

Call for Bids NS22-1:

Research, Innovation and Exploration Opportunities

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Natural Resources and Renewables

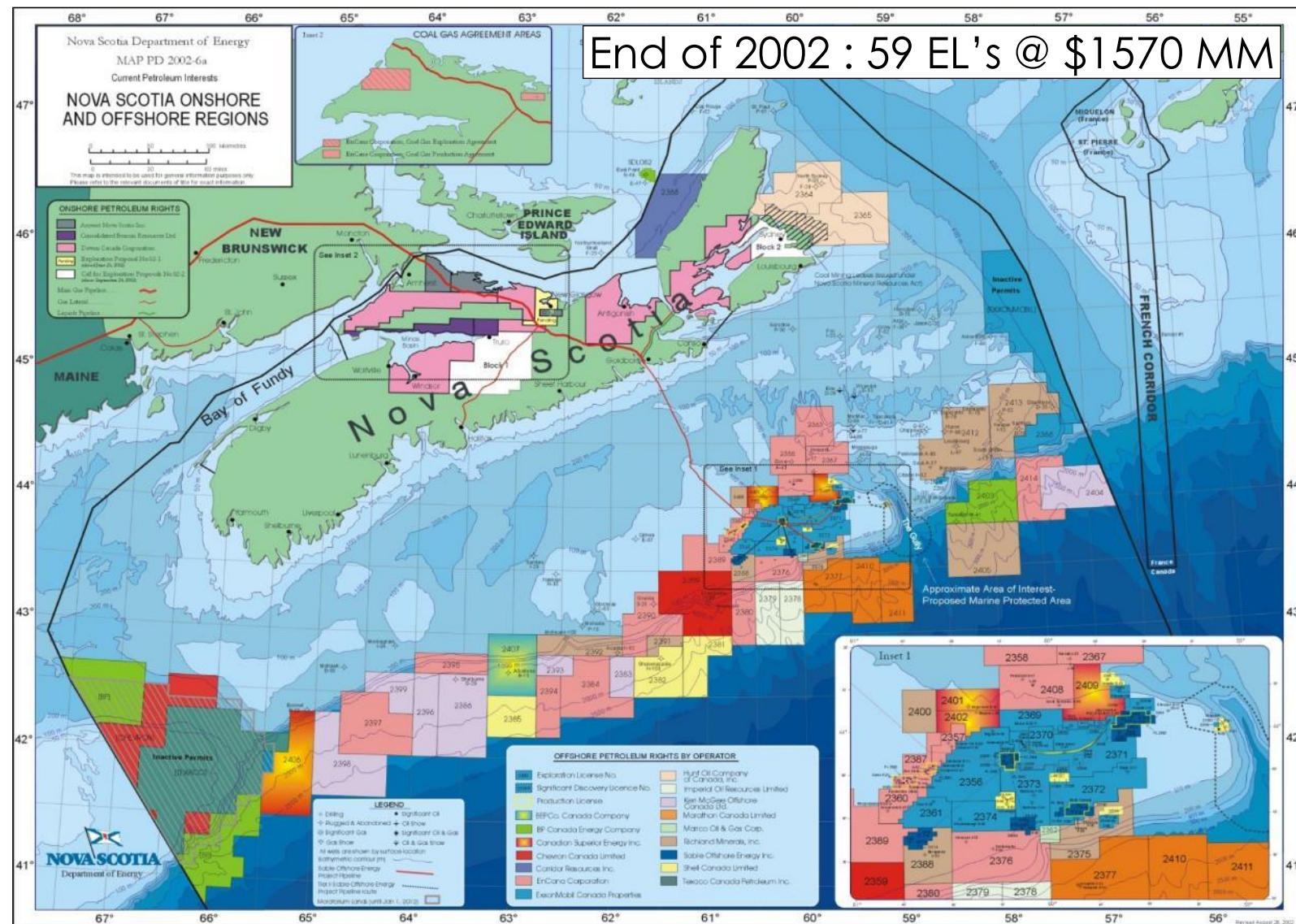
Booth #450



Outline

- Introduction to Nova Scotia
- Recap of Geoscience Initiatives
- Call for Bids NS22-1 Summary
- Integration Atlas and Untapped Potential
- Available Data
- Transitional Energy Opportunities

Peak Exploration

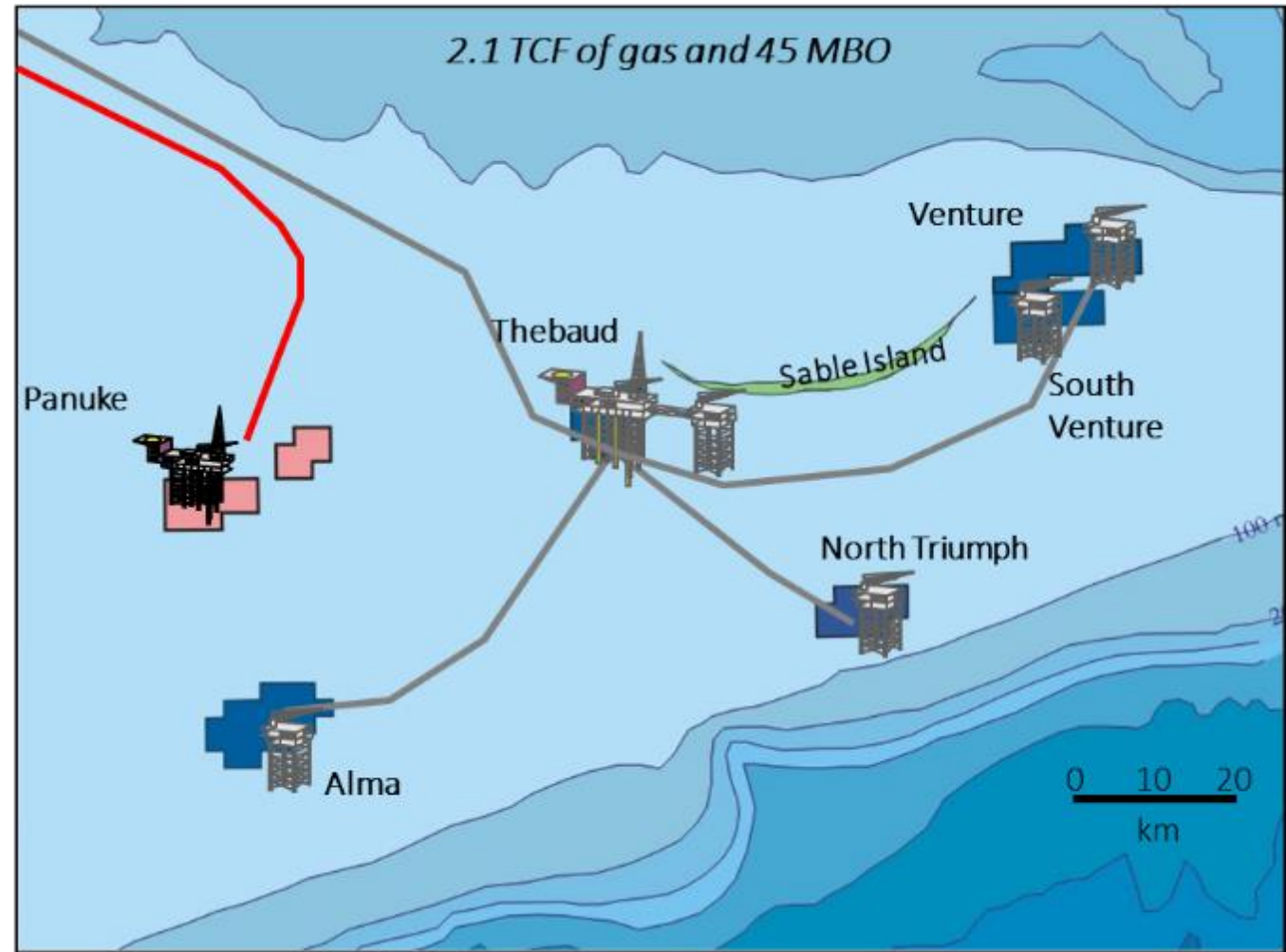
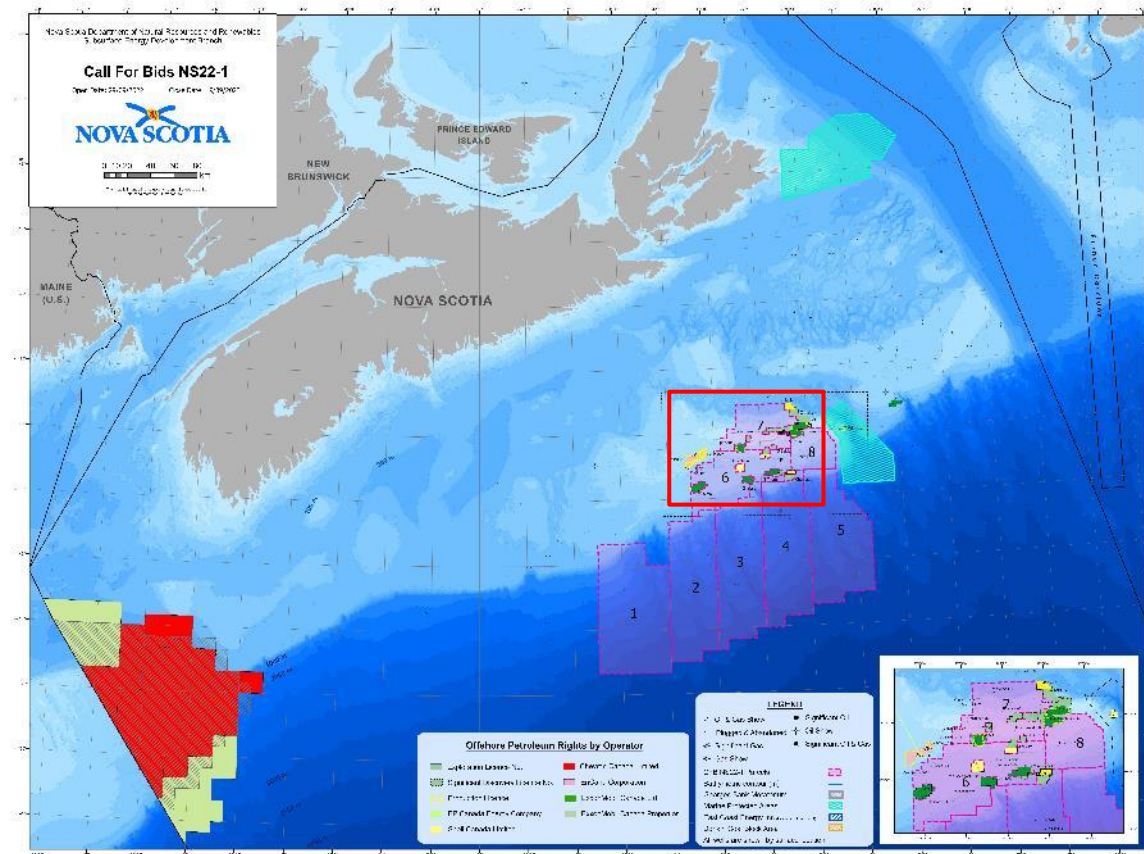


Previous Development

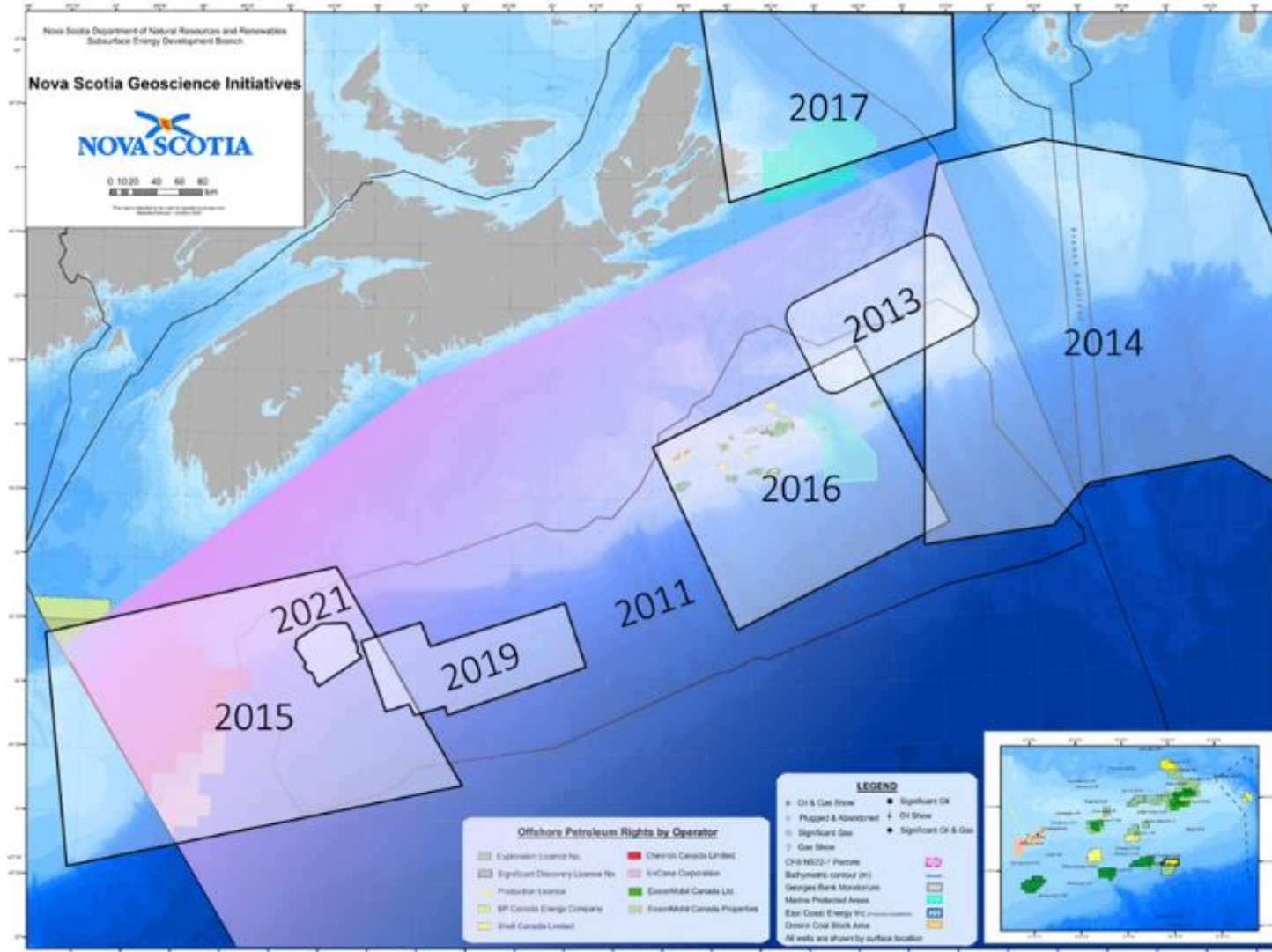
Three oil and gas projects produces on shelf in Sable Delta and Abenaki carbonate bank areas:

- Deep Panuke (2013-2018)
- Cohasset Panuke (1992-1999)
- Sable Offshore Energy Project (1999-2019)

Additional 15 undeveloped significant discoveries.



Geoscience Initiatives



Offshore Petroleum Geoscience Research

- 2009-11: Scotian Shelf PFA
- 2013 : Northeast Shelf
- 2014 : Laurentian Subbasin PFA
- 2015 : Shelburne Subbasin PFA (Updated 2019)
- 2016 : Central Slope PFA
- 2017 : Sydney Basin PFA
- 2020: Barrington Reprocessing
- 2021-23: PaGeo & Geochemistry Programs

Over \$32 M has been spent on geoscience.

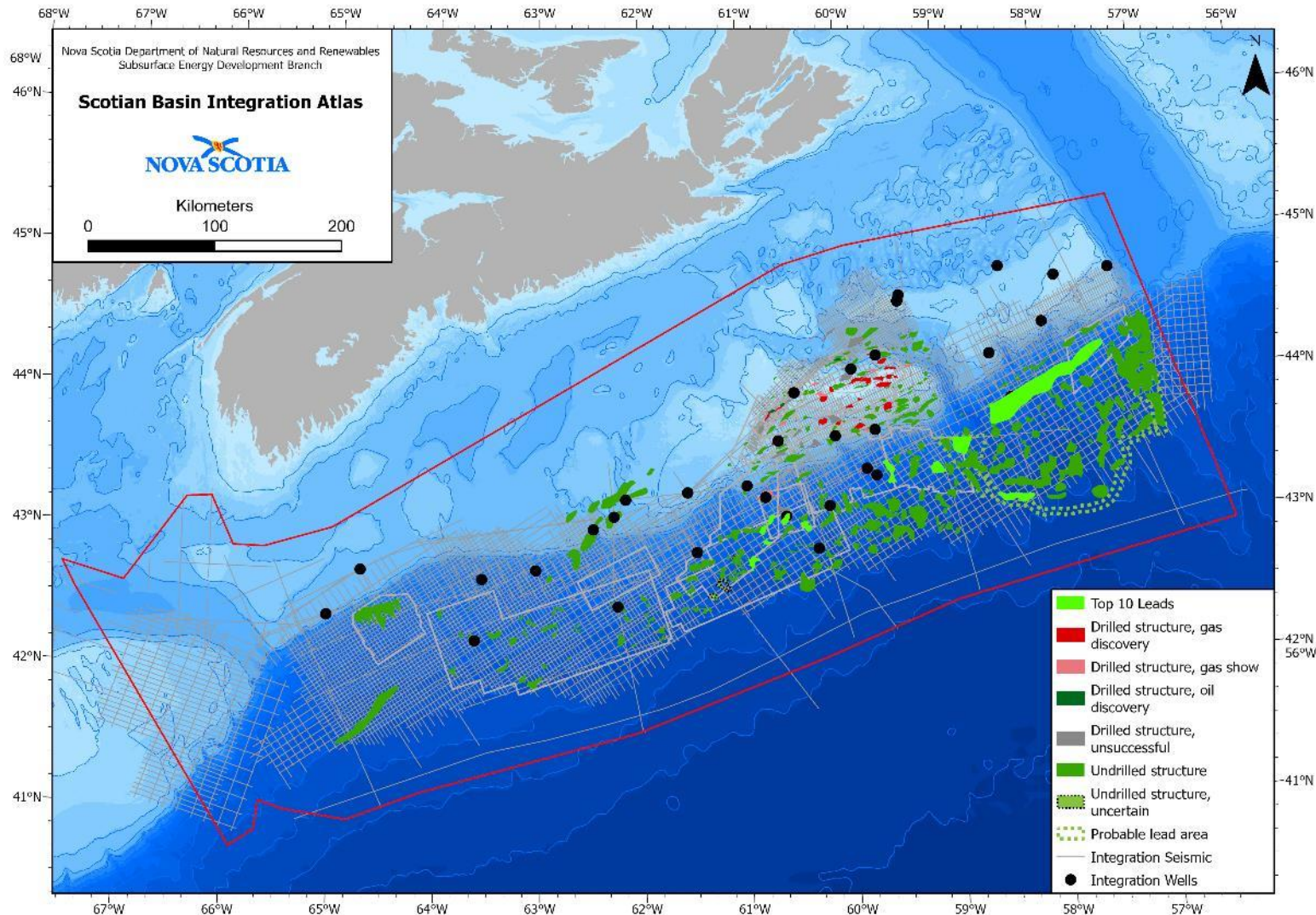
2011 PFA estimated > 8 Bbbls oil and 120 tcf gas potential, unrisks.

