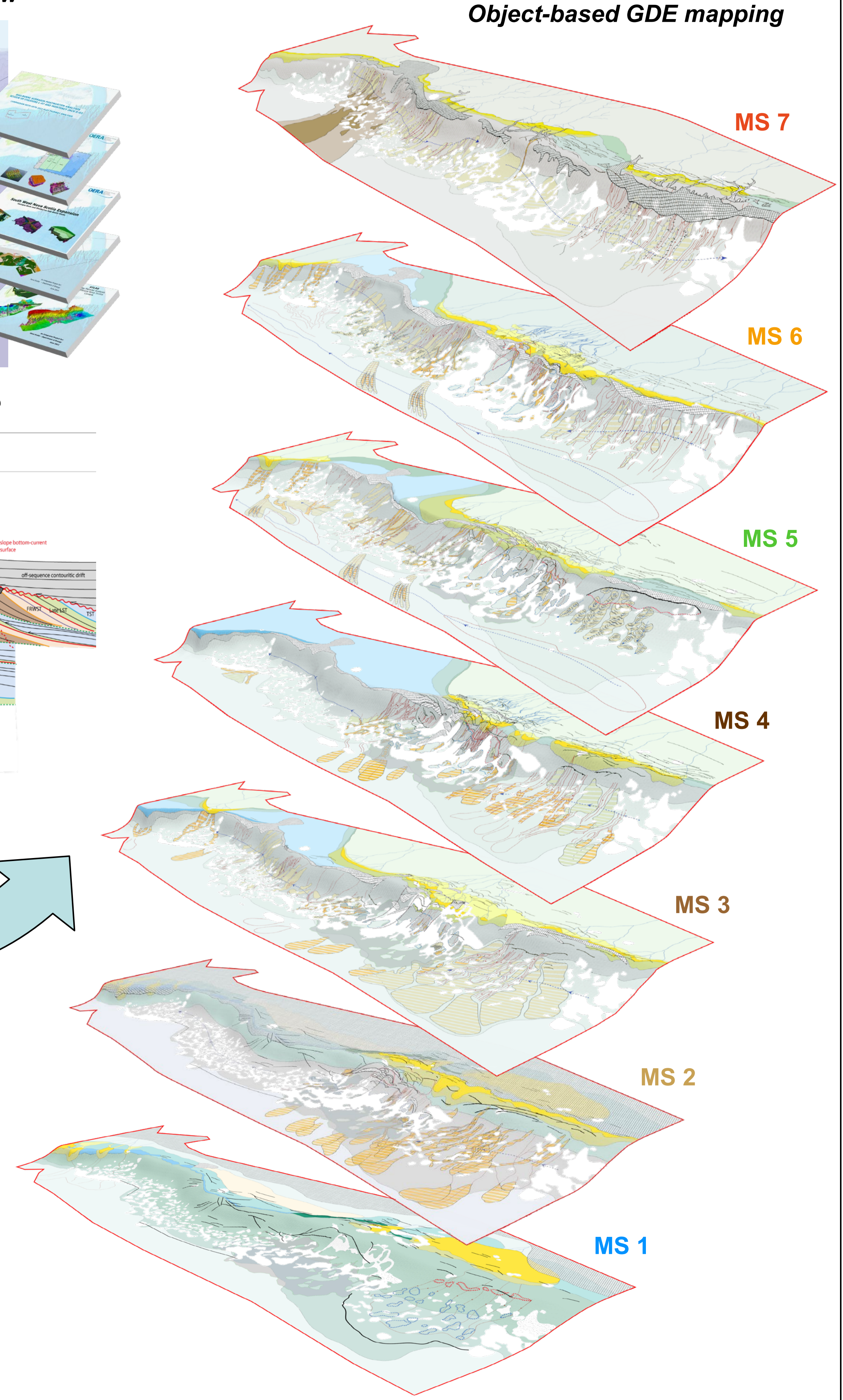
Sequence Stratigraphy and Chronostratigraphic chart update



