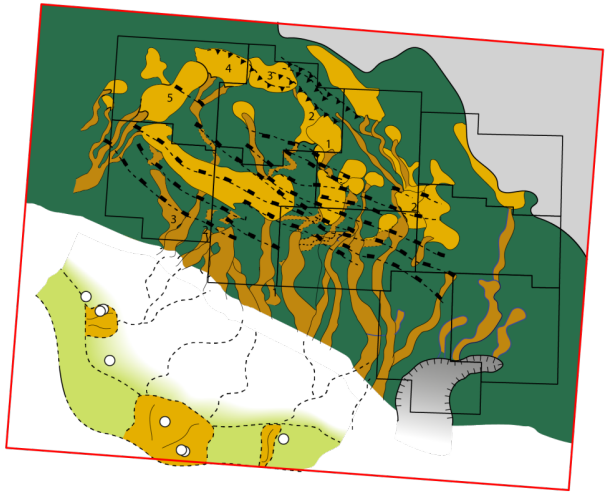
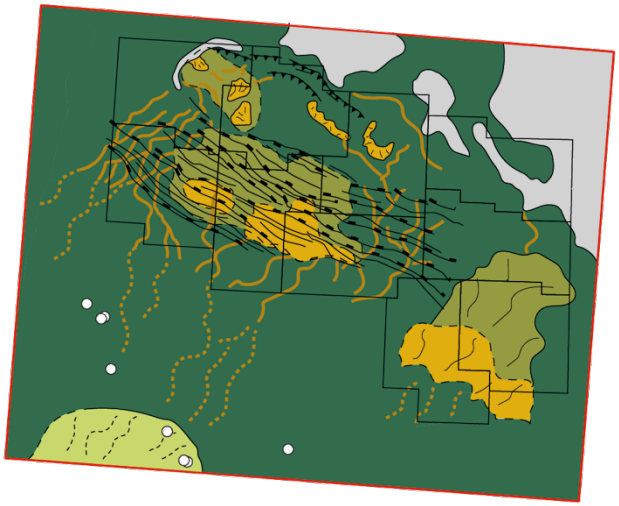
Gross Depositional Environment maps

Cenozoic (gravity system)

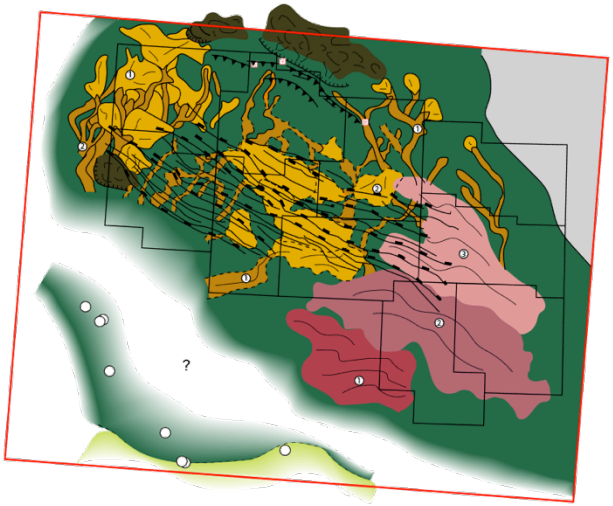
Lower Eocene



Upper Eocene



Oligocene



- Paleo Churchill river trapping turbiditic sand in the listric fault system
- Those fan complexes are remodeled by the onset of deep water bottom currents from the Labrador Sea

Alluvial plain
Lake
Alluvial fan
Transitional deltaic
Transitional to neritic
Slope shaly deposit
Basinal shaly deposit

No deposit/bypass/erosion
No data / low resolution
Structural high
Volcano-clastics

Alluvial fan
Silty lobe
Sandy lobe
Erosive channel/canyon
Sedimentary pathway/channel
Hypothetical sedimentary pathway
Slump / debris flow

Future oceanic crust boundary
Transform fault zone
Normal faults
Reverse faults
Well
Flow direction

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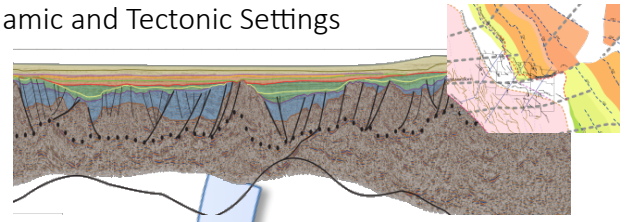
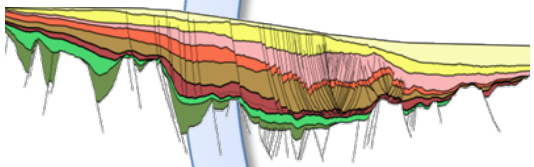
Beicip-Franlab and Nalcor Workflow