Over \$2 billion in Exploration Commitments Since 2011

*continues to be valid

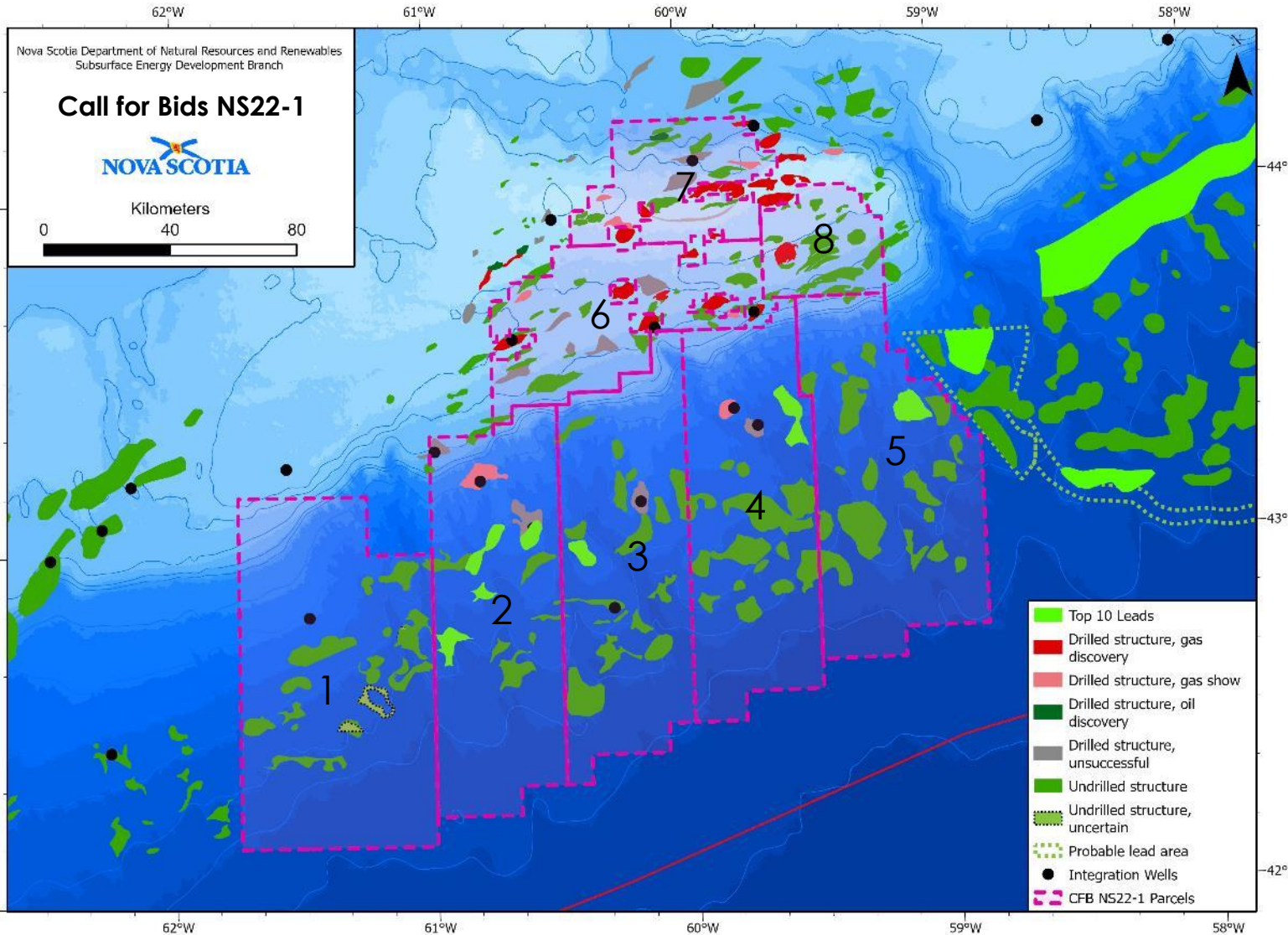


Geoscience Initiatives



- 2020: AUV Cruise
Geochemistry – North Central Atl.
Scotian Shelf Oils Projects
- 2020/21: Reprocessed Barrington 3-D
Survey; AVO analysis & Inversion
- 2020-23: PaGeo Projects
- Geochemistry
 - Paleocean climate
 - Biostrat & Paleo bathymetry,
Source to sink
- 2021: ROV Cruise
Depositional Modelling
- 2022: Migration Pathway Mapping
Shelf to Slope Mapping
- 2022-23: Integration Project

NS22-1 Call for Bids



Call Summary

Area: 7.43 Million Acres

Parcels on Offer: Eight

Parcel 1	1.59 Million Acres
Parcel 2	1.22 Million Acres
Parcel 3	1.21 Million Acres
Parcel 4	1.19 Million Acres
Parcel 5	0.79 Million Acres
Parcel 6	0.69 Million Acres
Parcel 7	0.45 Million Acres
Parcel 8	0.30 Million Acres

Basin: East Shelburne Sub-Basin (1-2)
Sable Sub-Basin (2-8)

Water Depths: From ~160 ft to 14,000 ft

Closing Date: September 19, 2023

Land Tenure – Terms and Conditions

Exploration Licence:

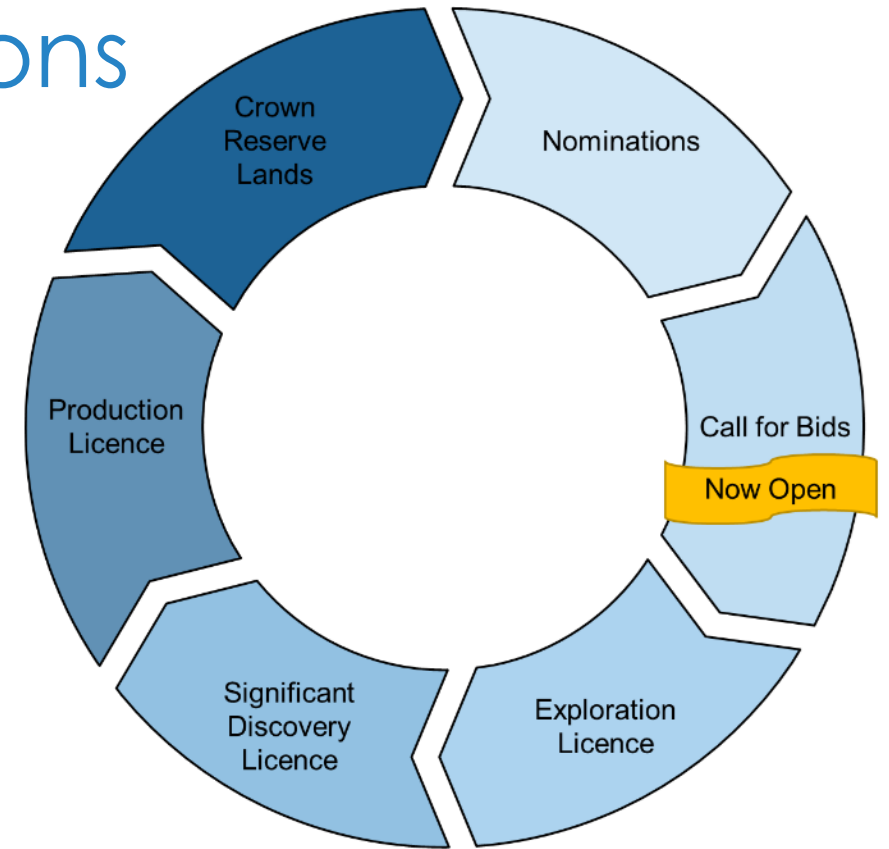
- EL awarded to company with highest bid
- Minimum bid \$1,000,000
- 25% Work Deposit
- EL provides exclusive right to drill
- Maximum 9-year term

Significant Discovery Licence

- Exploration well is drilled & has a successful well test
- Exclusive right to develop the hydrocarbon discovery

Production Licence

- Issued prior to start of production
- Title to petroleum produced
- 25 year term



Period 1 Allowable Expenditures	Current AE Credits
All pre-licence AE up to 3 years before EL is issued	300%
All AE (including 1st well) within first 3 years of EL	200%
All AE (including 1st well) for the remainder of Period 1 of EL	200%
Drilling (Period 1)	200% - 1st well 300% - 2nd well 400% - 3rd or additional wells

Period 1 Extension	Drilling Deposit
Year 7	\$1,000,000
Year 8	\$2,000,000
Year 9	\$3,000,000



Scotian Basin Integration Atlas 2023

A collaborative study of stratigraphy, architecture,
evolution, and geologic prospectivity

CERA

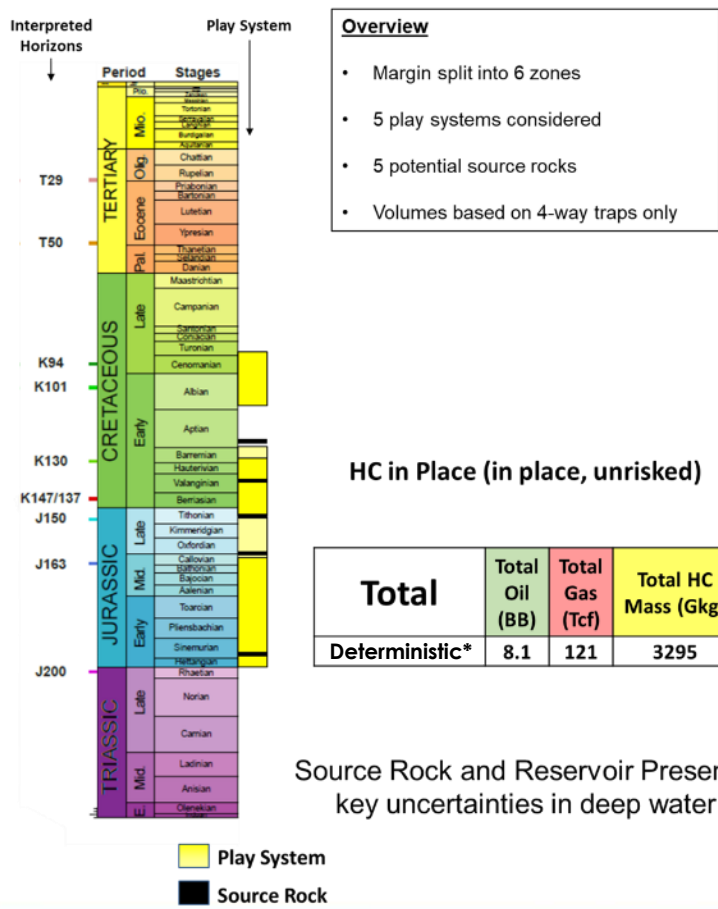

NOVA SCOTIA

BeicipFranlab 

Nova Scotia Deep Water Potential

- Collaborative and comprehensive new play fairway analysis of the deepwater sub-basins
- It builds on legacy work published during the last decade

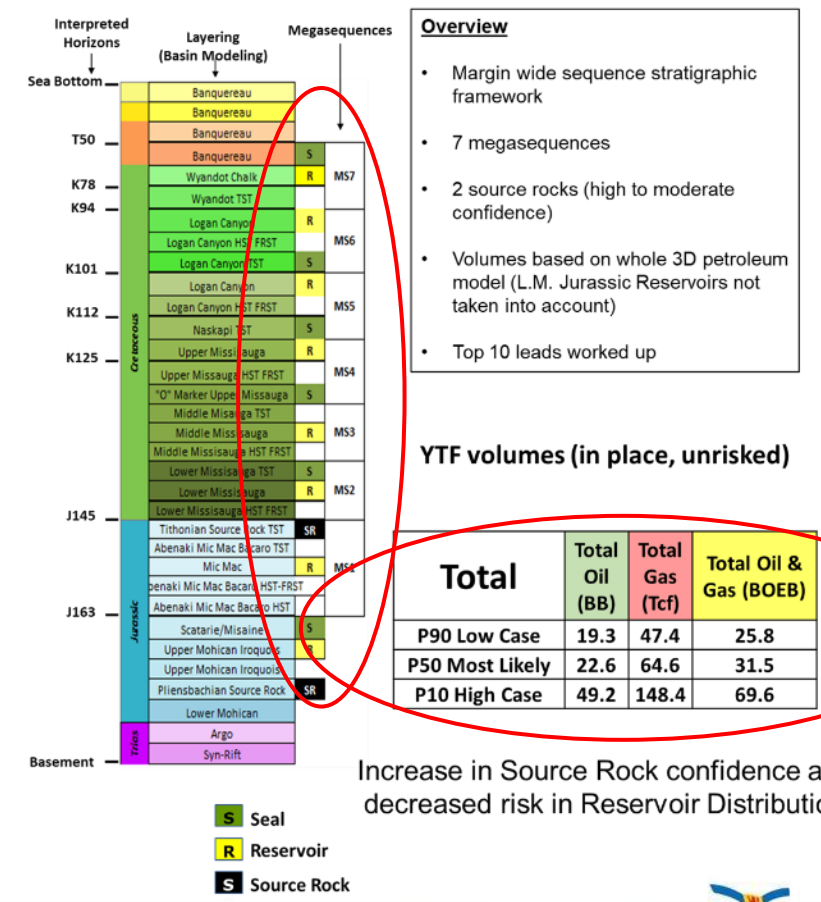
2011 Play Fairway Analysis



Key Advancements

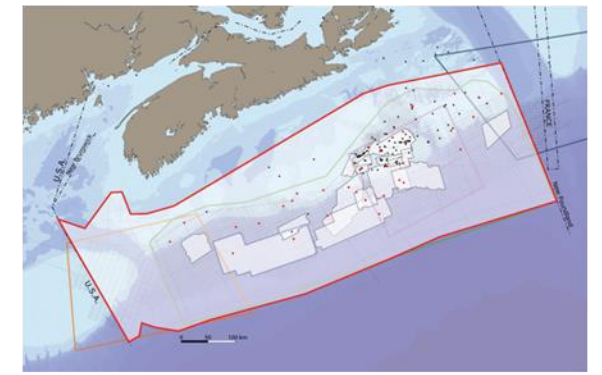
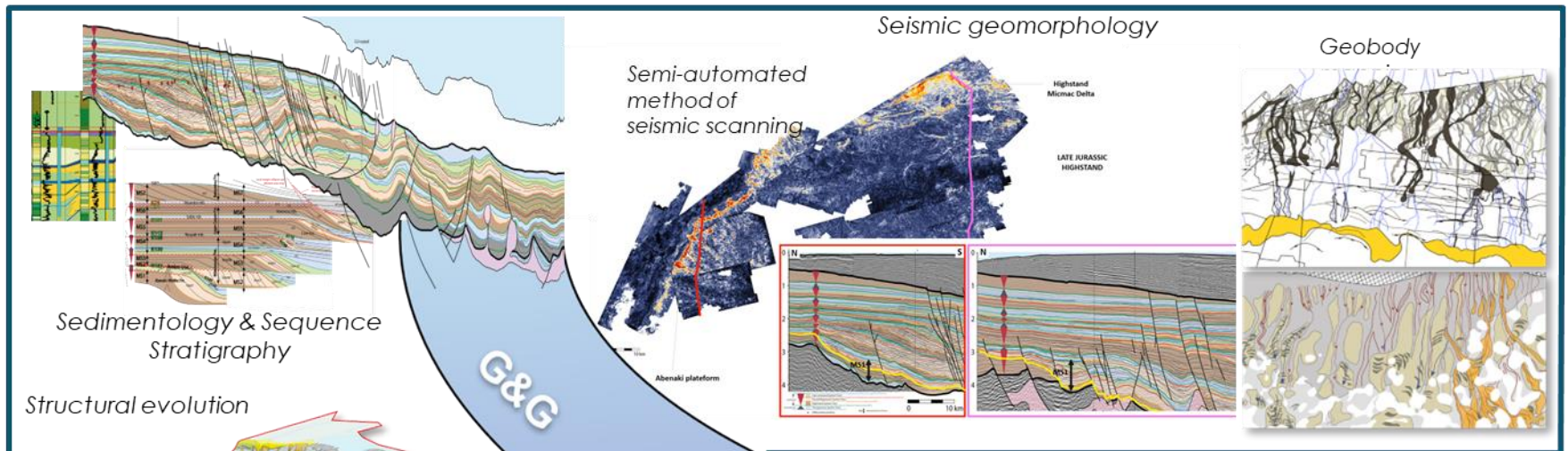
- 2 very large 3D WAZ seismic surveys
- 3 deepwater exploration wells
- New regional framework
- Rigorous sequence stratigraphy & reservoir distribution assessment
- Increased confidence in 2 effective source rocks across the whole of the deepwater province

2023 Scotian Basin Integration Atlas

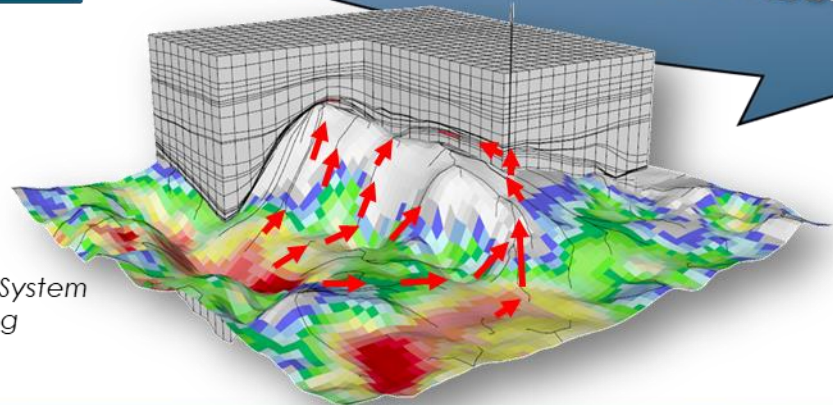
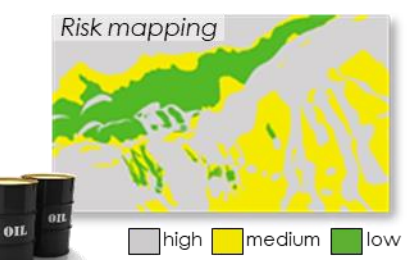
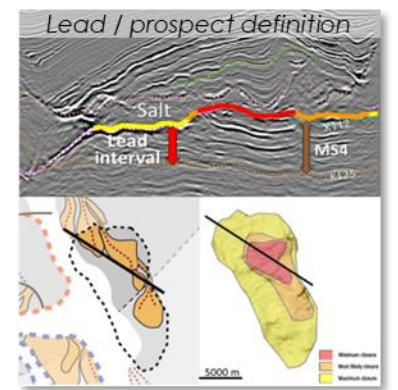


Increase in Source Rock confidence and decreased risk in Reservoir Distribution

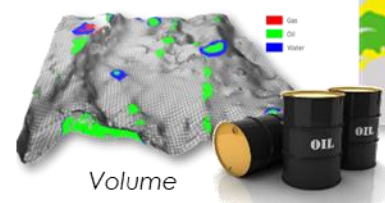
Project Workflow



Play/Prospect analysis - risks & volumetrics



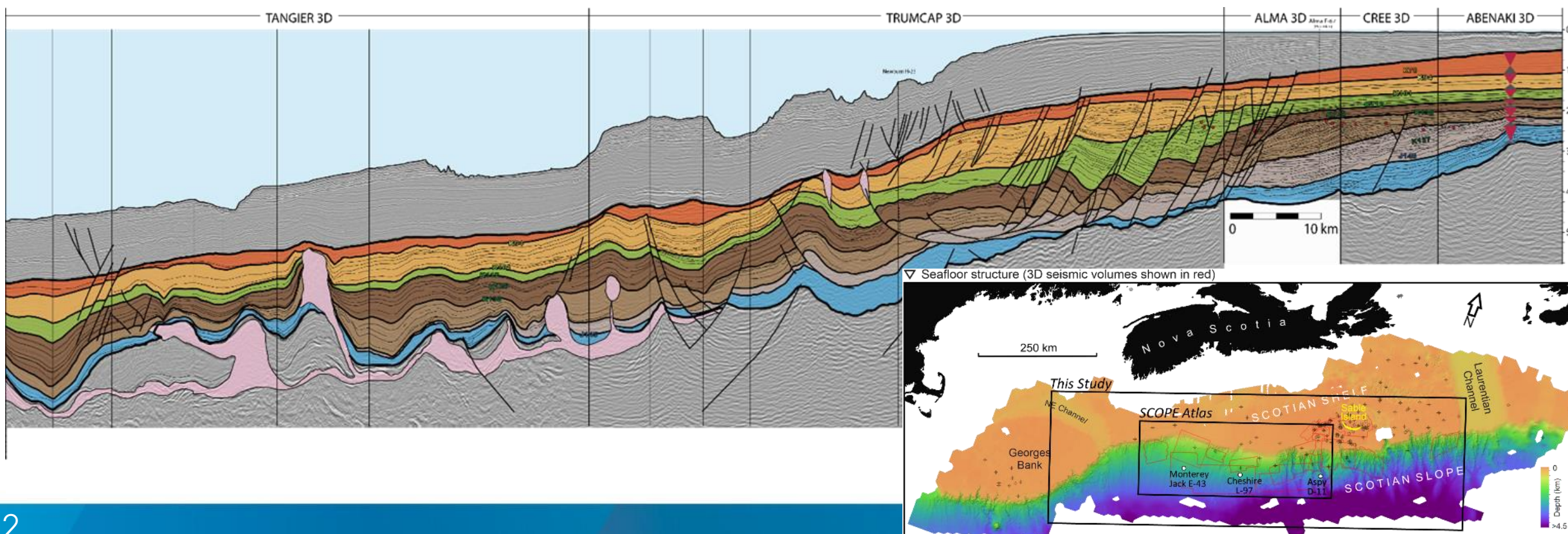
3D Petroleum System Modelling



Volume

New Regional Seismic Framework

- Recent exploration:
 - Two large wide-azimuth 3D reflection seismic volumes on the central to western Scotian Slope (Shelburne 3D and Tangier 3D)
 - Three wildcat exploration wells (Cheshire L-97/L-97A, Monterey Jack E-43/E-43A, and Aspy D-11/D-11A).
- Markers were used to constrain spatial and temporal variations in margin structure, sediment thickness distribution on the continental shelf, slope, and rise, and salt expulsion history (see Deptuck and Kendell 2017). These markers were also used to guide advanced seismic interpretation tools like PaleoScan, presented in Chapter 3 and Appendix 3.

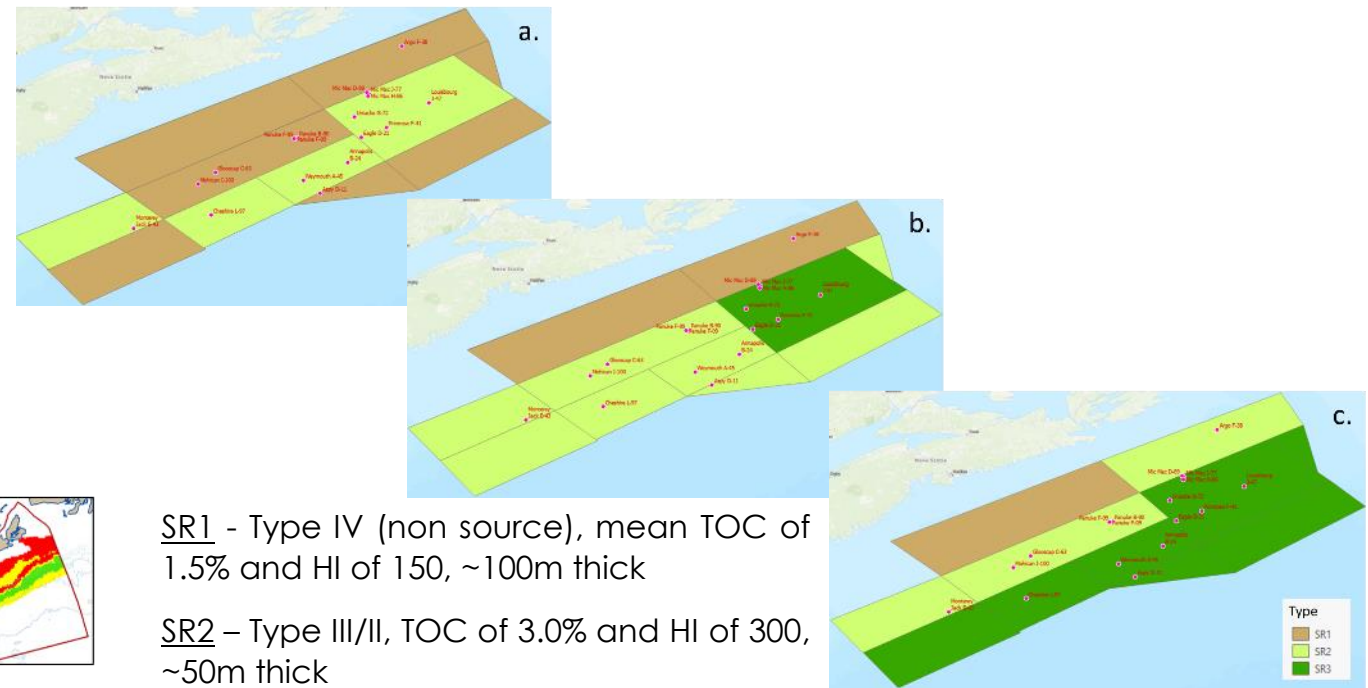


Lower Jurassic Source Rock Understanding

- Majority of the hydrocarbons discovered on the Scotian Shelf are gas often associated with light oils/condensates.
 - Distinct terrigenous signature of a deltaic source rock with Type III-II organic matter,
 - Indicative of Nova Scotia's proven Tithonian aged Source Rock
- Recent Studies indicate there is a considerable amount of circumstantial evidence which suggests that a Lower Jurassic source rock may exist.