Gemorphology analysis & geobody mapping

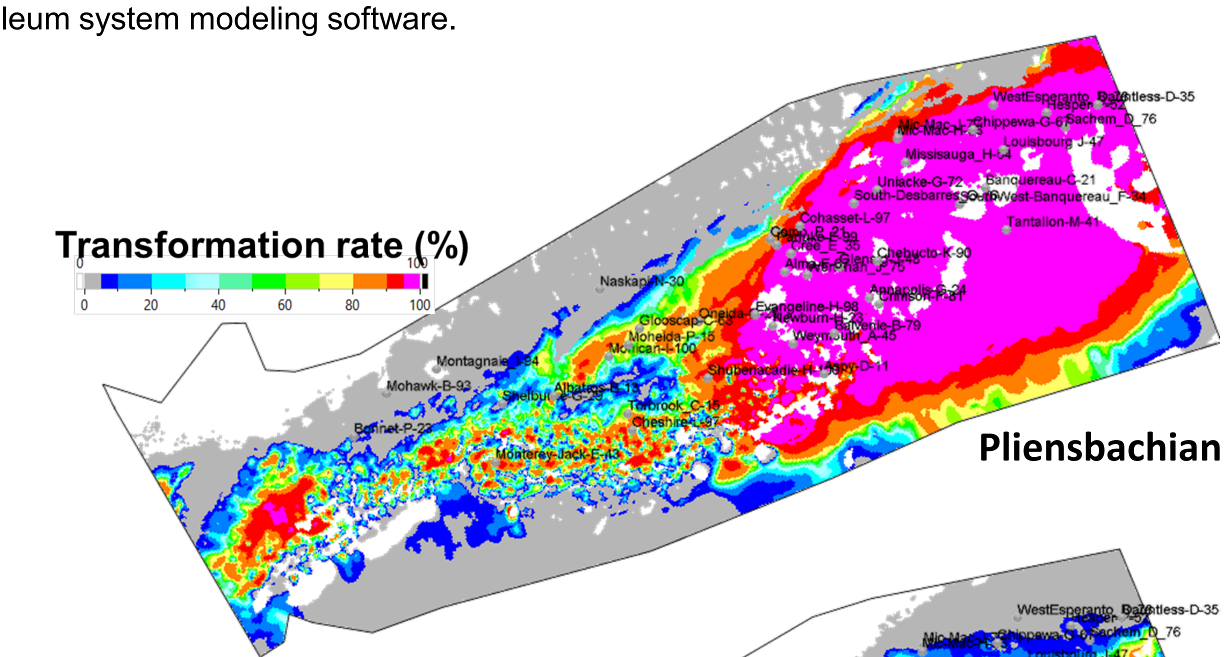


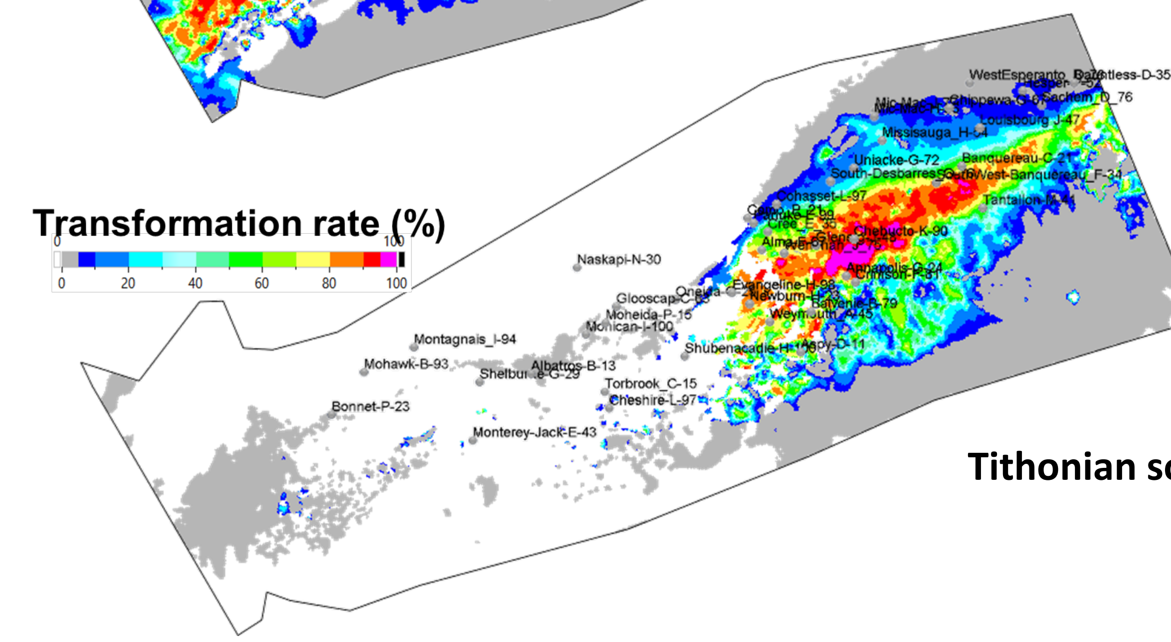
Object-based GDE mapping



Hydrocarbon Charge