	Source Rock	Age	Initial TOC	Kerogen Type	Thickness (m)	HI (mgHC/gTOC)	Focus
2011	Tithonian	148 Ma	3%	II/III (mix)	0-50	424	Basin wide study incorporating (1) previous studies (2) large existing geochemical database (+40 years of exploration) (3) review of all available and new TOC/Geochemical analysis, (4) characterization of oil families, and (5) new GC/GCMS analyses of oil, condensates and hydrocarbon fluid inclusions. Aptian and Vananginian sources also considered in this project.
	Callovian	160 Ma	2%	II/III (mix)	0-20	424	
	Pliensbachian (L.M. Jurassic)	196 Ma	5%	II (marine)	20	600	

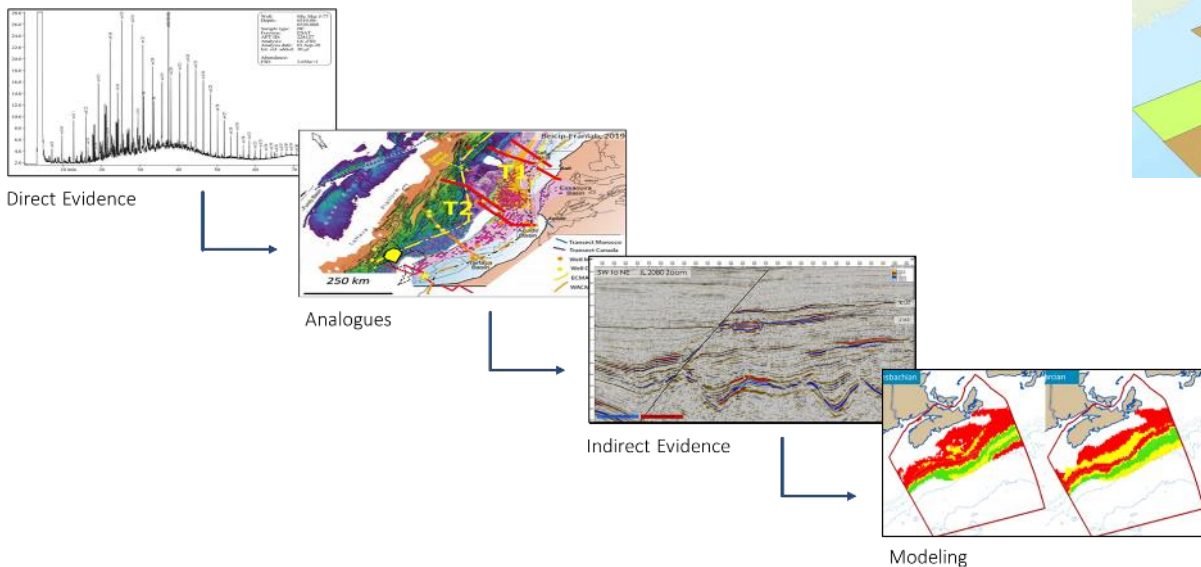
	Source Rock	Age	Initial TOC	Kerogen Type	Thickness (m)	HI (mgHC/gTOC)	Focus
2023	Tithonian	150 Ma	0-5%	II/III	0-20	400	Synthesis of numerous studies regarding source rock on the Scotian Margin including (1) Dr. Andy Bishop's independent view of NS Lower Jurassic source rock potential and parameterization and regional review of Lias source rocks from Atlantic domain including Europe and globally, (2) Dr. Martin Fowler's research on the source of shelf oils indicating the presence of two distinct source rocks, and (3) various supporting paleogeographic and migration projects. Three scenarios of Lias source rocks tested (See Chapter 5 for details).
	Pliensbachian	196 Ma	3-4%	II	0-30	300-500	



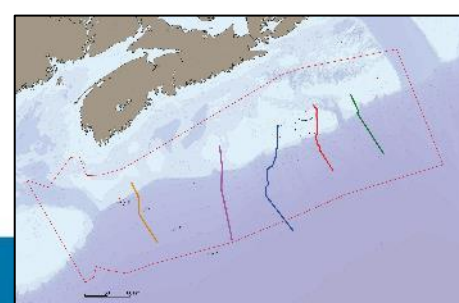
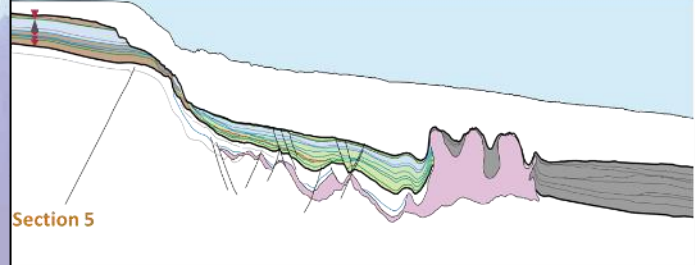
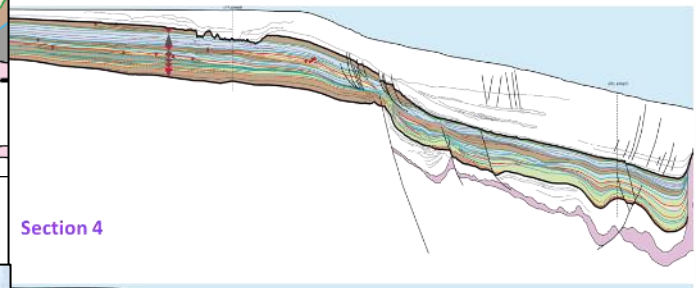
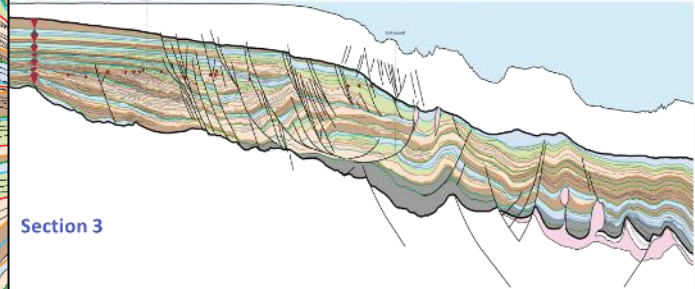
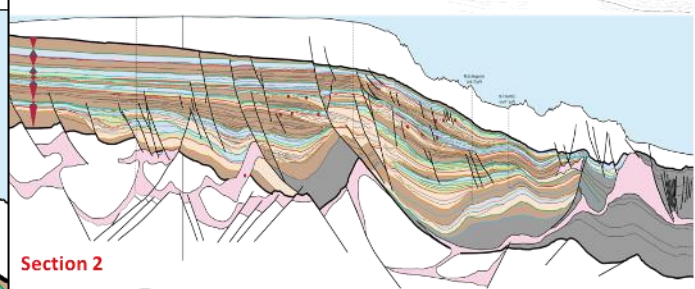
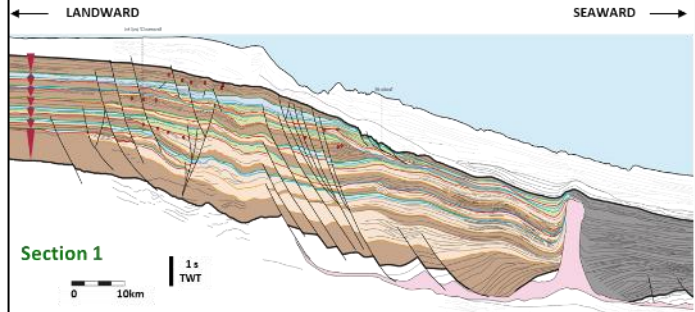
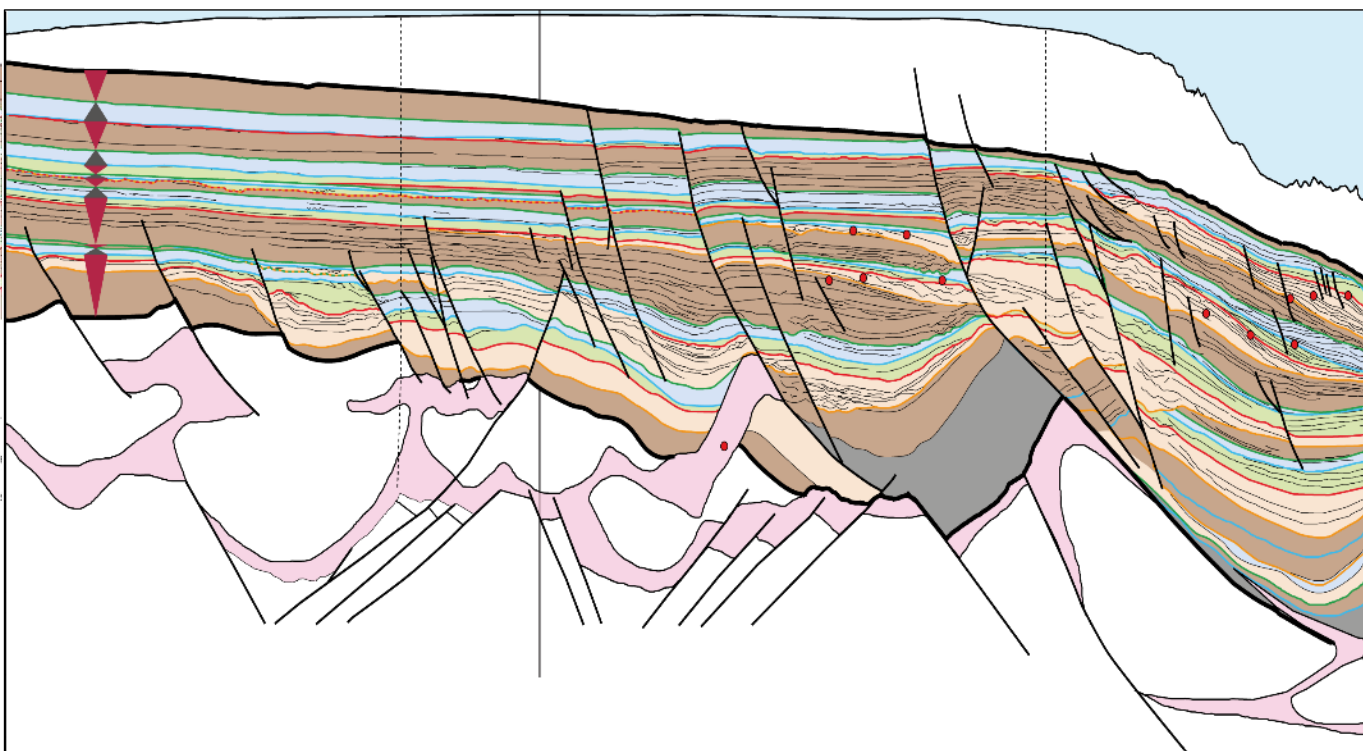
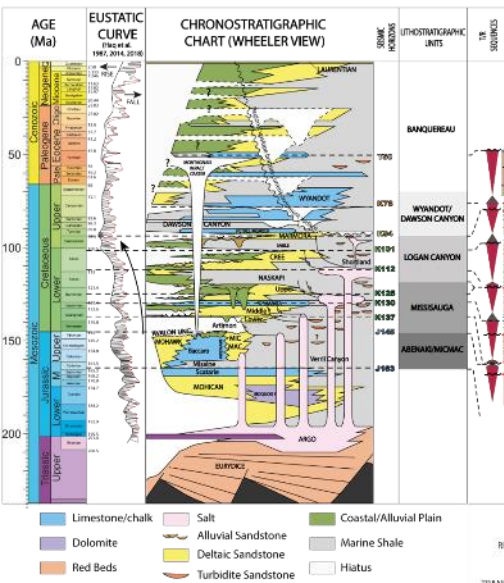
SR1 - Type IV (non source), mean TOC of 1.5% and HI of 150, ~100m thick

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



Sedimentology and Sequence Strat

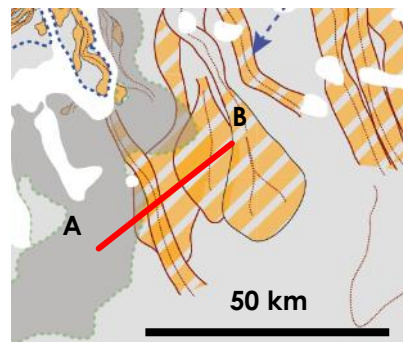
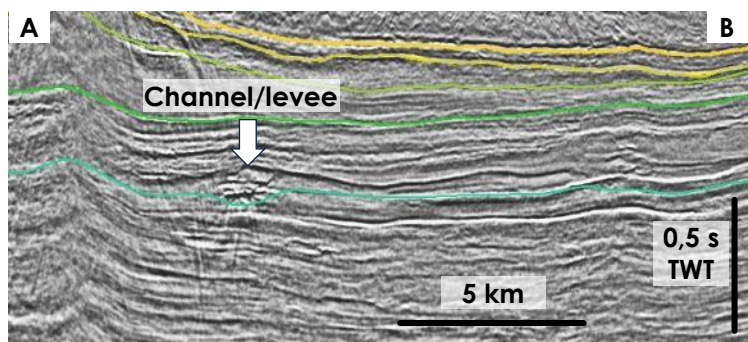


Gross Depositional Environment

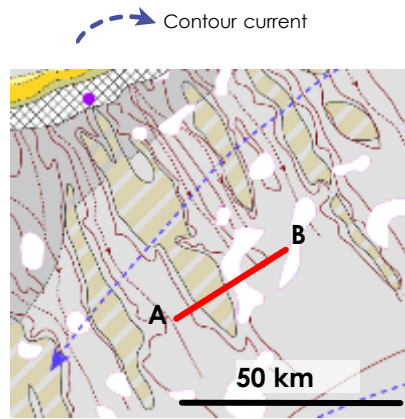
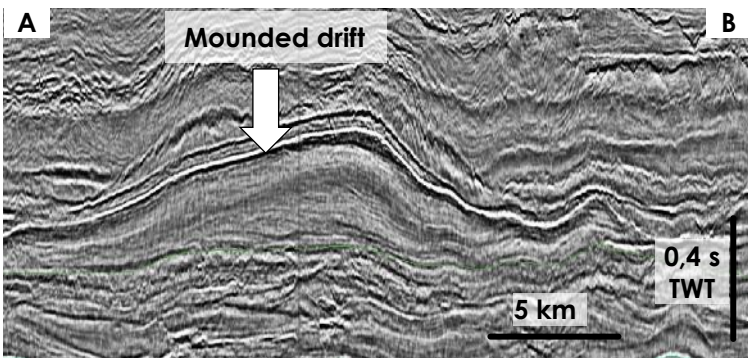
- Relevant geobodies were key play elements for the petroleum system and building blocks that fill the Gross Depositional Environment maps
- Facies assigned based on seismic signature and nearby well control
- The stratigraphic context of deposition also taken into consideration

2D Lines

Turbiditic fan system

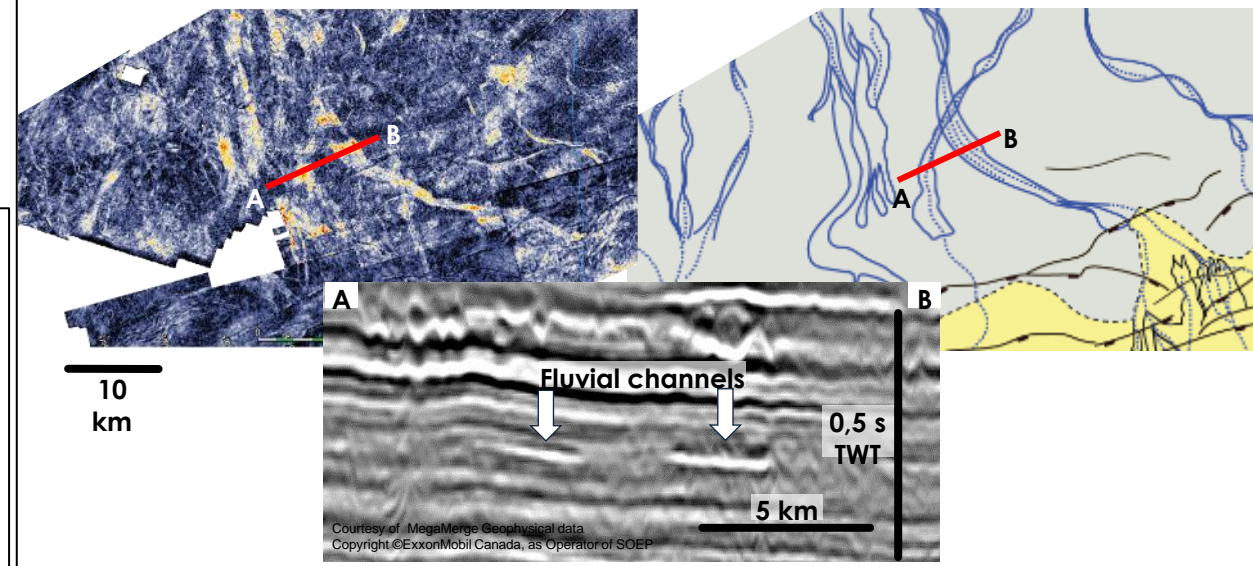


Mounded drift system

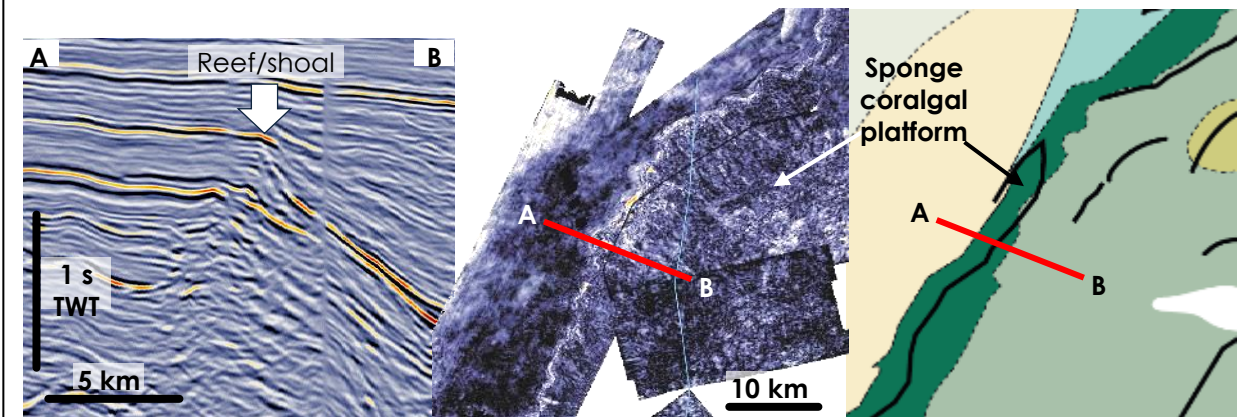


3D Cubes

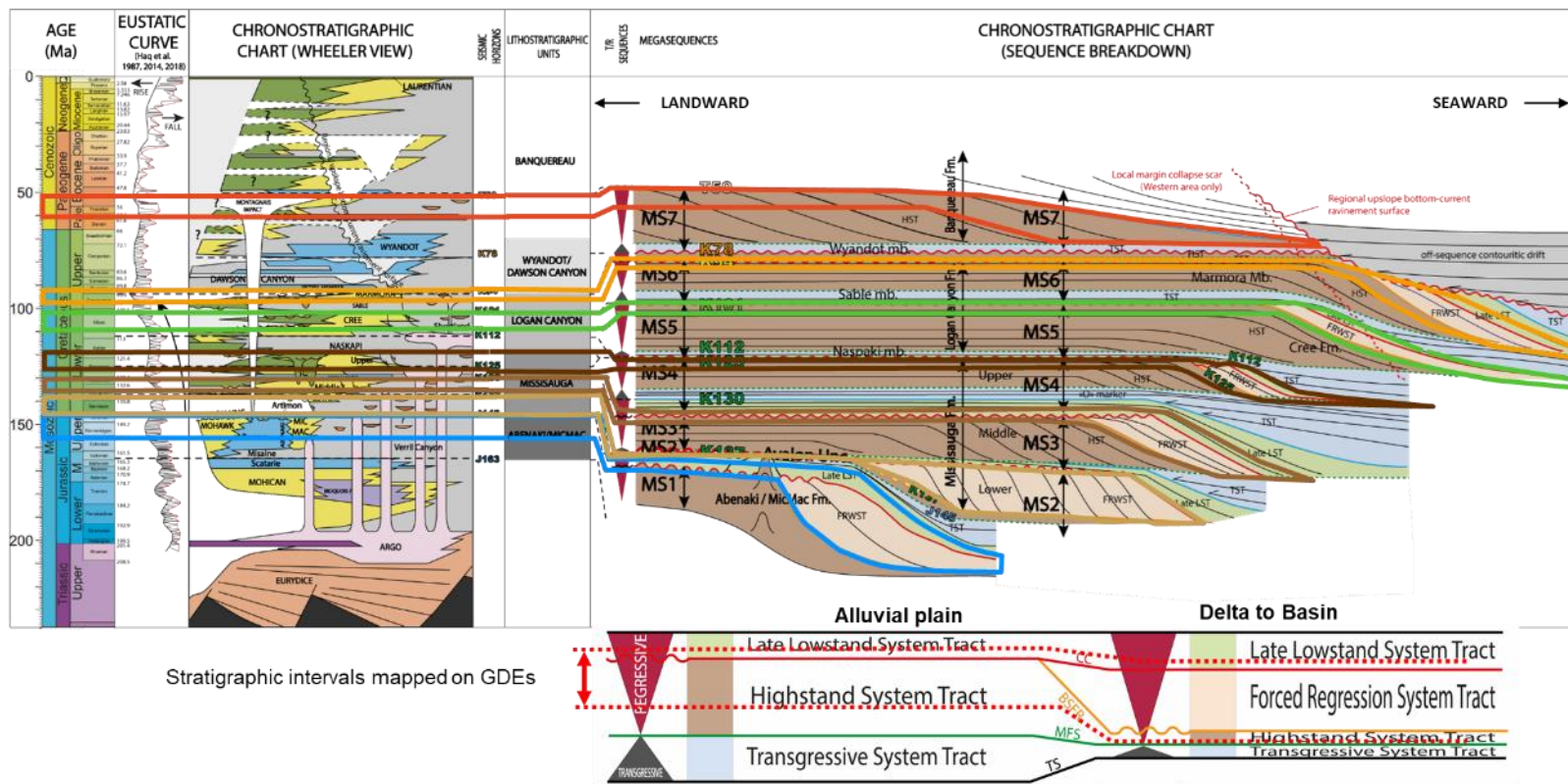
Fluvial-deltaic clastic systems (MicMac, Mississauga and Logan Canyon Fm)