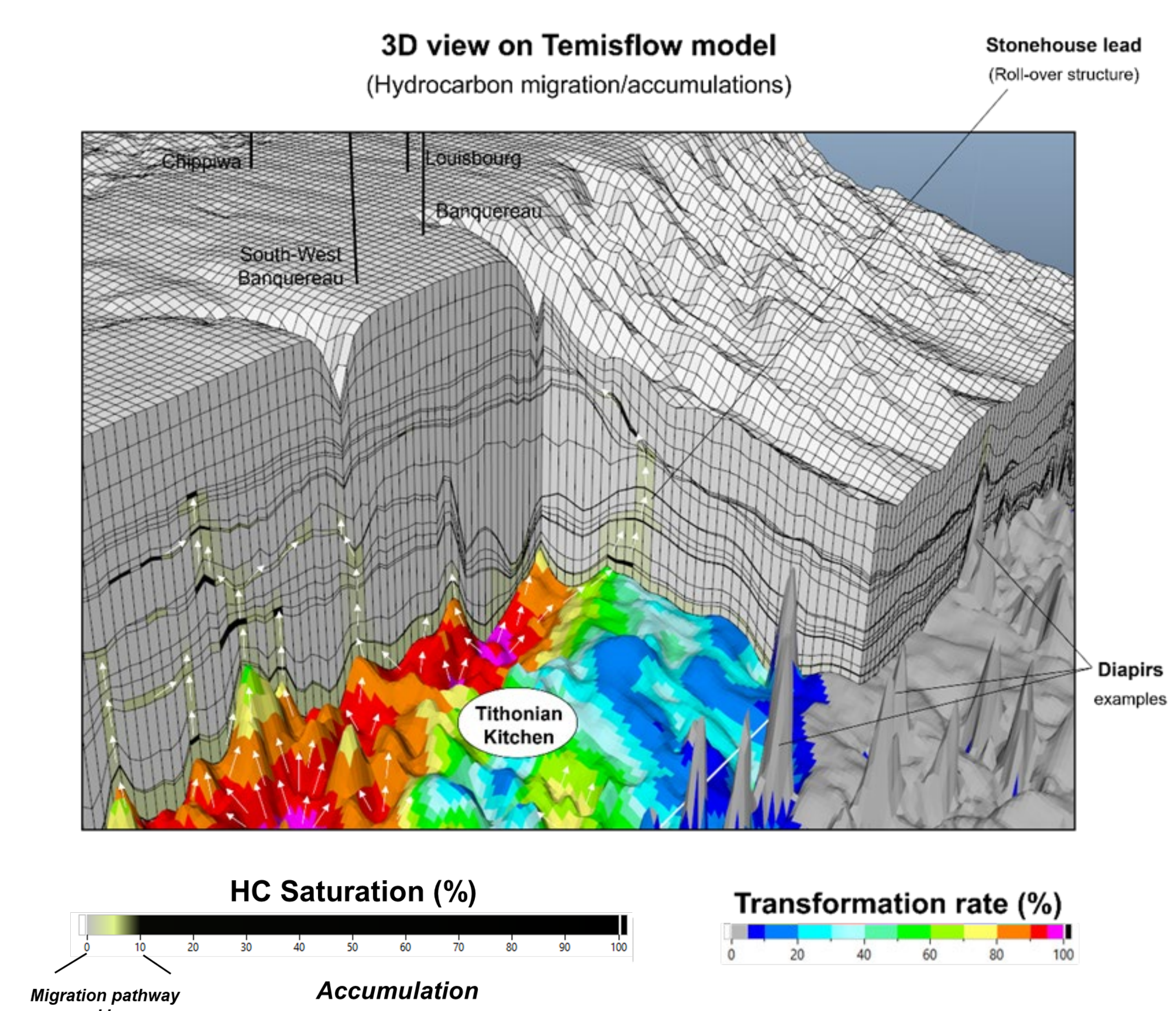
Temperature, maturity, generation, expulsion and timing of both Tithonian and Pliensbachian source rocks were modeled with TemisFlow™ Petroleum system modeling software.

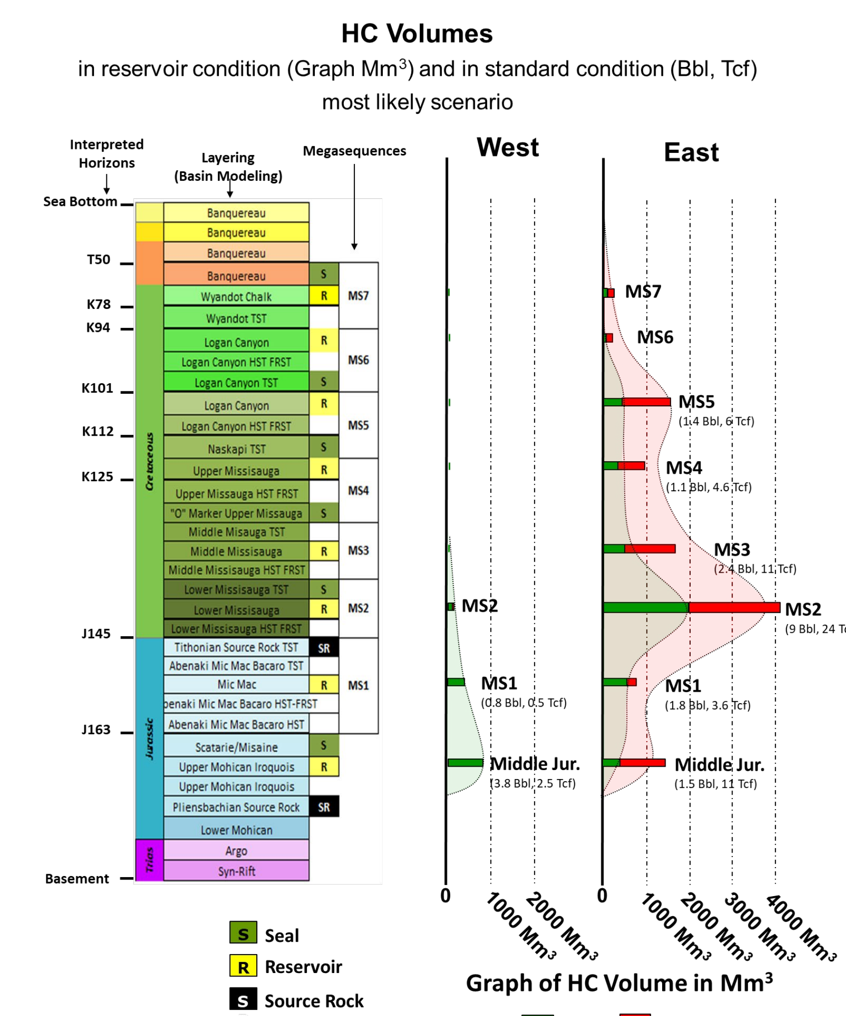




3D migration model

Migration modelled using the full Darcy capabilities of TemisFlow™ that relate the flow of phase I to the different driving forces (calculation of HCs and water movement through the porous water media). In this case, the grid resolution is 2km x 2km (cell size). The distribution of the resource by stratigraphy and region is shown below.