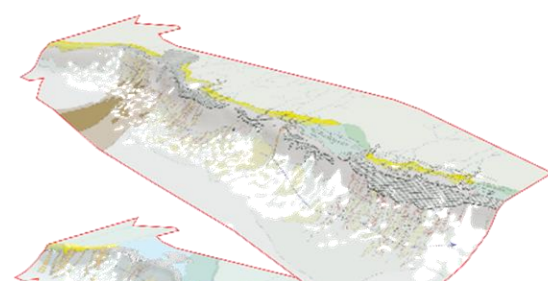
Shallow marine sponge/corallal platform (Artimon formation)



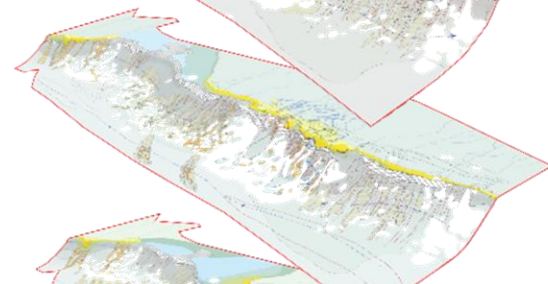
Gross Depositional Environment



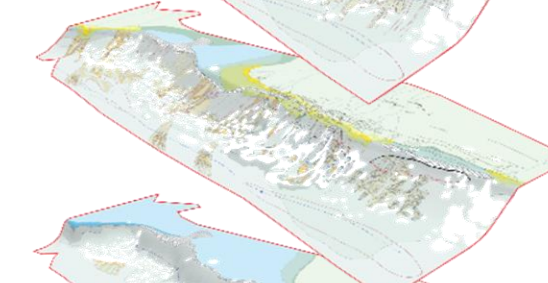
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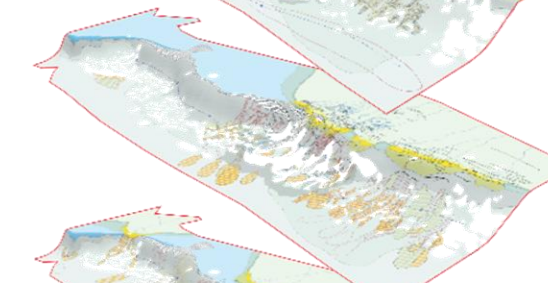
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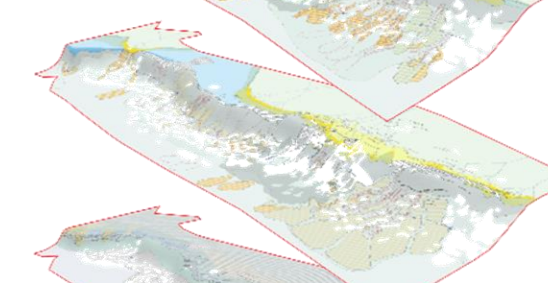
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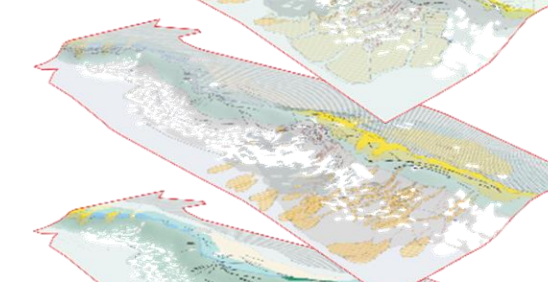
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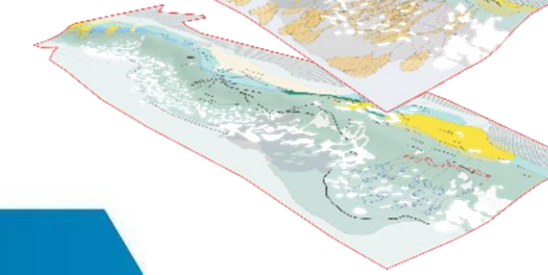
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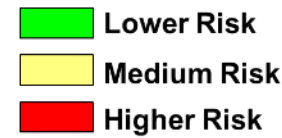
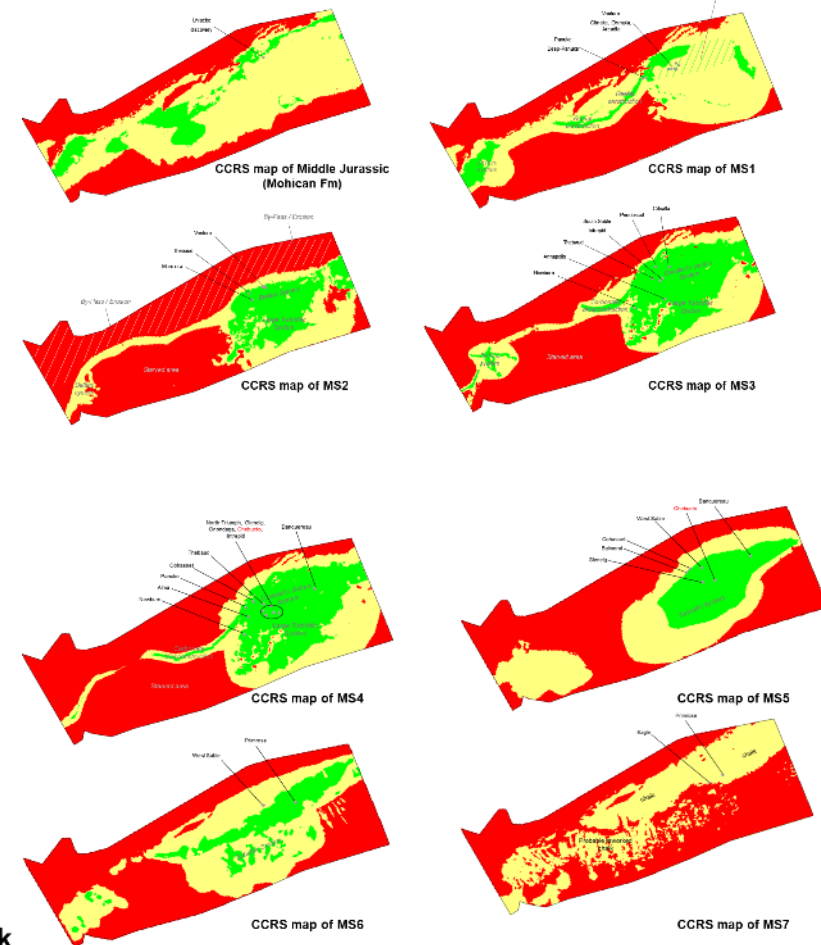
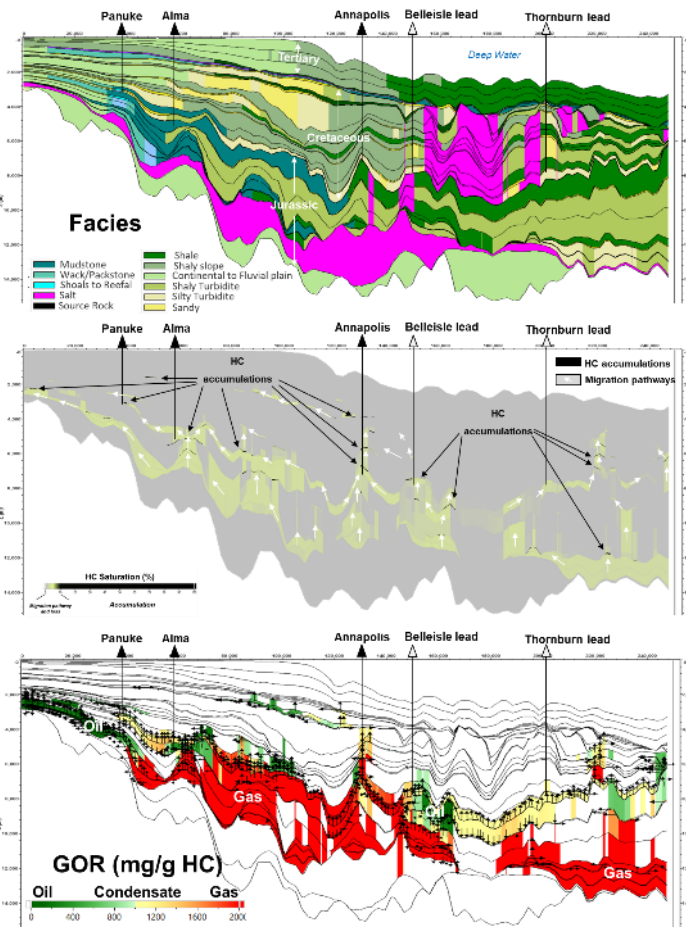
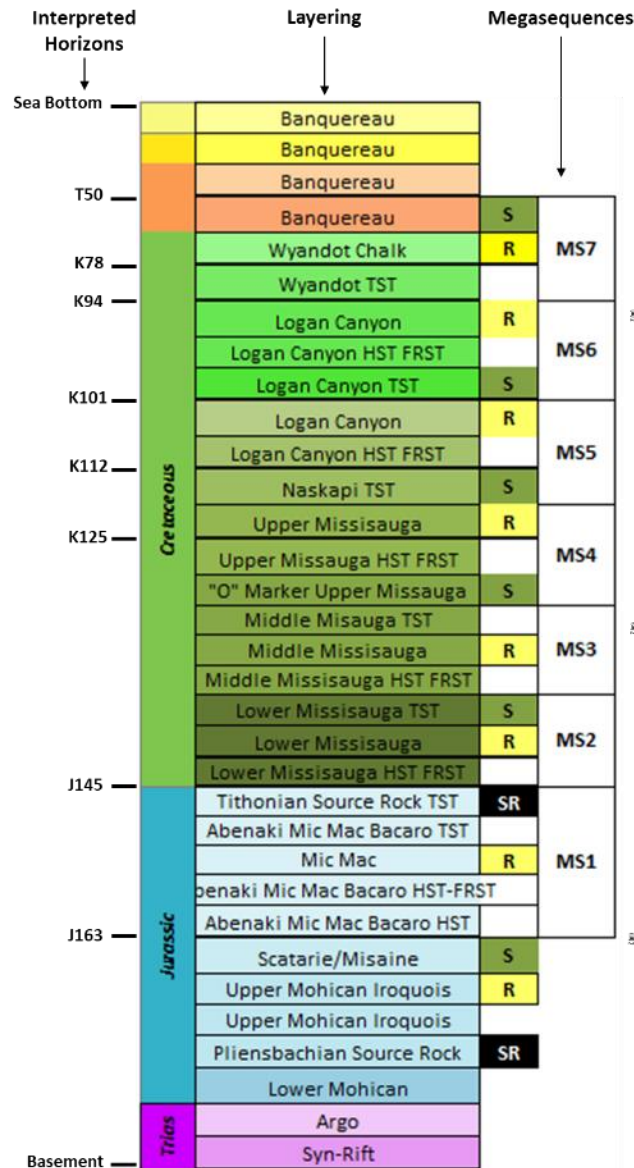
MEGASEQUENCE 2



MEGASEQUENCE 1



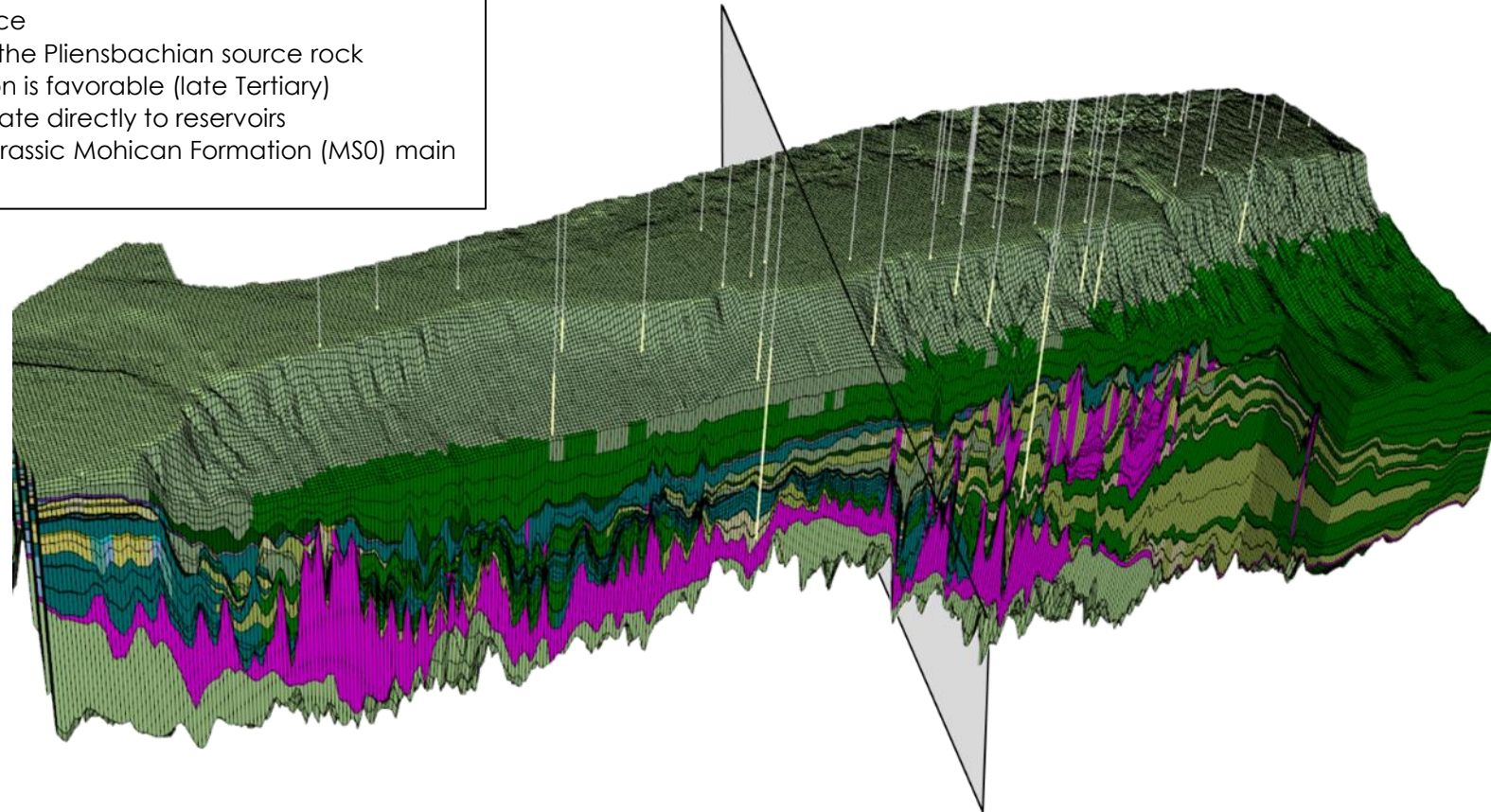
Basin Modeling and Common Risk Segment Mapping



Yet to Find

- In place, yet to find values for the entire study area were calculated
- Result combines various 3D petroleum system models
 - Variations in uncertainties on net reservoir thickness, source rock richness, hydrocarbon saturation cut-off and hydrocarbon mass cut-off in reservoir cells
- Probabilistic assessment comes from Monte Carlo simulations derived from the petroleum system models to provide the P10, P50, and P90.

- West**
- Oil Province
 - Timing of the Pliensbachian source rock generation is favorable (late Tertiary)
 - can migrate directly to reservoirs
 - Middle Jurassic Mohican Formation (MSO) main target



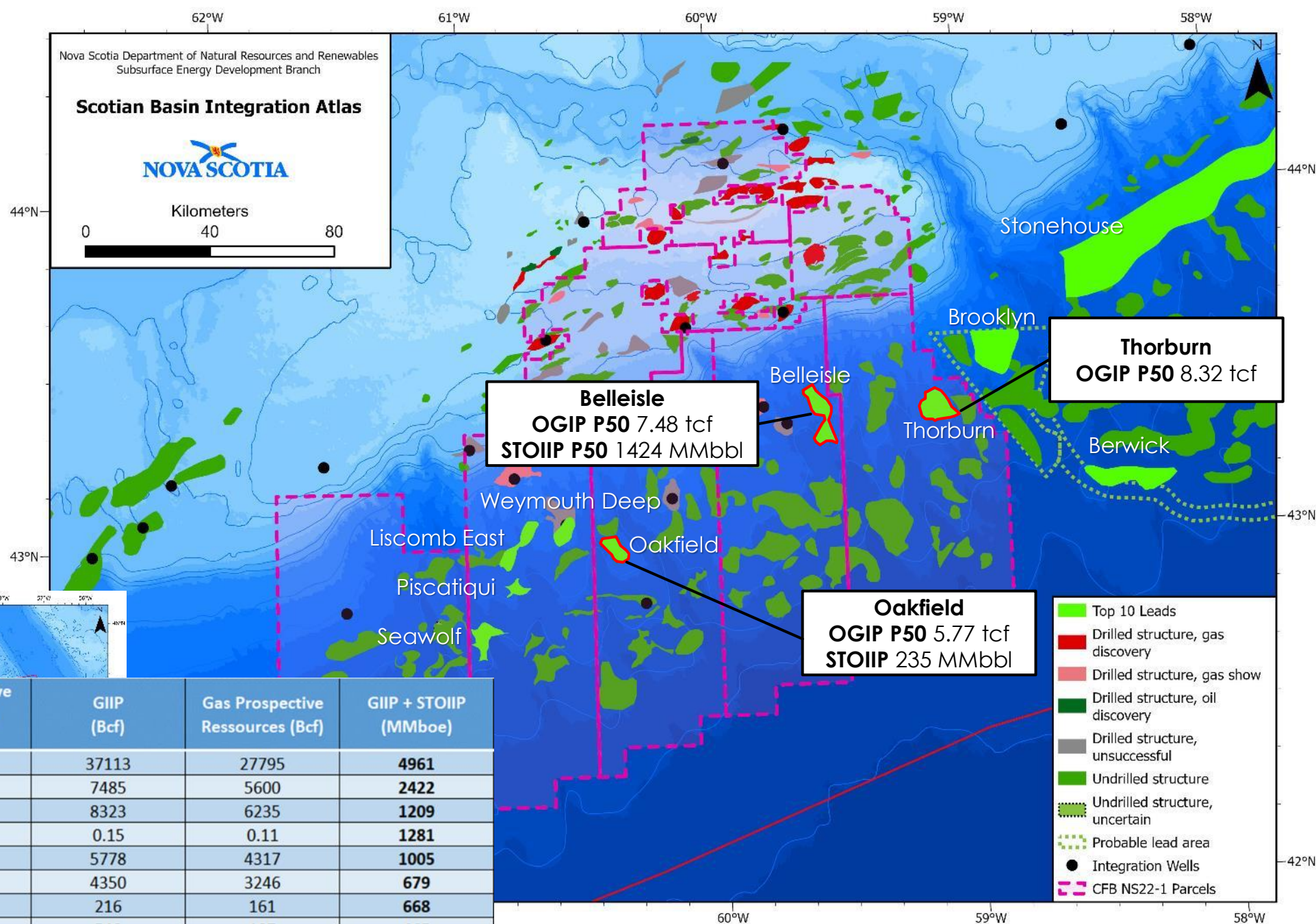
- East**
- Large turbiditic system above the mature Tithonian source rock
 - Pliensbachian an additional contributor.
 - Gas and condensate dominate
 - transition from condensate to oil such as at Panuke on the shelf (proven) and Tangier blocks on the slope.
 - MS2 and MS3 main target for exploration at play level
 - Faults, fractures and diapirism provide some efficient vertical conduits

Total	Total Oil (Bbl)	Total Gas (Tcf)	Total Oil & Gas (Bbl oe)
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

Leads

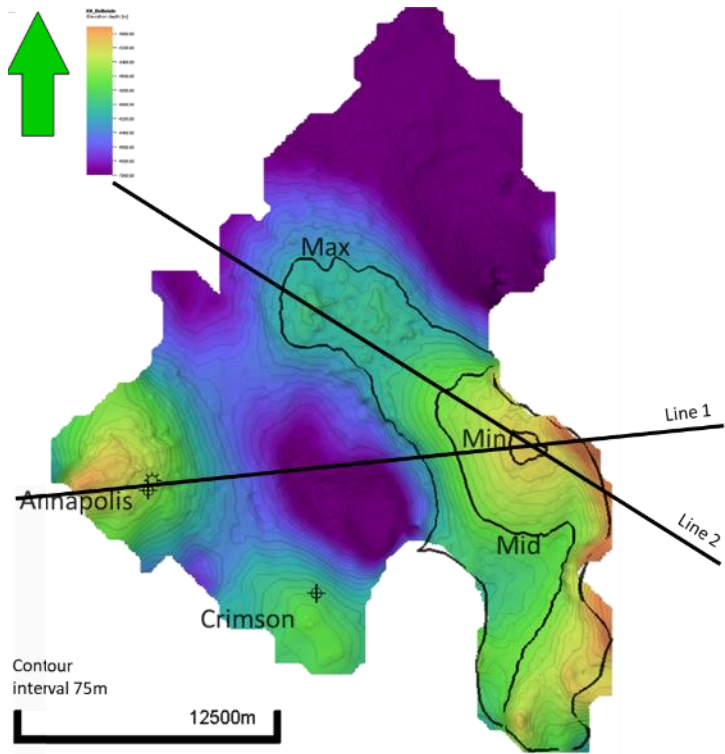
Estimation of the resource potential was completed by:

- (1) Calculating a whole basin Yet to Find (YTF)
- (2) Completing a ranking of 25 candidate leads
- (3) Calculate conventional volumetrics for 10 top ranked leads



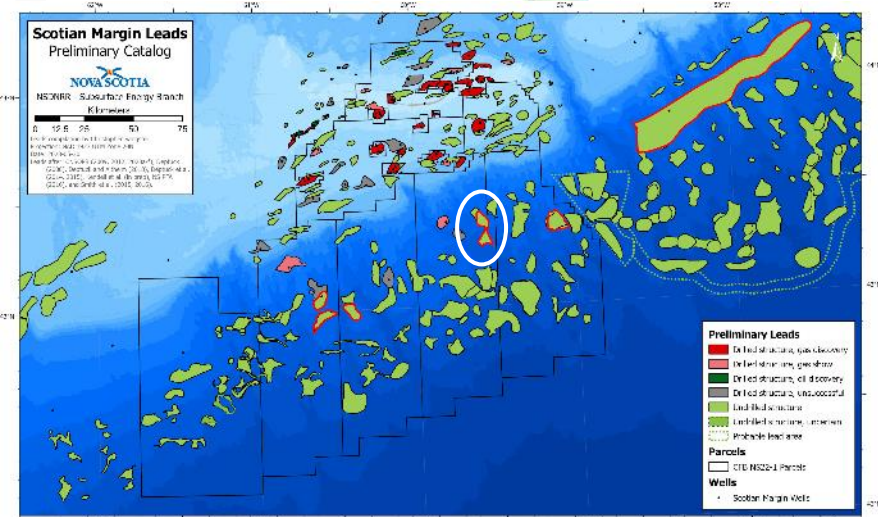
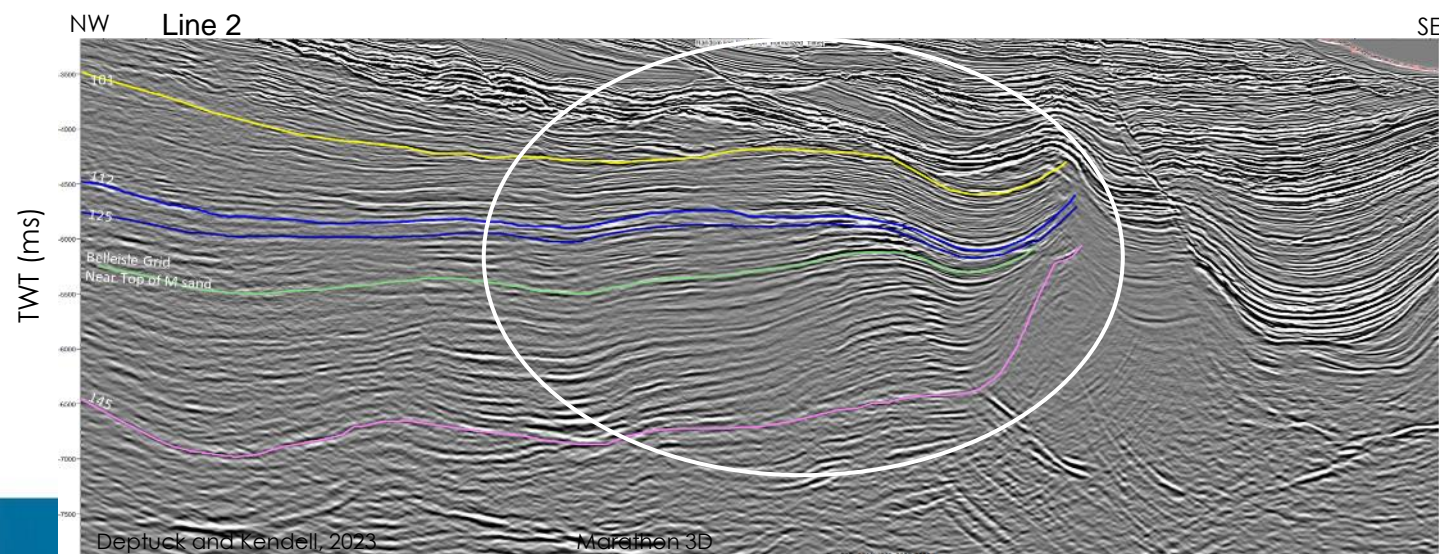
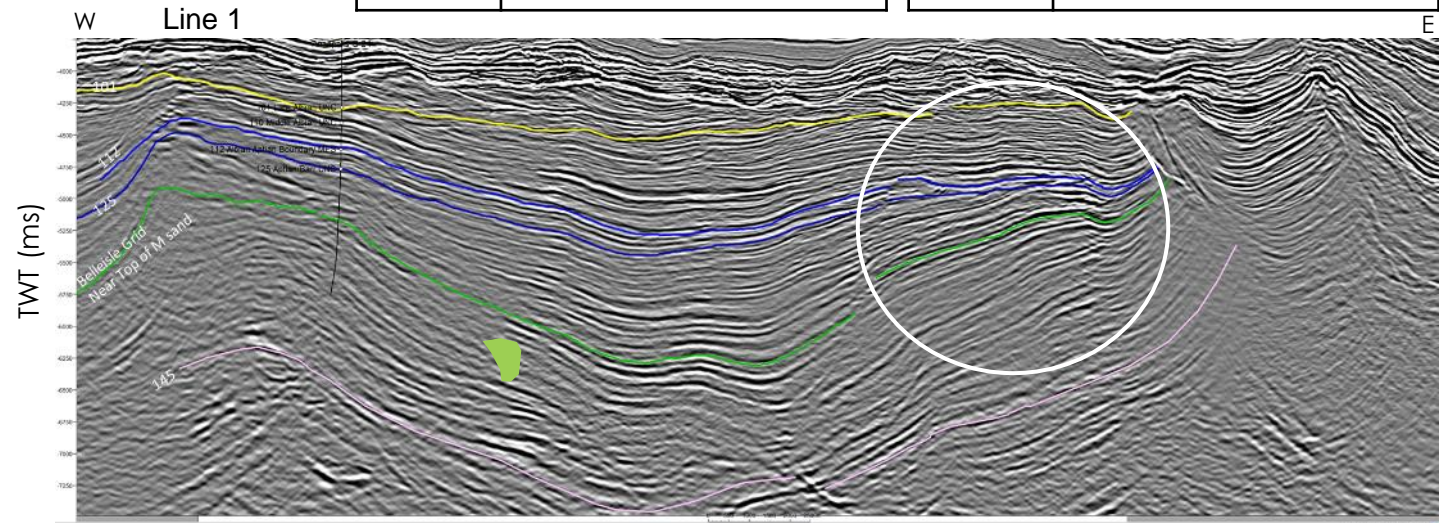
Lead Name	STOIIIP (MMbbl)	Oil Prospective Ressources (MMbbl)	GIIP (Bcf)	Gas Prospective Ressources (Bcf)	GIIP + STOIIIP (MMboe)
Stonehouse	13	10	37113	27795	4961
Belleisle	1424	536	7485	5600	2422
Thorburn	99	39	8323	6235	1209
Piscatiqui	1281	322	0.15	0.11	1281
Oakfield	235	80	5778	4317	1005
Weymouth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

Belleisle

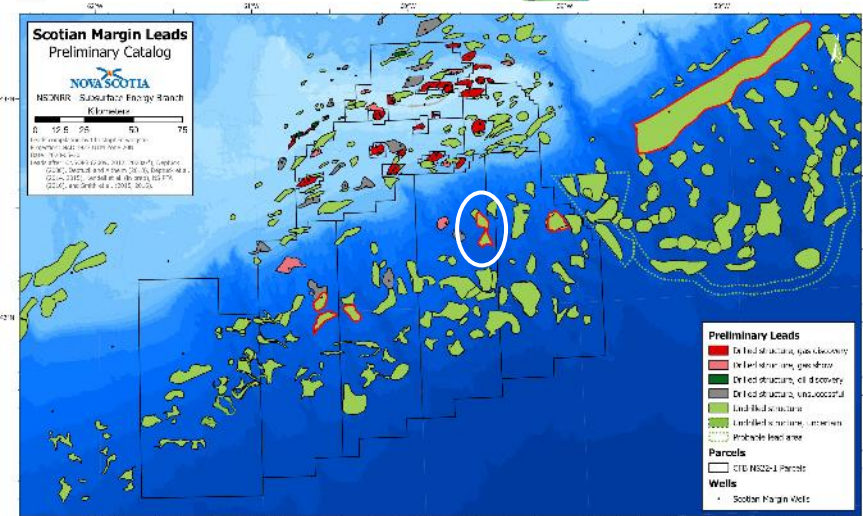
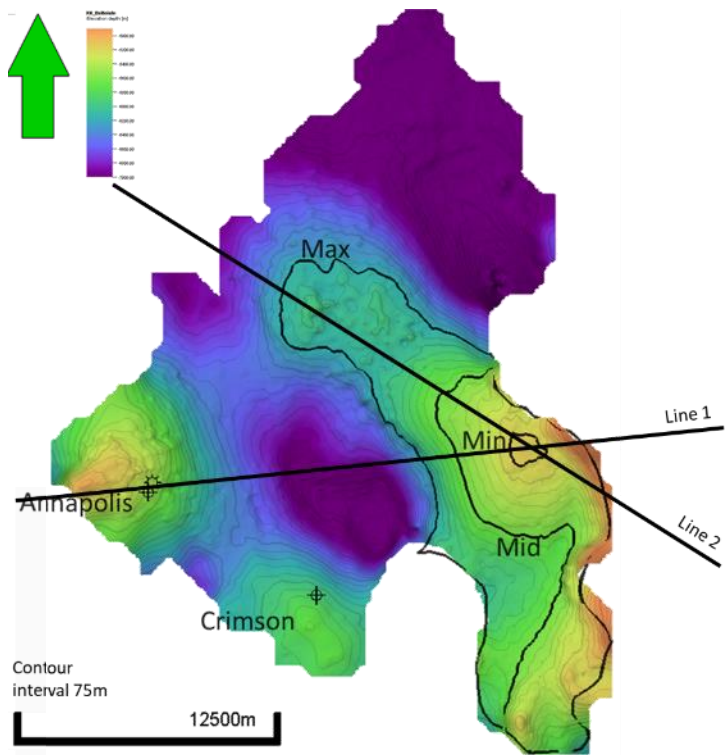


Belleisle: Three-way closure against fault and salt (salt related anticline)

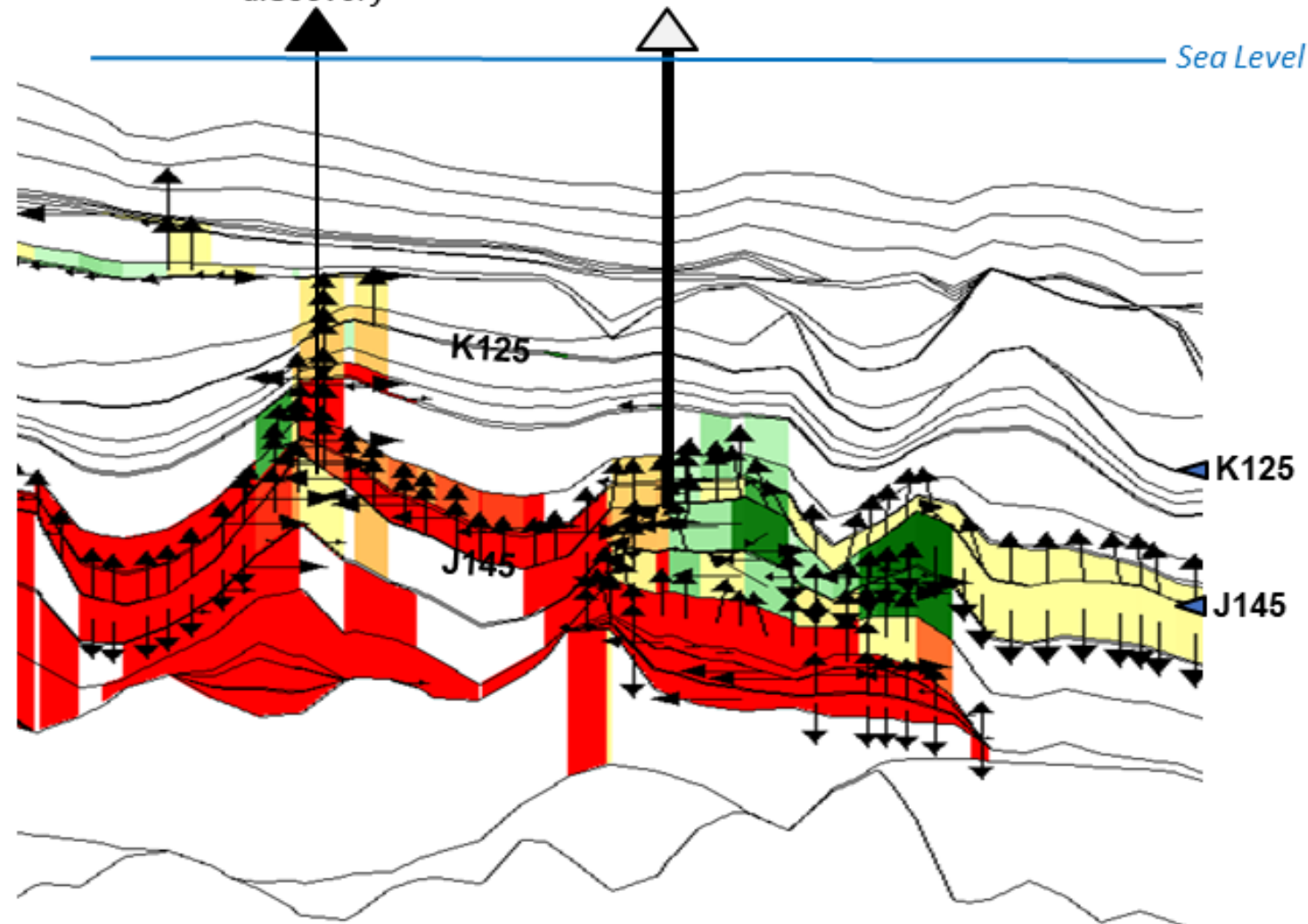
	STOIIP (MMbbl)		OGIP (tcf)
P90	582	P90	3.04
P50	1424	P50	7.48
P10	2896	P10	15.21



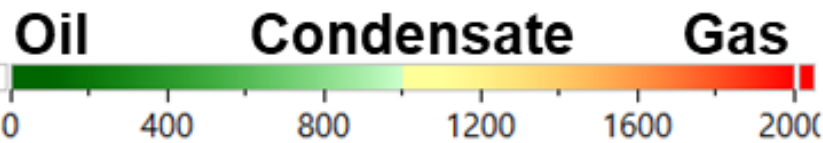
Belleisle



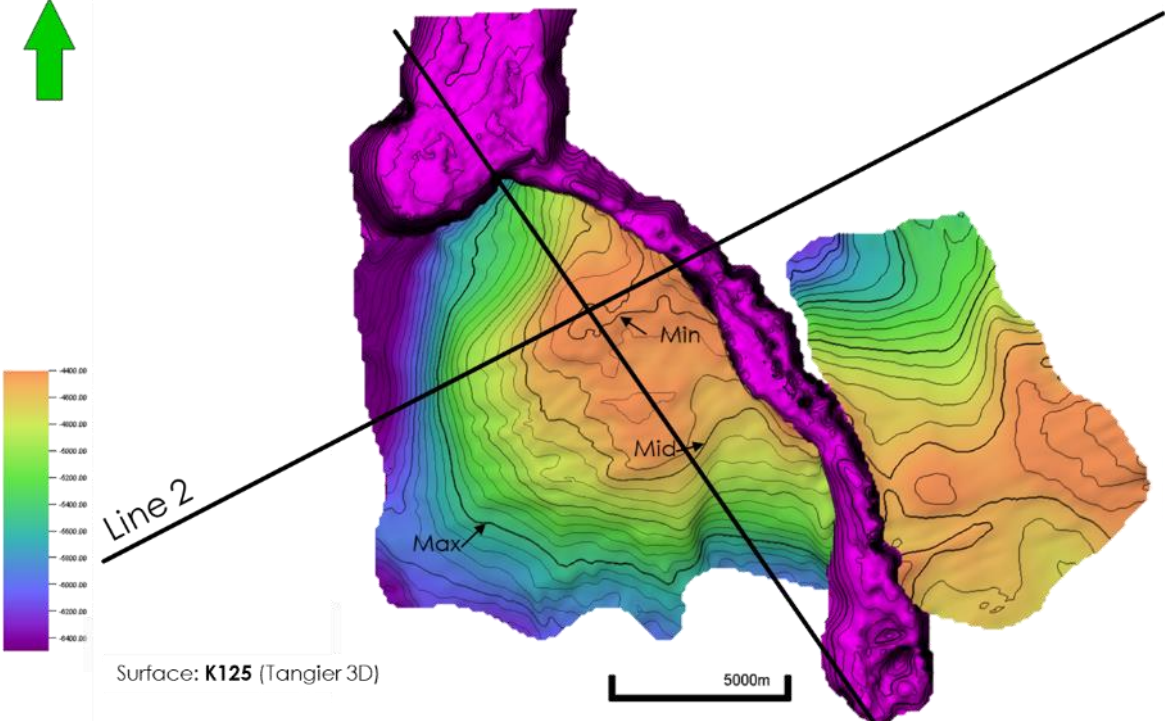
W Annapolis discovery Belleisle lead E



GOR (mg/g HC)

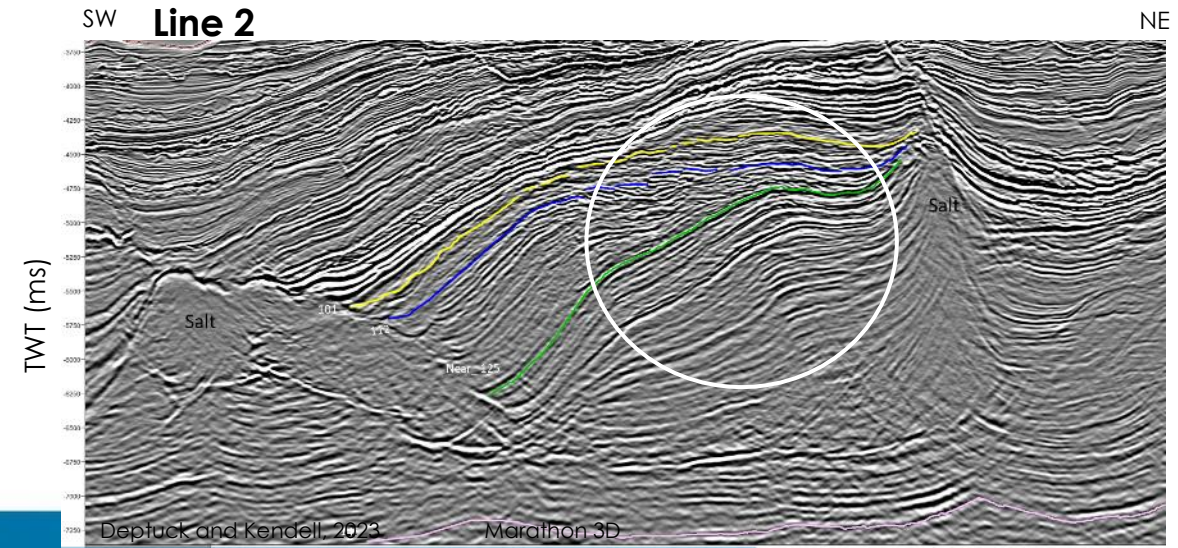
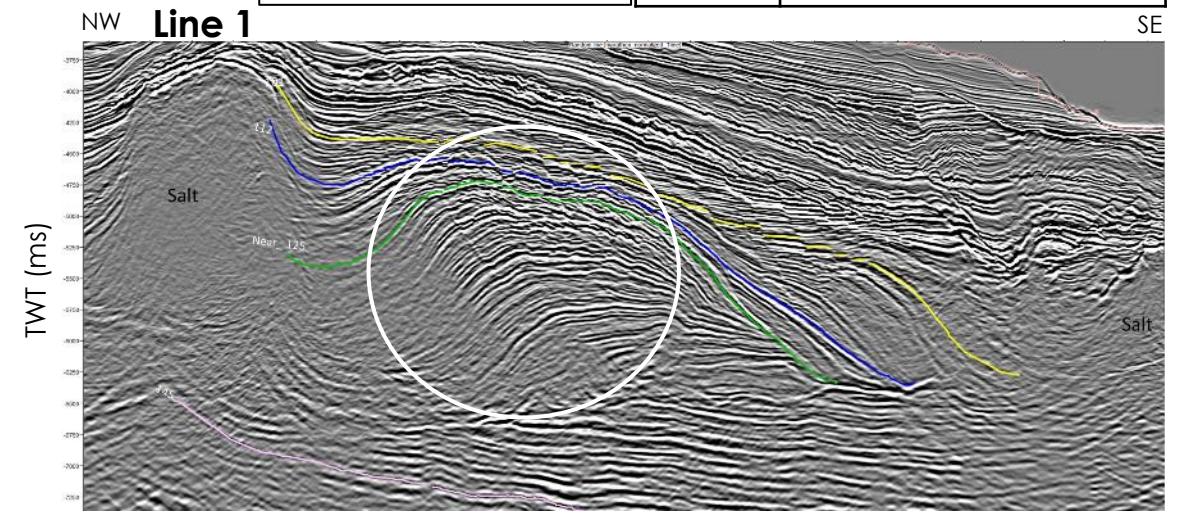