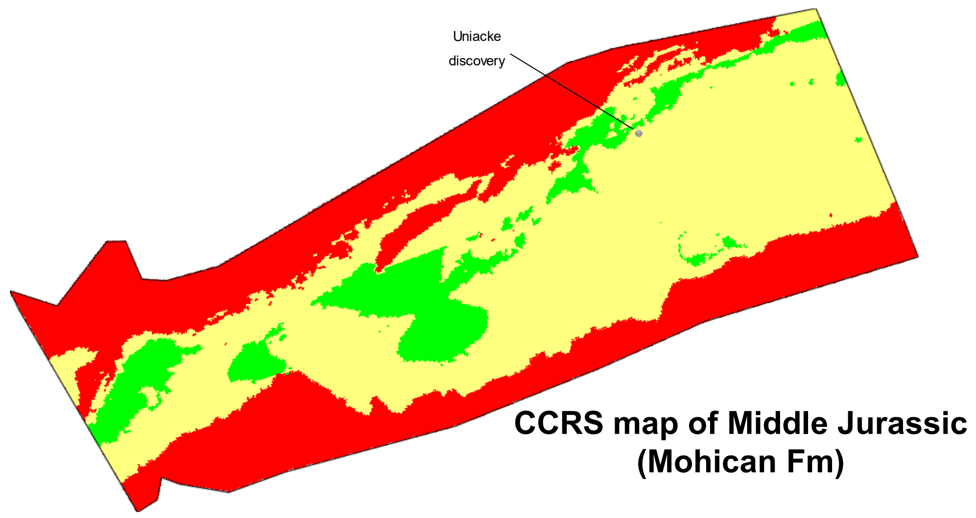
Executive Summary

Common Risk Segment (CRS) mapping

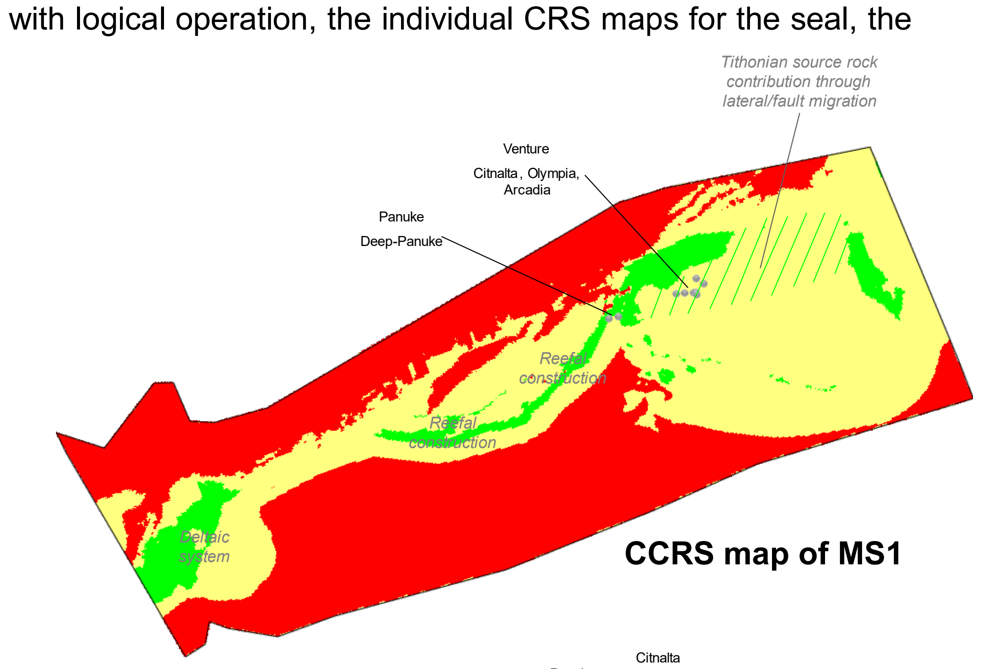
CRS mapping for the seal, the reservoir and the charge was performed for each Megasequence combining, with logical operation, the risks on the presence and on the effectiveness to generate the CRS map of the seal and the CRS map of the reservoir, and combining the risks on the source rock presence, the source rock maturity and the timing of the charge for CRS map of the charge.

Composite Common Risk Segment (CCRS) mapping

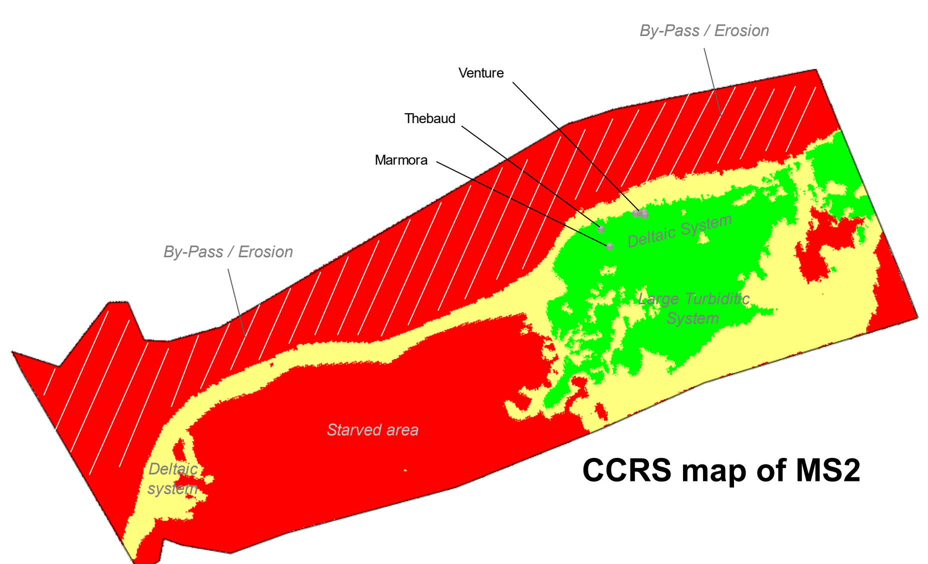
CCRS maps were also produced for each Megasequence combining, with logical operation, the individual CRS maps for the seal, the reservoir and the charge.



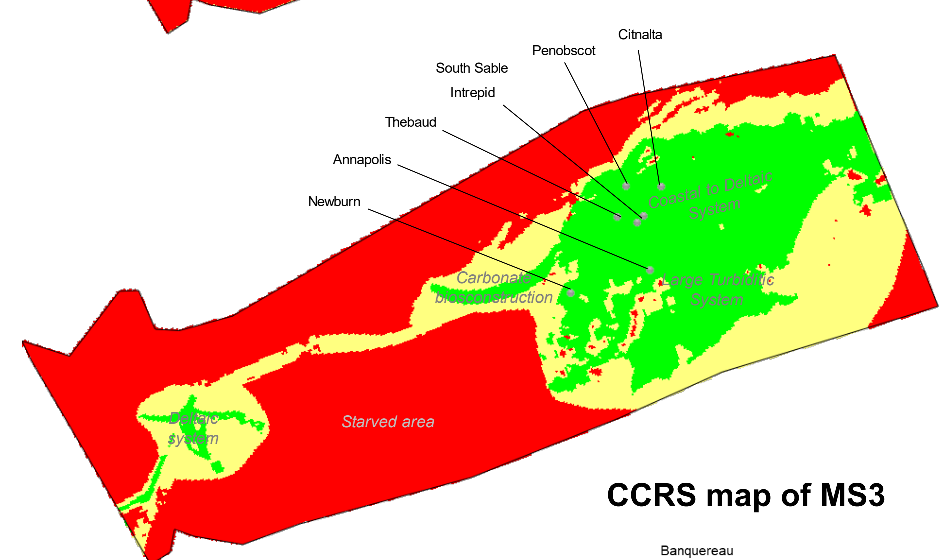
CCRS map of Middle Jurassic (Mohican Fm)