Thorburn

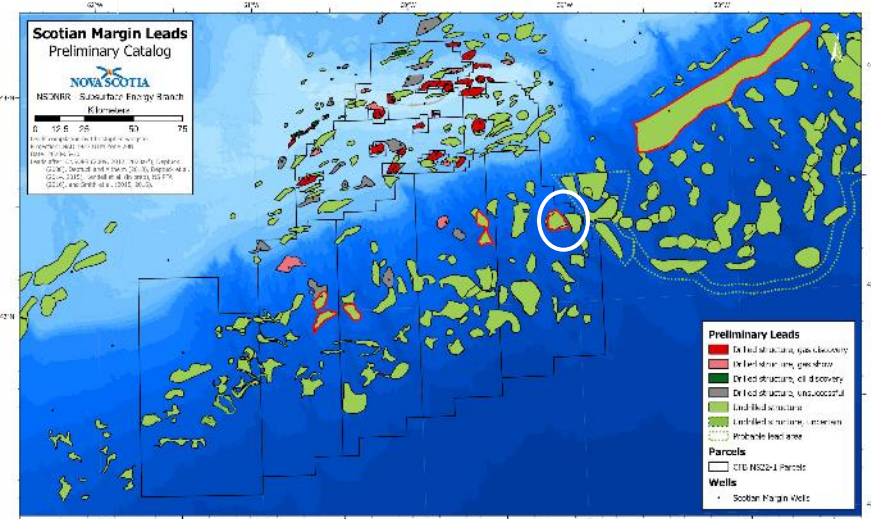


Thorburn: Three-way closure against salt (turtle back)

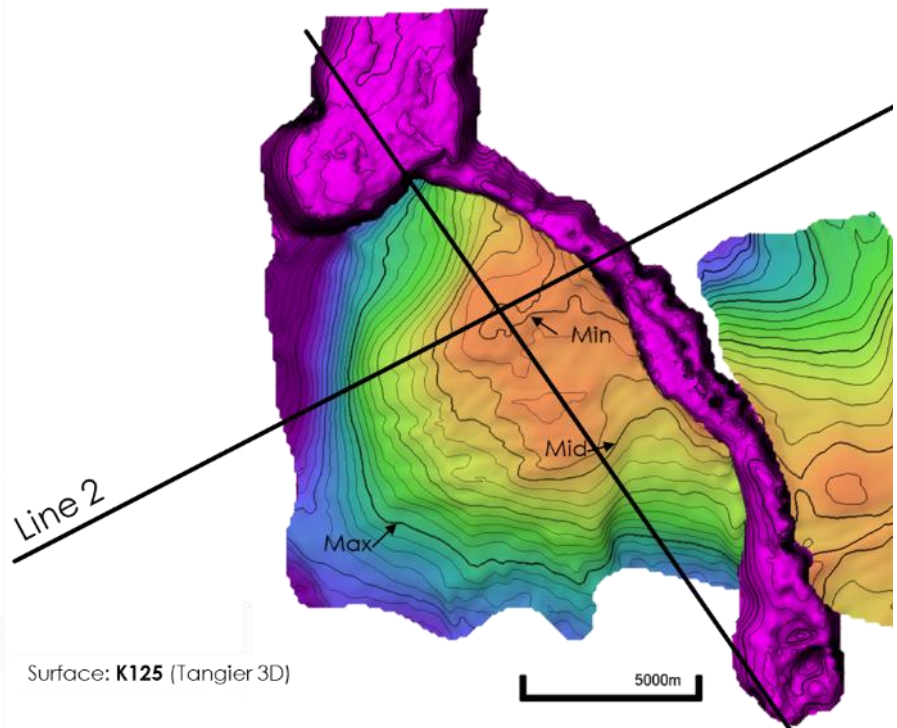
	OGIP (tcf)
P90	2.53
P50	8.32
P10	18.72



Deptuck and Kendall, 2023 Marathon 3D



Thorburn

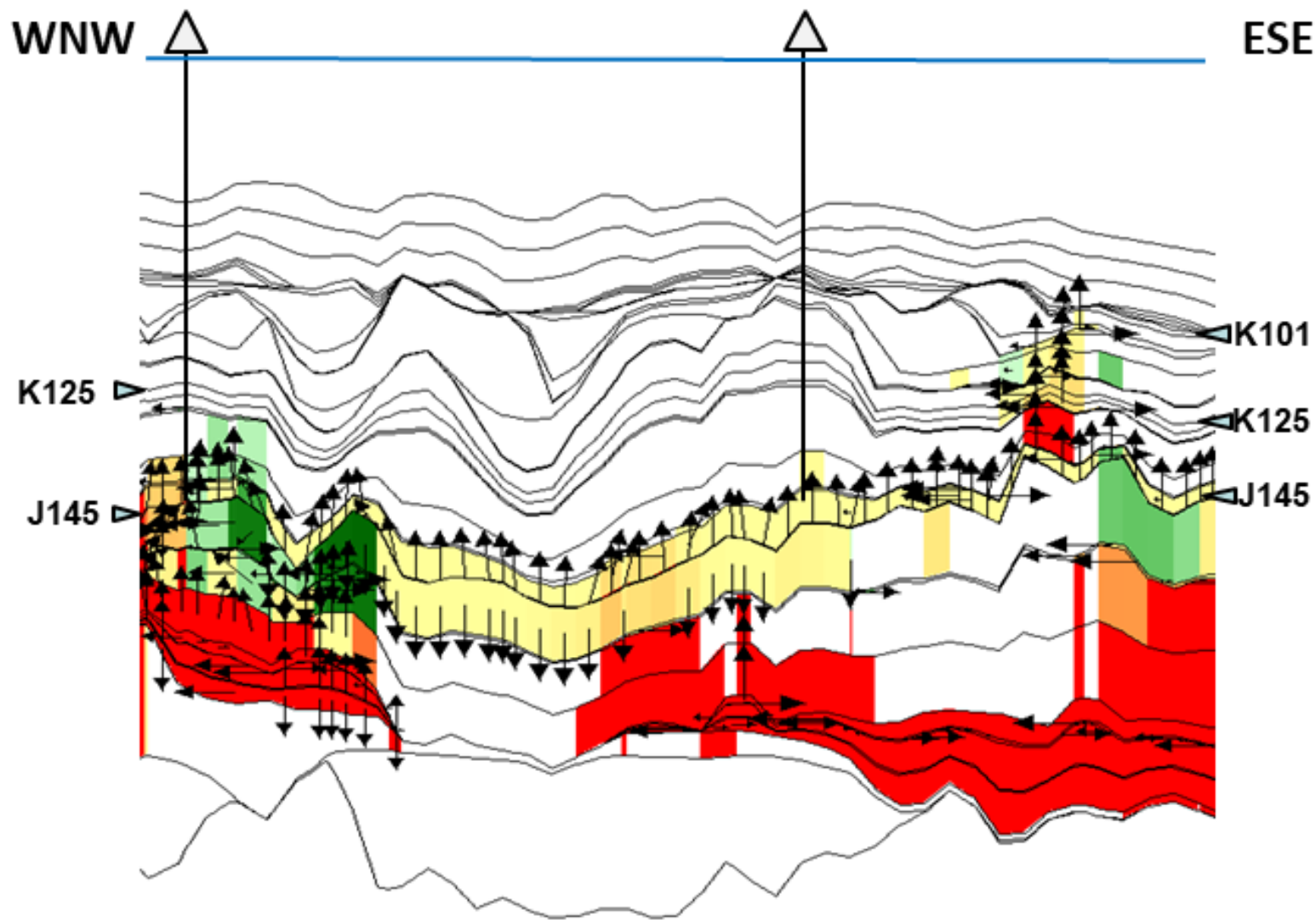


Belleisle lead

Thornburn lead

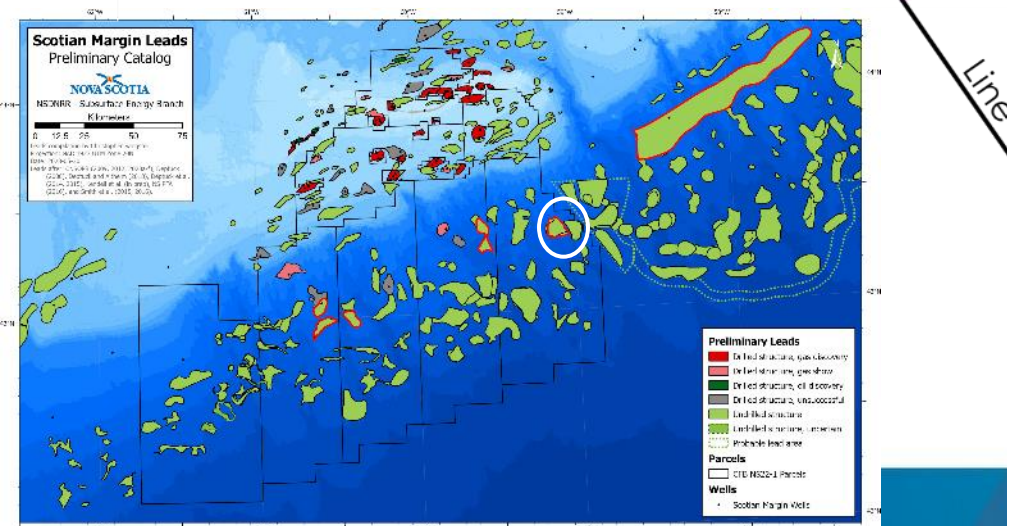
WNW

ESE

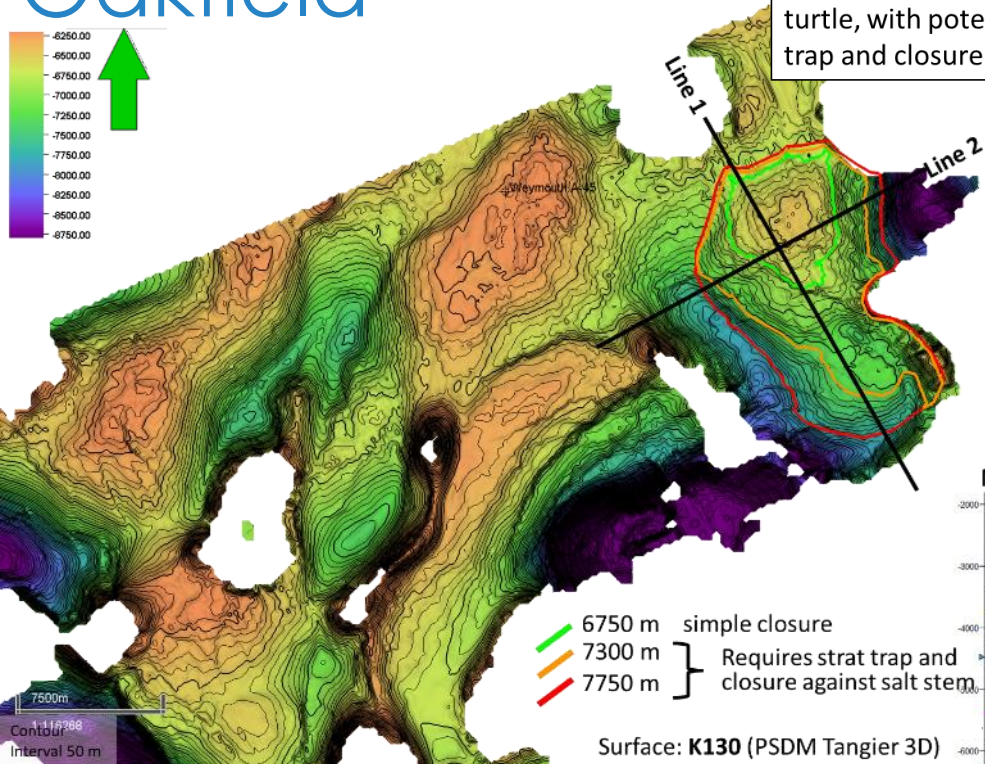
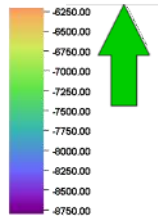


GOR (mg/g HC)

Oil Condensate Gas



Oakfield

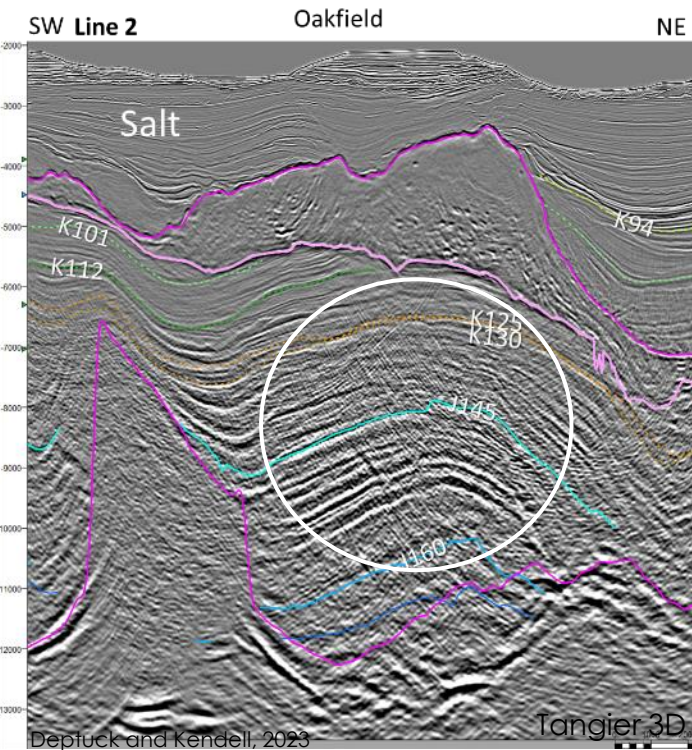
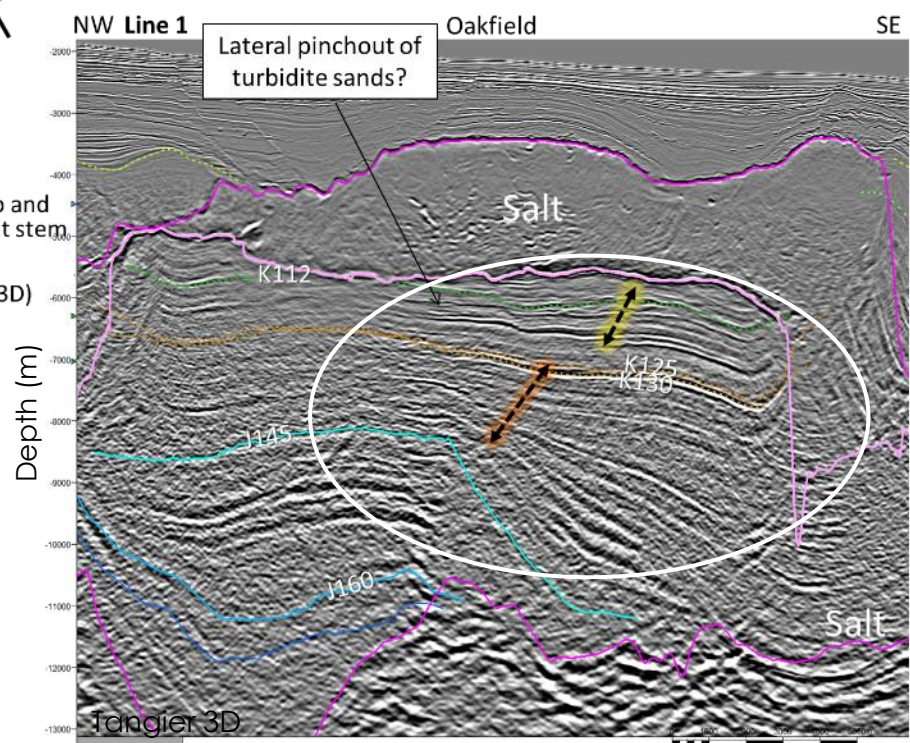
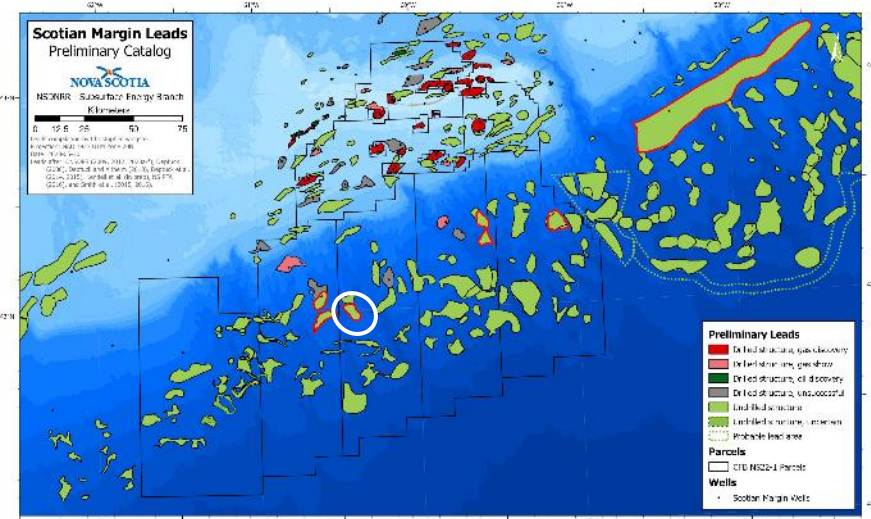


Oakfield: Subsalt (below canopy) four-way dip closure (min.) above a Jurassic turtle, with potential up-dip stratigraphic trap and closure against salt stem.

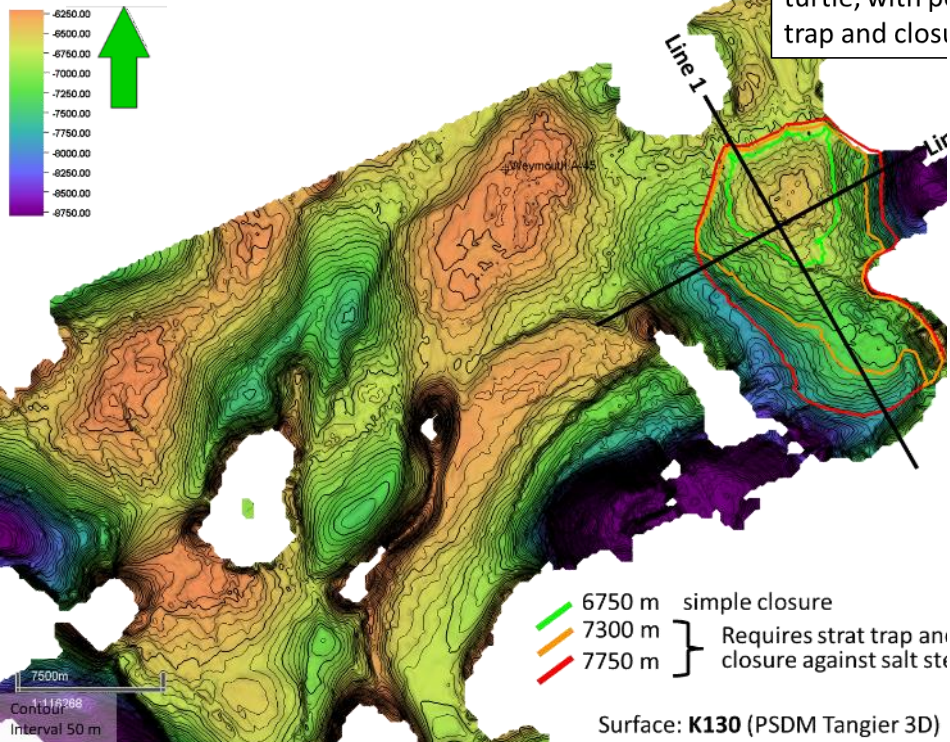
- 6750 m simple closure
- 7300 m } Requires strat trap and closure against salt stem
- 7750 m }

Surface: K130 (PSDM Tangier 3D)

	STOIIP (MMbbl)		OGIP (tcf)
P90	120	P90	2.97
P50	235	P50	5.78
P10	366	P10	8.98

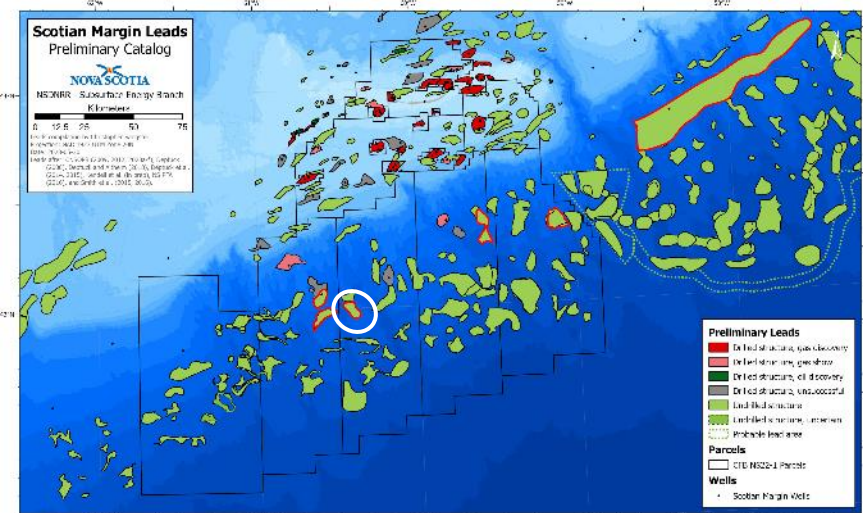


Oakfield



- 6750 m simple closure
- 7300 m } Requires strat trap and
- 7750 m } closure against salt str

Surface: K130 (PSDM Tangier 3D)