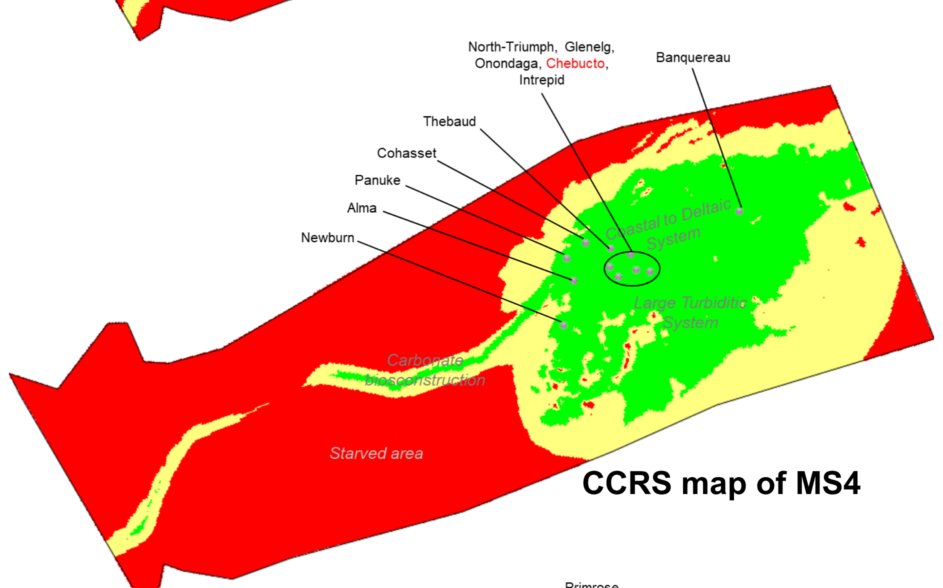
CCRS map of MS1



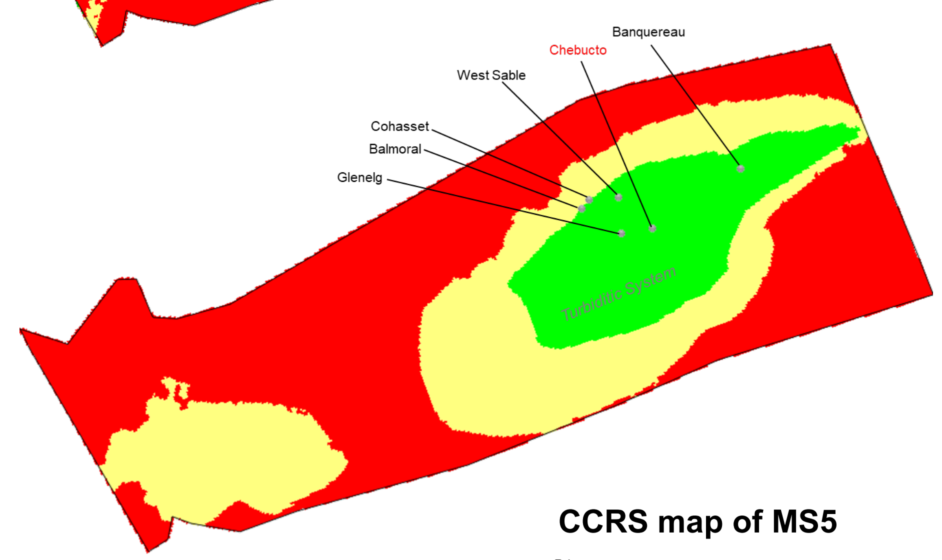
CCRS map of MS2



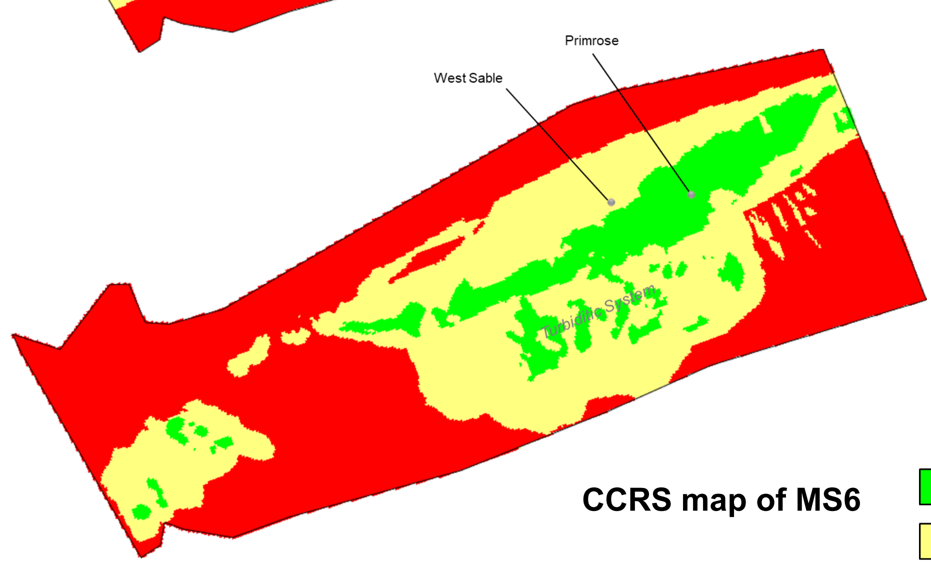
CCRS map of MS3



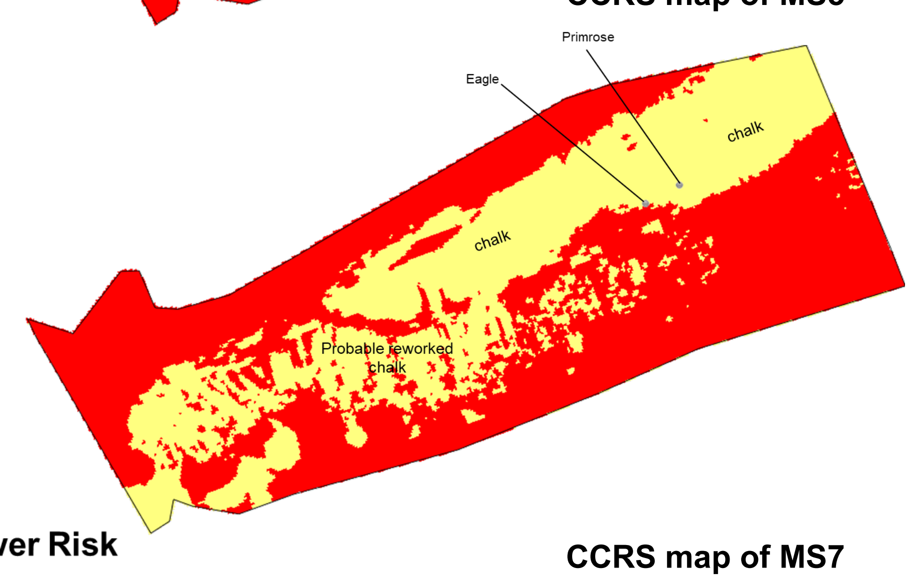
CCRS map of MS4



CCRS map of MS5



CCRS map of MS6

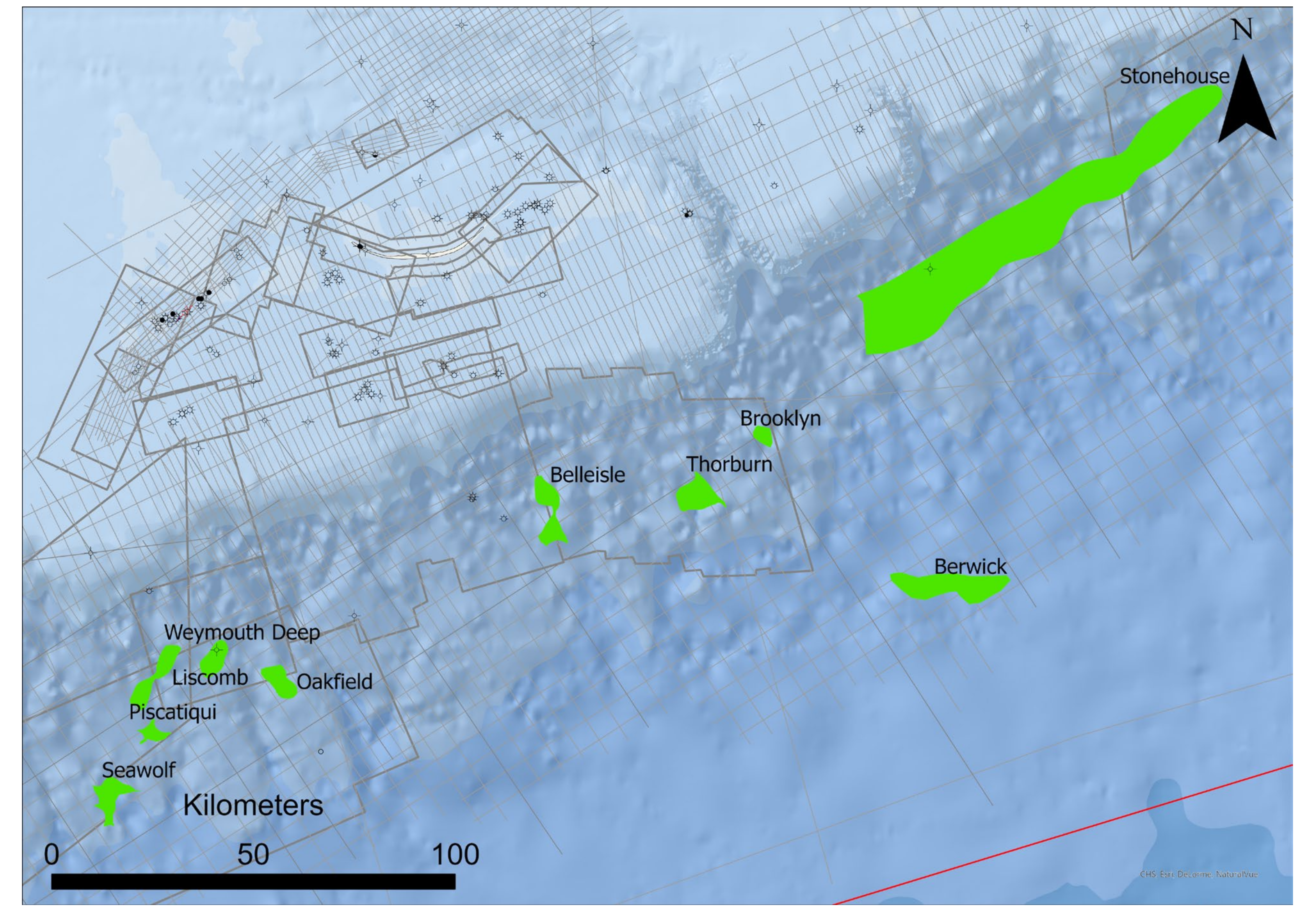


CCRS map of MS7

- Lower Risk
- Medium Risk
- Higher Risk

Prospective resources evaluation

Volumes in place of oil (STOIIP) and gas (GIIP) and prospective resources of oil and gas were computed for each of the 10 selected leads displayed on the figure below.



Lead Name	Trap Style	STOIIP (MMbbl)	Oil Prospective Ressources (MMbbl)	GIIP (Bcf)	Gas Prospective Ressources (Bcf)	GIIP + STOIIP (MMboe)
Stonehouse	Anticline	13	10	37113	27795	**4961**
Belleisle	Trap against salt	1424	536	7485	5600	**2422**
Thorburn	Anticline	99	39	8323	6235	**1209**
Piscatiqui	Trap against salt	1281	322	0.15	0.11	**1281**
Oakfield	Stratigraphic trap	235	80	5778	4317	**1005**
Weymouth Deep	Anticline	99	39	4350	3246	**679**
Seawolf	Trap against salt	639	147	216	161	**668**
Liscomb East	Anticline	393	156	540	107	**465**
Brooklyn	Trap against salt	0	0	2764	2061	**369**
Berwick	Anticline	1	1	2232	1672	**299**

Leads score and ranking

The GCOS combines the individual COS: [Trap] x [Charge] x [Reservoir]. The GCOS range between 9% to 28% for the 10 top ranked leads that were selected for detailed evaluation. This is a purely technical ranking based on the chance of finding trapped hydrocarbons. It does not include any economic considerations.

Lead Name	Trap Risk	Charge Risk	Reservoir Risk	GCOS
Liscomb East	0.75	0.50	0.75	**28%**
Belleisle	0.50	0.75	0.75	**28%**
Weymouth Deep	0.75	0.50	0.50	**19%**
Oakfield	0.25	0.75	0.75	**14%**
Thorburn	0.50	0.50	0.75	**19%**
Stonehouse	0.50	0.75	0.50	**19%**
Piscatiqui	0.25	0.75	0.75	**14%**
Seawolf	0.25	0.75	0.75	**14%**
Berwick	0.50	0.25	0.75	**9%**
Brooklyn	0.25	0.50	0.75	**9%**