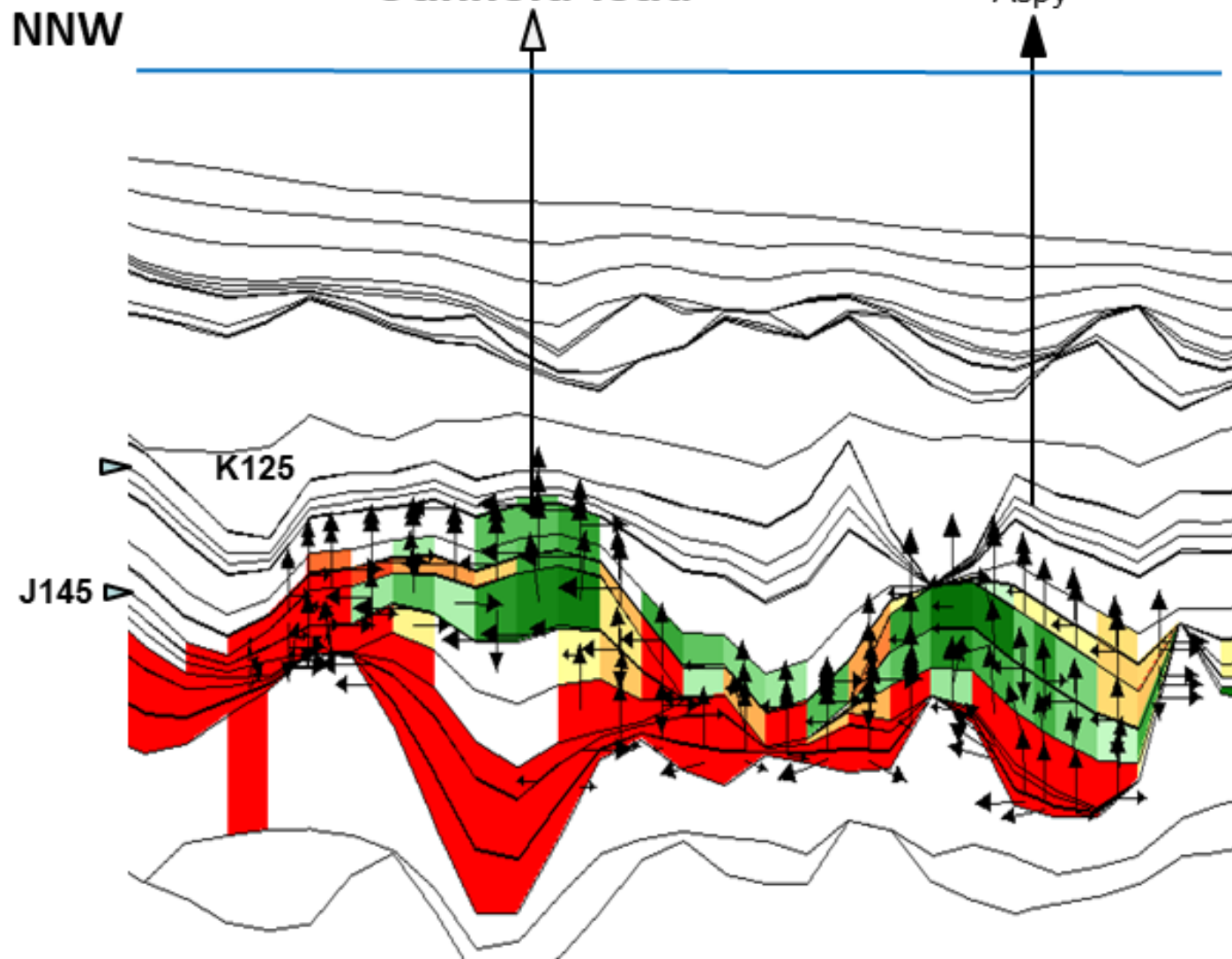
Depth (m)

Oakfield lead

NNW

Aspy

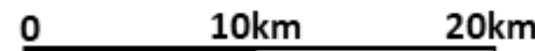
SSE



Oil

Condensate

Gas

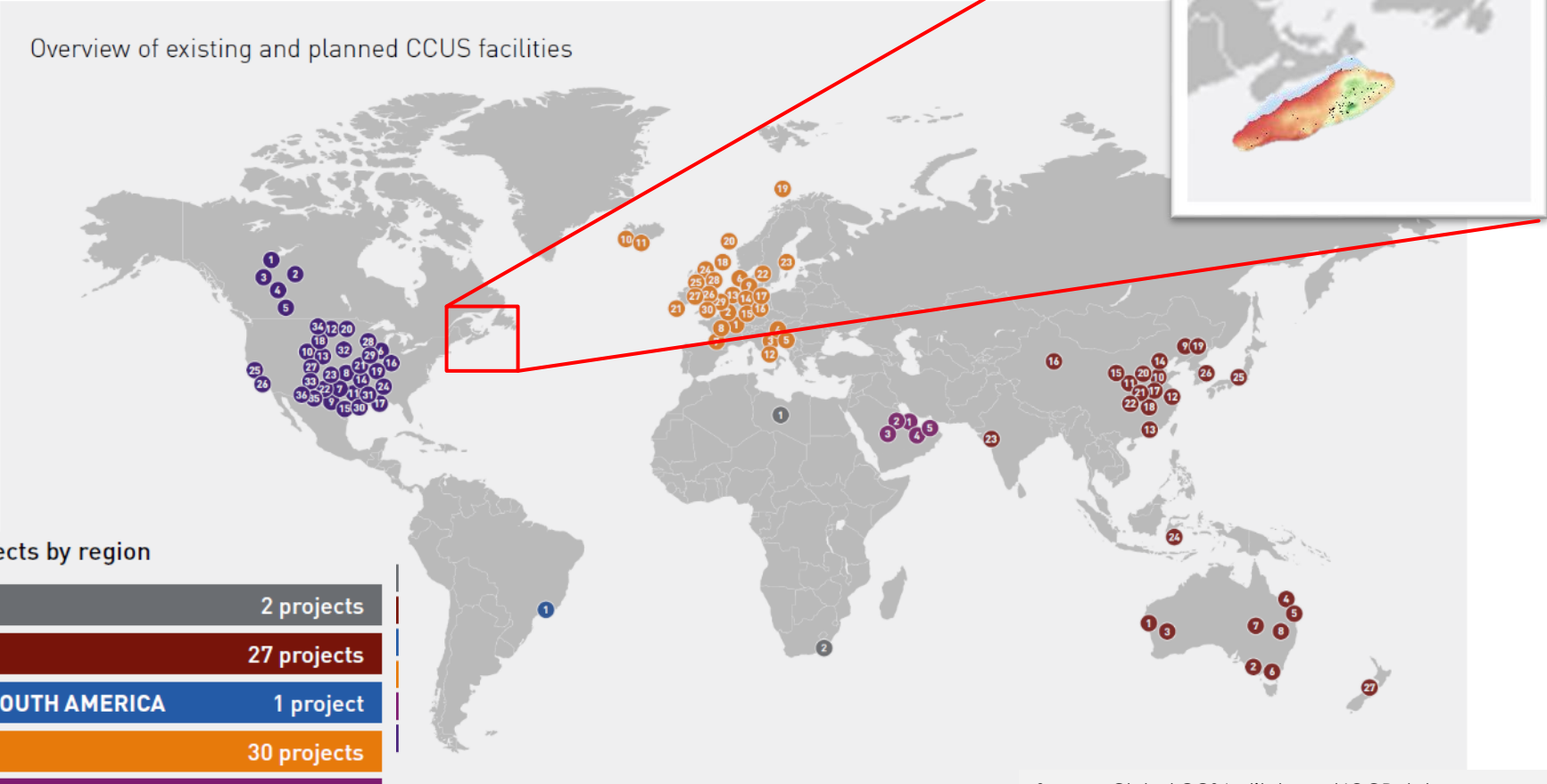


Energy Transition Potential



Nova Scotia in a Global Context

Overview of existing and planned CCUS facilities



Number of projects by region

AFRICA	2 projects
ASIA PACIFIC	27 projects
CENTRAL AND SOUTH AMERICA	1 project
EUROPE	30 projects
MIDDLE EAST	5 projects
NORTH AMERICA	36 projects

Source: Global CCS Institute and IOGP data

Energy Transition Potential - CCS

CO₂ Storage in Deep Saline Aquifers:

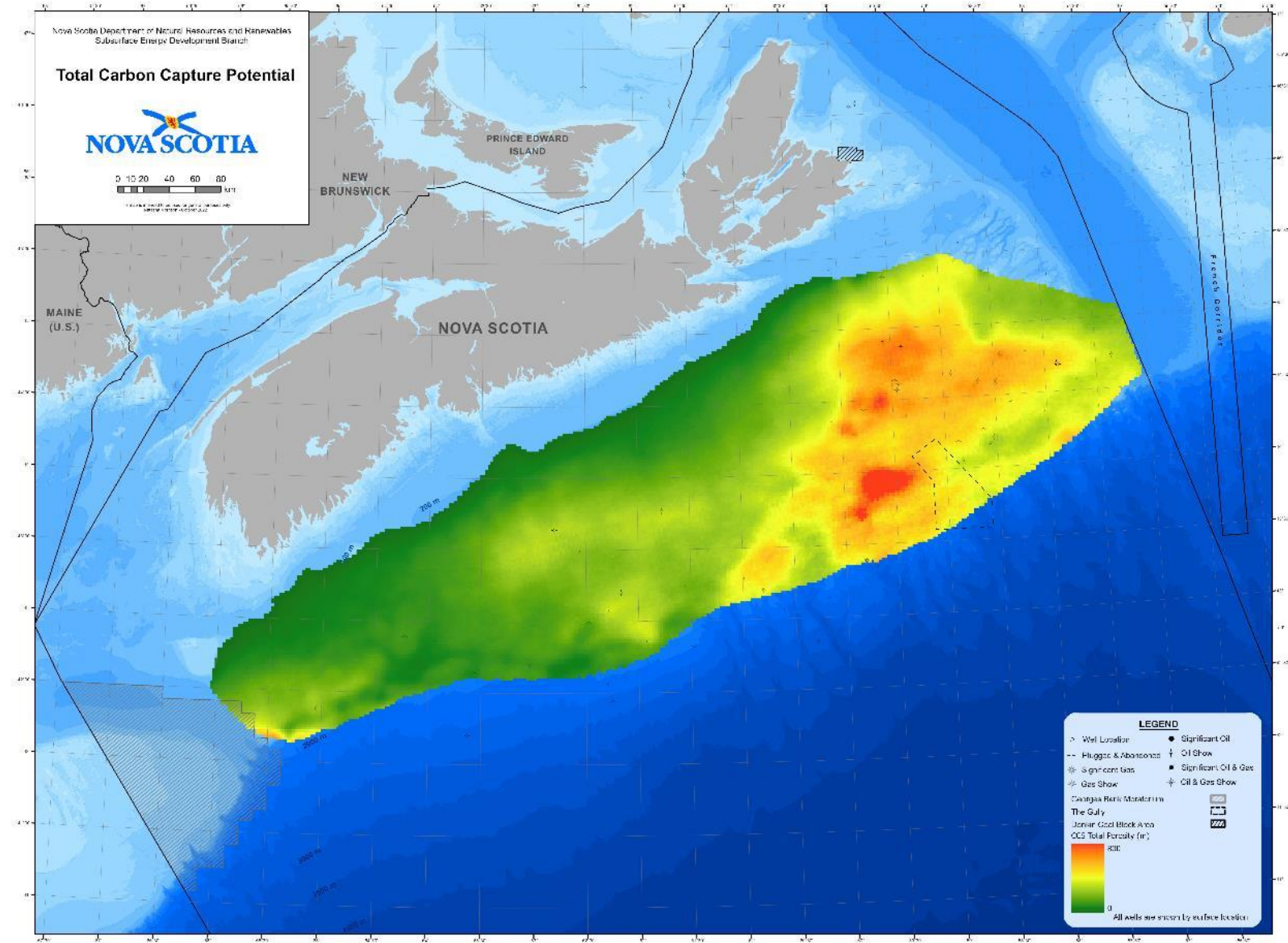
(1) Good Late Cretaceous / Cenozoic top seal;
sub-regional internal seals within the clastics
(containment)

(2) High NTG & PHI-K (suitable for storage &
injectivity) in Sable Island Delta & margin of
Abenaki Bank

(3) No requirement for conventional hydrocarbon
trapping – mainly residual trapping (drainage –
imbibition)

(4) Storage efficiencies in deep saline aquifers are
in the 1%-10% range (analogues and models)

(5) Estimated storage volumes & carbon pricing
indicate Profitable commercialization



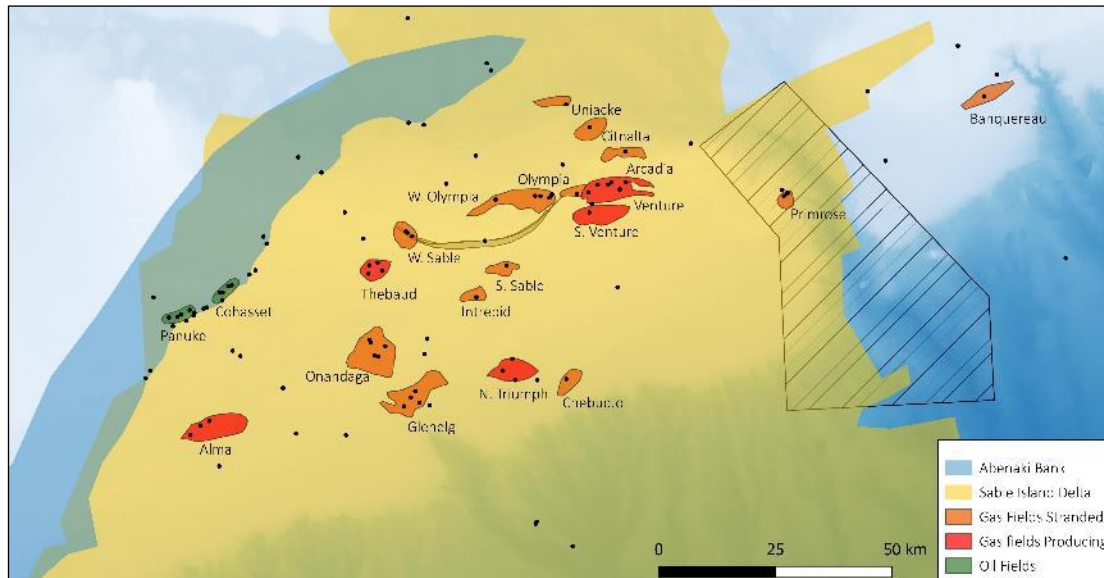
Energy Transition Potential - CCS

Depleted Fields Storage

- Cumulative gas production
- Formation Volume Factors
- Range of densities and Storage Efficiencies

Stranded Fields Storage

- P50 CNSOPB resources
- Formation Volume Factors
- Range of densities and Storage Efficiencies



Depleted fields	CNSOPB published cumulative production		Estimated weighted FVF (Estimated from Dev. Plans)	CO2 Storage Density=0.7 E= 75%
	BCF / MBO	10 ³ sm ³		
S.Venture	314.6	8,908,194	285.0	16.4
Venture	493.6	13,977,451	350.0	21.0
North Triumph	292.2	8,273,692	300.0	14.5
Alma	516.0	14,612,931	250.0	30.7
Thebaud	501.3	14,194,298	360.0	20.7
Sub-Total	2117.7	59,966,566		103.2
Deep Panuke	147.3	4,170,559	400.0	5.5
CoPan	44.5	7,066,810	0.8	4.6
Total	2264.9	131,170,500		113.4

Stranded Gas Fields (if depleted)	CNSOPB SDL Report (2014) P50 Resources		Estimated weighted FVF (Estimated from report)	CO2 Storage Density=0.7 E= 75%
	BCF	10 ⁹ M ³		
Arcadia	158	4.5	400	5.9
Banquereau	170	4.8	280	9.0
Chebucto	66	1.9	275	3.6
Citnalta	172	4.9	290	8.8
Glenelg	508	14.4	270	28.0
Intrepid	54	1.5	260	3.1
Olympia	143	4.1	350	6.1
Onondaga	304	8.6	250	18.1
Primrose	127	3.6	160	11.8
South Sable	8	0.2	265	0.4
Uniacke	20	0.6	405	0.7
West Olympia	30	0.8	330	1.4
West Sable	93	2.6	170	8.1
West Venture C-62	31	0.9	375	1.2
West Venture N-91	68	1.9	385	2.6
Total	1952.0	55.3		108.8

Energy Transition Potential - CCS

Excellent database for offshore subsurface geology and engineering

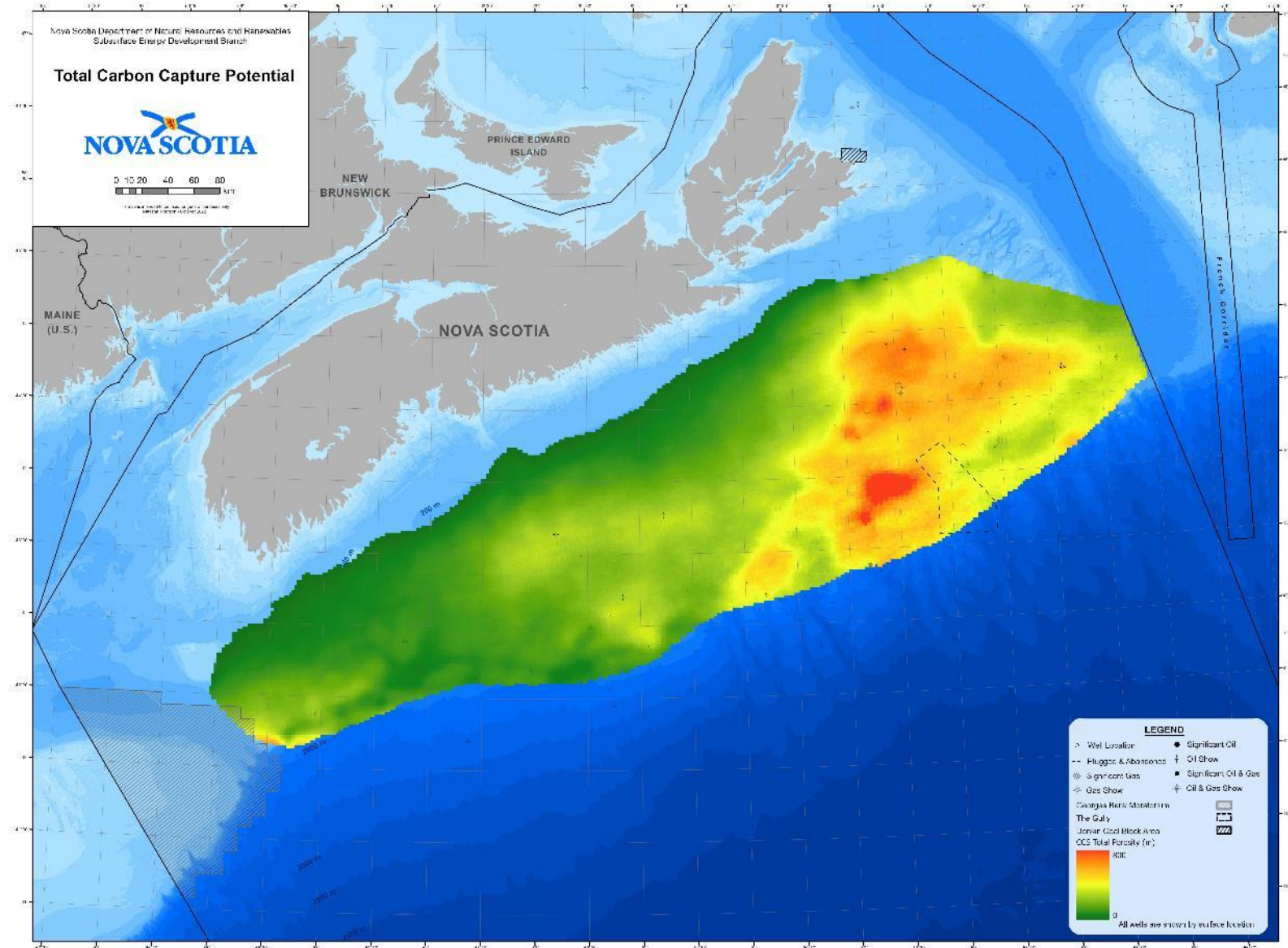
Range of storage volumes 15 – 154 – 618 GtCO₂ in the ideal deep Saline Aquifers

Depleted (8) and Stranded (15) Fields:
113 & 108 GtCO₂

Canada's Emissions are 670 MtCO₂ / year:
Nova Scotia 14 MtCO₂ / year
New Brunswick 12 MtCO₂ / year
Quebec 76 MtCO₂ / year
Ontario 149 MtCO₂ / year



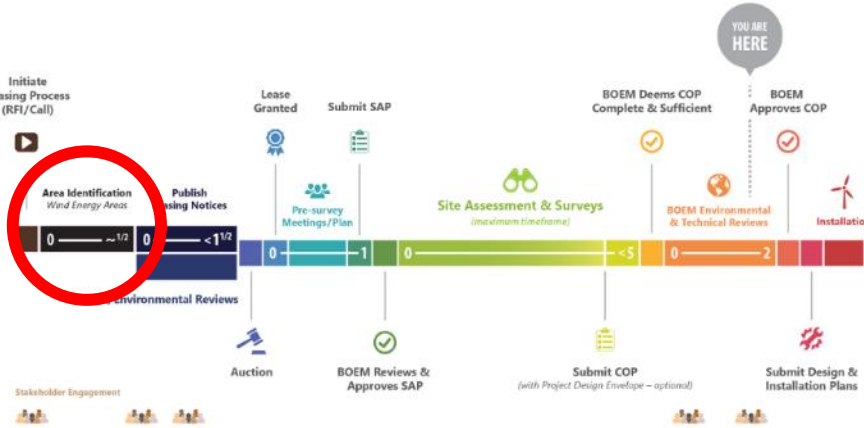
251 MtCO₂ = 613 years
of unreduced permeant
storage available



Energy Transition Potential – Offshore Wind

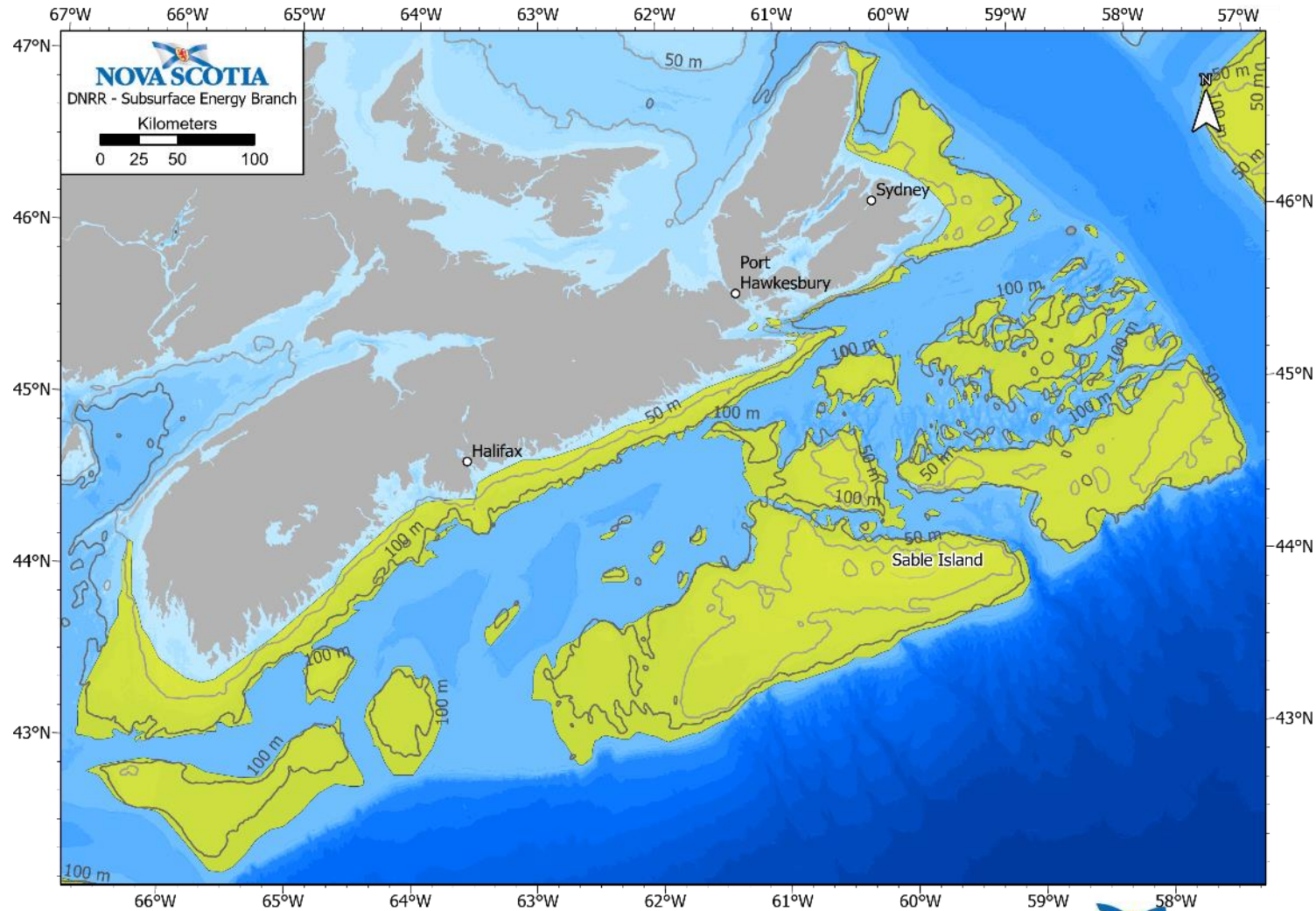
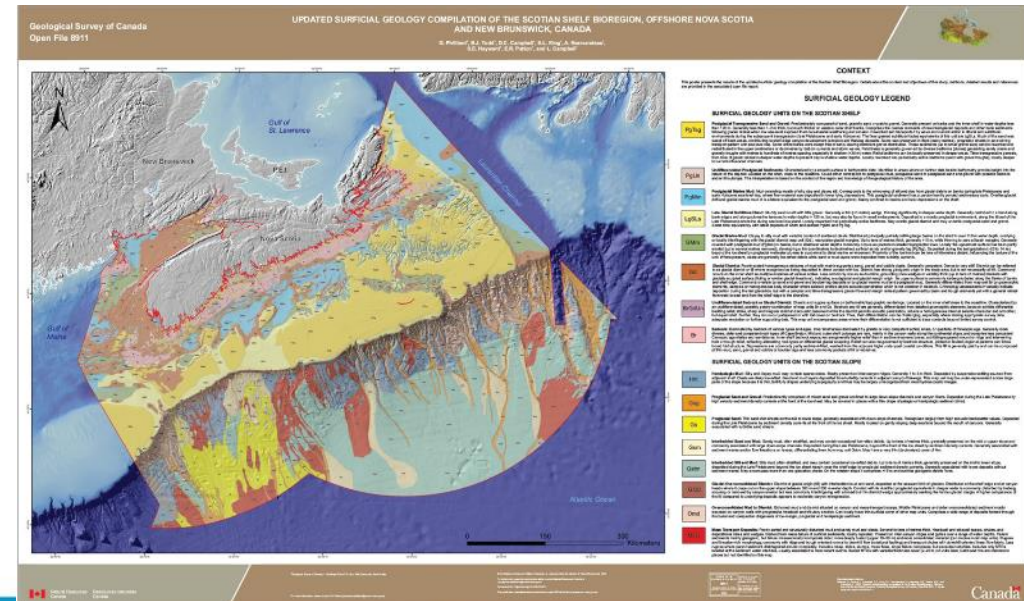
The Renewable Energy Process: Leasing to Operations

BOEM, 2022



Areas of Interest

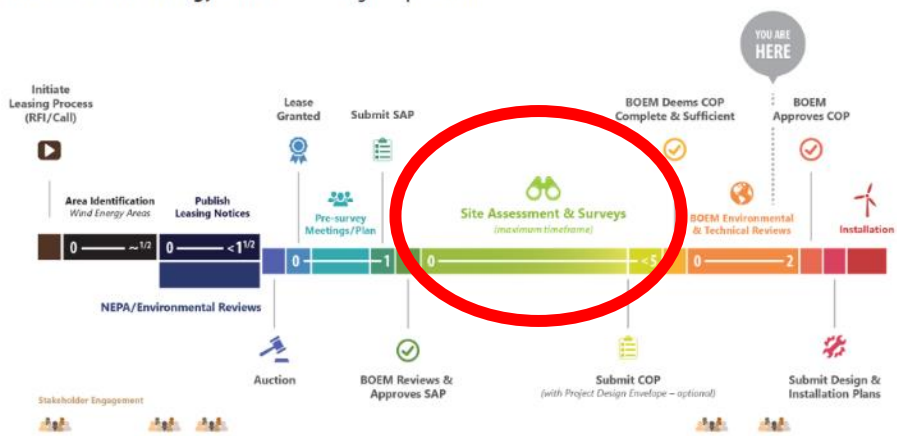
- 50-100 meter “Fairways” of sands and gravel



Energy Transition Potential – Offshore Wind

The Renewable Energy Process: Leasing to Operations

BOEM, 2022

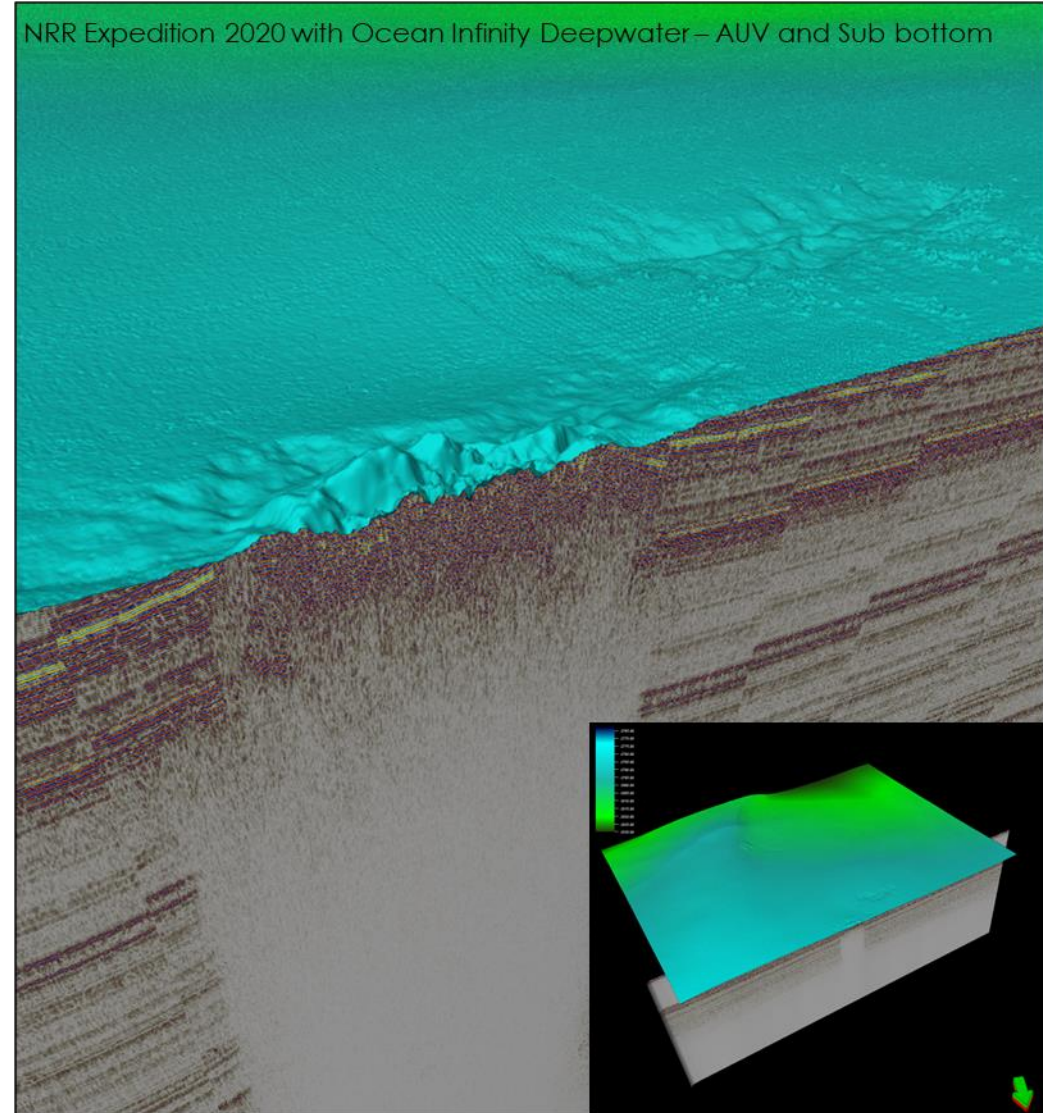
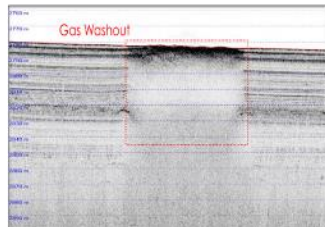
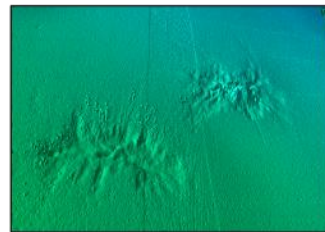
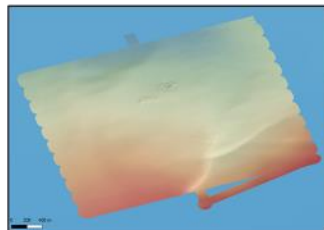
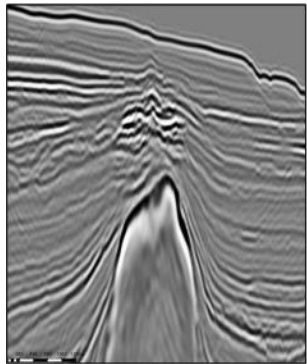


Subsurface Understanding

Mapping of Fields and Transmission Corridors

Identification of Hazards

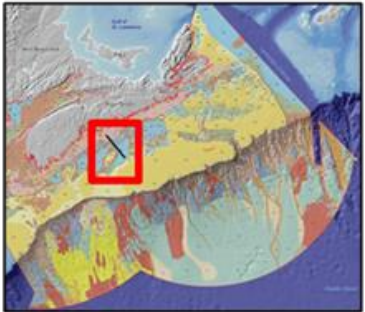
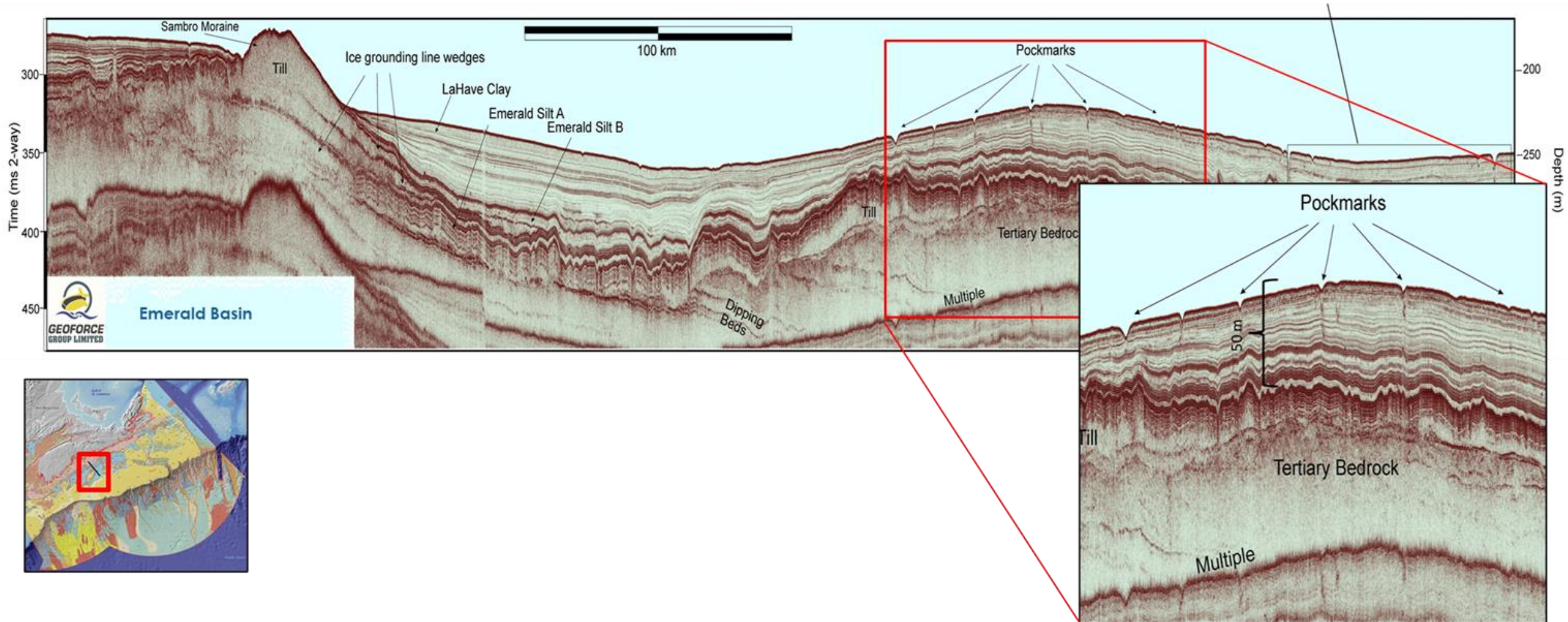
Geotechnical Evaluation



Energy Transition Potential – Offshore Wind

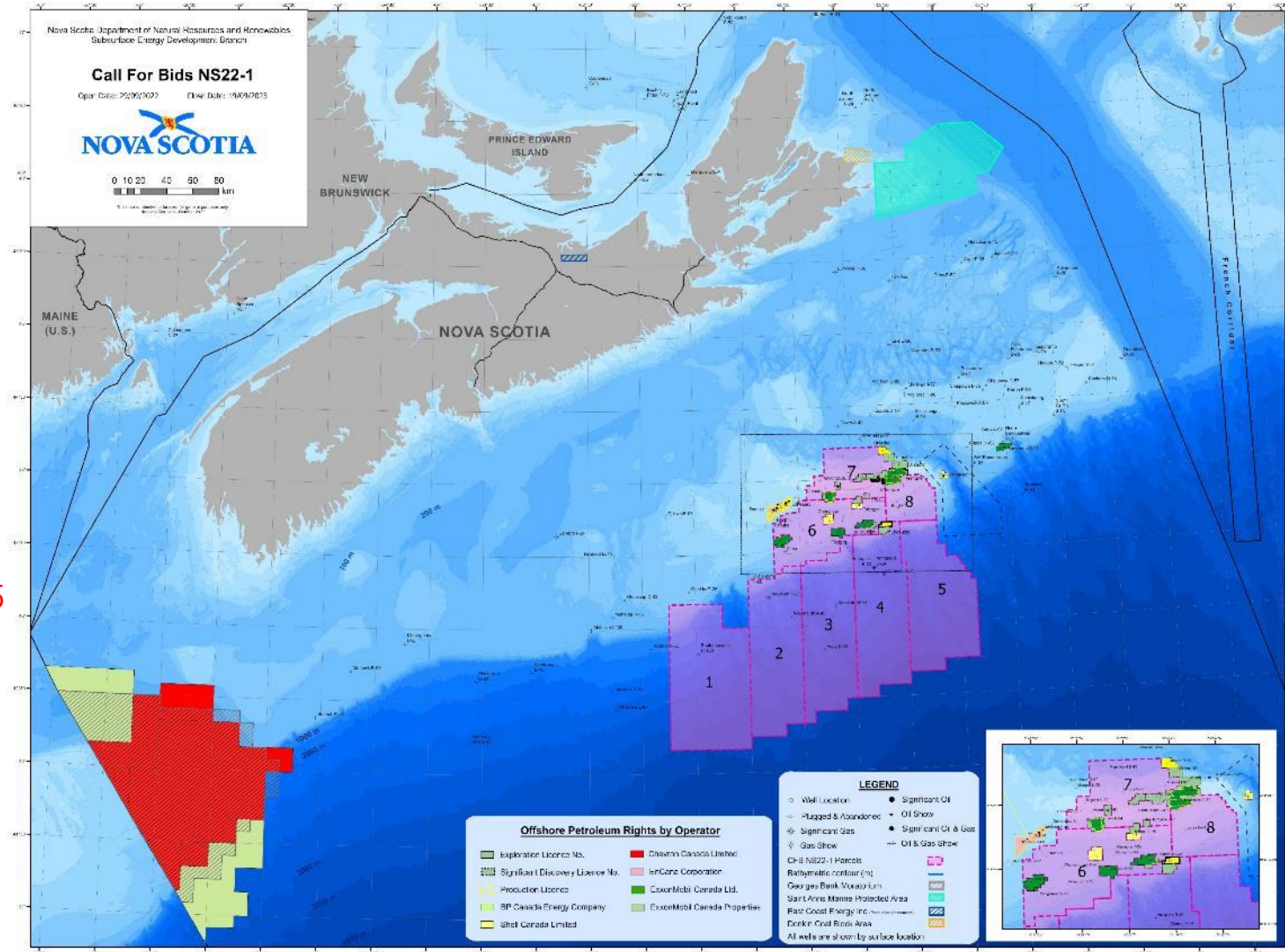
Shallow Geophysics for Hazards

From Mosher, Standen and Campbell, NRCan, OpenFile 8497



Closing Reminders

- CFB NS22-1 Excellent Acreage & Tenure terms
Closes September 19, 2023
- Integration project and updating 2011 PFA research finalized **August 2023**
- Leads/Prospects Identified – Virtual Data Room available
- Diversity of Energy Options – Critical for Success
 - Offshore Petroleum **NG & Oil**
 - Offshore Wind **1st Call for Bids Estimated for 2025**
 - CCUS Offshore hub off Nova Scotia can deliver negative emissions for NS and opportunity for the future.
 - Hydrogen Development



Research Partners

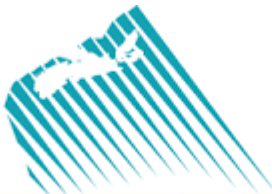


North Africa Research Group

www.narg.org.uk



CNSOPB



CANADA-NOVA SCOTIA
OFFSHORE PETROLEUM BOARD

BeicipFranlab



Thank You!

Please visit our booth #450 to discuss opportunities!

Nova Scotia Department of Natural Resources and Renewables

NOVA SCOTIA CANADA

Offshore Opportunity

Scotian Basin Integration Atlas

- Regional Assessment by Stage Complete
- Detailed Technical Review and Technical Discussion and Addressed
- Approved for 2022-2023, 2024 and 2025

Sequence Strategy to Object-based Depositional Environment Mapping

- Identified sequence stratigraphic units
- Identified stratigraphic units
- Sequence stratigraphic analysis to help identify production risk and production potential
- Identified sequence stratigraphic units

Top 10 Evaluated Leads

A subset of 10 leads were selected for more detailed technical assessment. Sequence leads were identified and assessed on the basis of: estimating a volume for the sequence stage (based on efficiency and timing of migration), log features and well logs and seismic processing.

Discover Nova Scotia's Energy Opportunities

A. Shelfline

100% - 100% (100%)
100% - 100% (100%)
100% - 100% (100%)

Lead	Volume	Depth	Pressure	Temperature
1	100	100	100	100
2	100	100	100	100
3	100	100	100	100
4	100	100	100	100
5	100	100	100	100
6	100	100	100	100
7	100	100	100	100
8	100	100	100	100
9	100	100	100	100
10	100	100	100	100

B. Flankline

100% - 100% (100%)
100% - 100% (100%)
100% - 100% (100%)

Lead	Volume	Depth	Pressure	Temperature
1	100	100	100	100
2	100	100	100	100
3	100	100	100	100
4	100	100	100	100
5	100	100	100	100
6	100	100	100	100
7	100	100	100	100
8	100	100	100	100
9	100	100	100	100
10	100	100	100	100

C. Proximal

100% - 100% (100%)
100% - 100% (100%)
100% - 100% (100%)

Lead	Volume	Depth	Pressure	Temperature
1	100	100	100	100
2	100	100	100	100
3	100	100	100	100
4	100	100	100	100
5	100	100	100	100
6	100	100	100	100
7	100	100	100	100
8	100	100	100	100
9	100	100	100	100
10	100	100	100	100

Call for Bids NS22-1

Area: 100% - 100% (100%)
Date: 100% - 100% (100%)
Status: 100% - 100% (100%)

1. 100% - 100% (100%)
2. 100% - 100% (100%)
3. 100% - 100% (100%)
4. 100% - 100% (100%)
5. 100% - 100% (100%)
6. 100% - 100% (100%)
7. 100% - 100% (100%)
8. 100% - 100% (100%)
9. 100% - 100% (100%)
10. 100% - 100% (100%)

Canada-Nova Scotia Offshore Petroleum Board

Land Tenure Terms and Conditions

100% - 100% (100%)
100% - 100% (100%)
100% - 100% (100%)

Item	Value
100% - 100% (100%)	100%
100% - 100% (100%)	100%
100% - 100% (100%)	100%
100% - 100% (100%)	100%
100% - 100% (100%)	100%
100% - 100% (100%)	100%
100% - 100% (100%)	100%
100% - 100% (100%)	100%
100% - 100% (100%)	100%
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CCUS Potential

100% - 100% (100%)
100% - 100% (100%)
100% - 100% (100%)

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Onshore Research

Nova Scotia Onshore Energy Atlas

100% - 100% (100%)
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