Geodynamic and Tectonic Settings

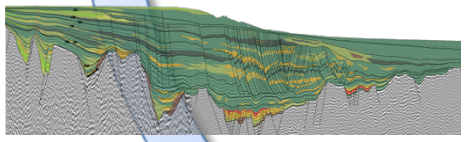
Fault and horizon picking



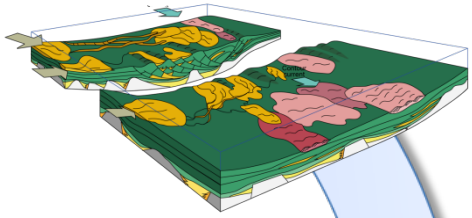
Structural restoration



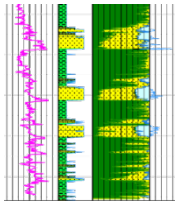
Seismic Stratigraphy

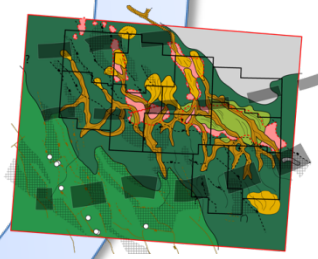


Sedimentology and Stratigraphy

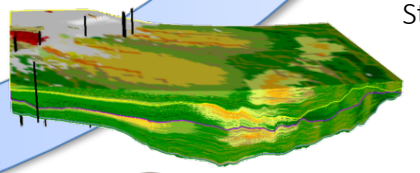


Petrophysical Evaluation





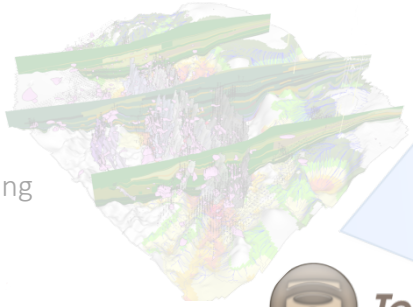
Gross Depositional Environment mapping



Stratigraphic/Lithological 3D Modelling

Play definition

DionisosFlow™



Petroleum system modelling Resources Assessment

TemisFlow™

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Forward stratigraphic modelling

DionisosFlow™

Seismic analysis

Well data

Maps
paleo environments
thickness, lithofacies…

Regional Sequence
+ facies stratigraphic
conceptual model

Environmental parameters

- Paleobathymetry + thickness maps
- Subsidence maps
- Sediment supply
- Transport parameters Diffusive equation

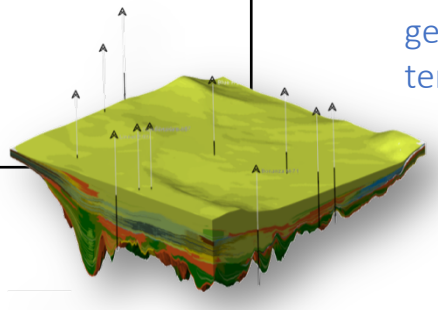
INVERSION = error loops calibration by setting environmental parameters (sediment supply, accommodation maps, water parameters, …)

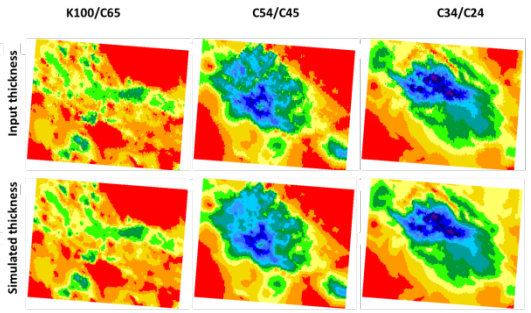
RESULT: high resolution 3D stratigraphic model

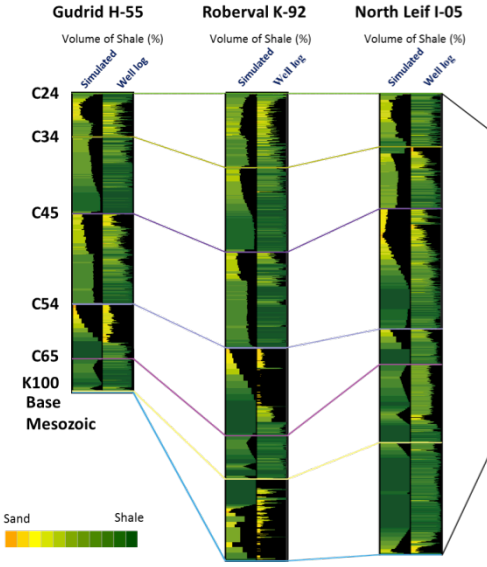
2x2 km grid cell
570 layers
0.1 and 0.5 Myr steps

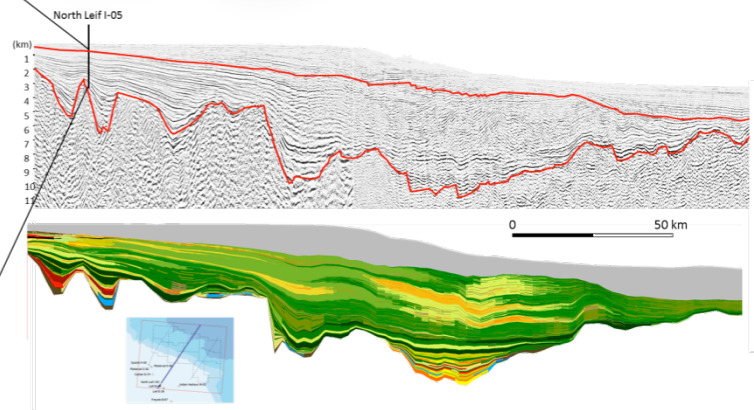
Calibration:

- Thickness
- Markers & Vsh at 6 wells
- Seismic stratigraphy, geobodies, stratal terminations









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From sedimento. / strati. to modelling

North Leif I-05

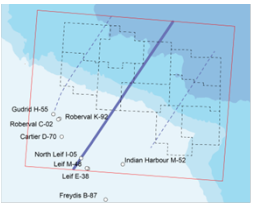
SW

Initial Seismic and Stratigraphic Interpretation

(Seismic interpretation & GDE mapping)

NE

- Continental shale
- Proximal sandstone
- Distal sandstone
- Siltstone
- Shale
- Tight shale
- Alluvial Fan / MTD
- Volcanic/Volcaniclastic



North Leif I-05

Neogene not simulated in DionisosFlow™

3D Forward Stratigraphic Model

(sand proportion 570 layers; 2x2 km grid)

% Sand

North Leif I-05

3D Forward Stratigraphic Model Facies Distribution

(20 sedimentary facies 570 layers; 2x2 km grid)

- Tight shale
- Shale
- Shaly turbidite
- Silty turbidite
- Silty lobe
- Silty slope
- Sandy turbidite
- Sandy lobe
- Sandy slope fan
- Sandy prodelta
- Silty outer platform
- Shaly platform
- Shoreface sand
- Alluvial plain channel
- Continental sand
- Shaly alluvial plain
- Alluvial fan
- Shaly deep lacustrine
- By-pass
- Pre-rift

0 50 km

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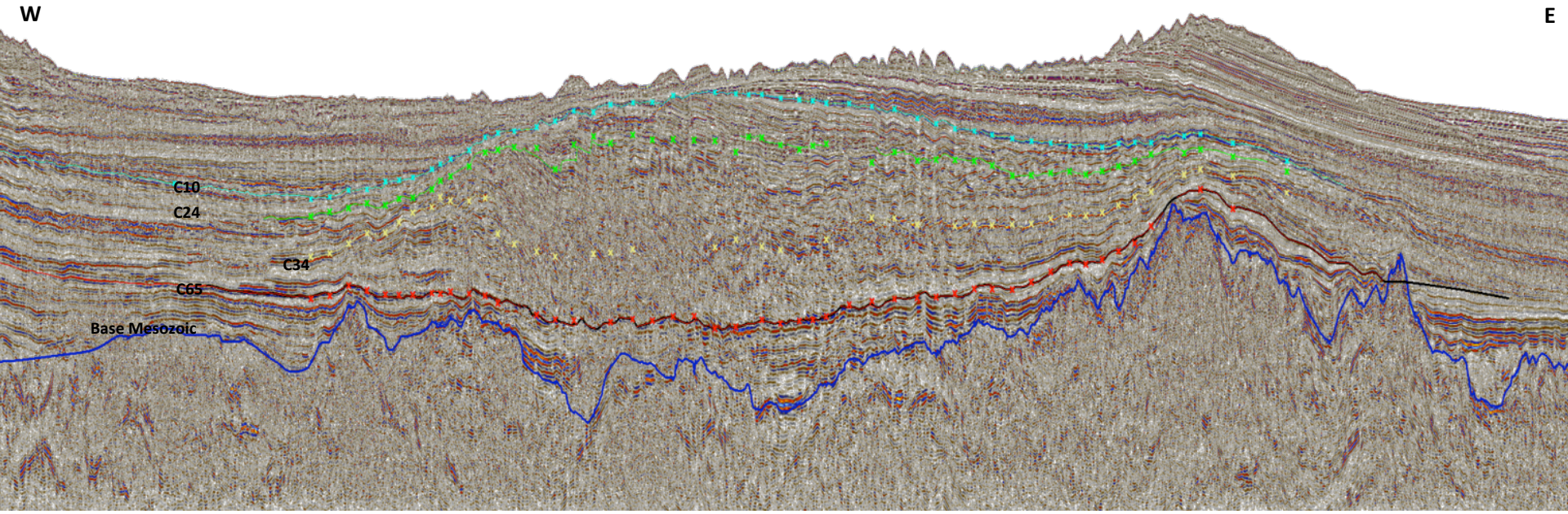
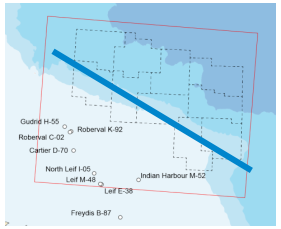
What is the play potential of the area?



Seismic data from Nalcor invested TGS/PGS multiclient 2D broadband long offset seismic program offshore Newfoundland (2012-2017)



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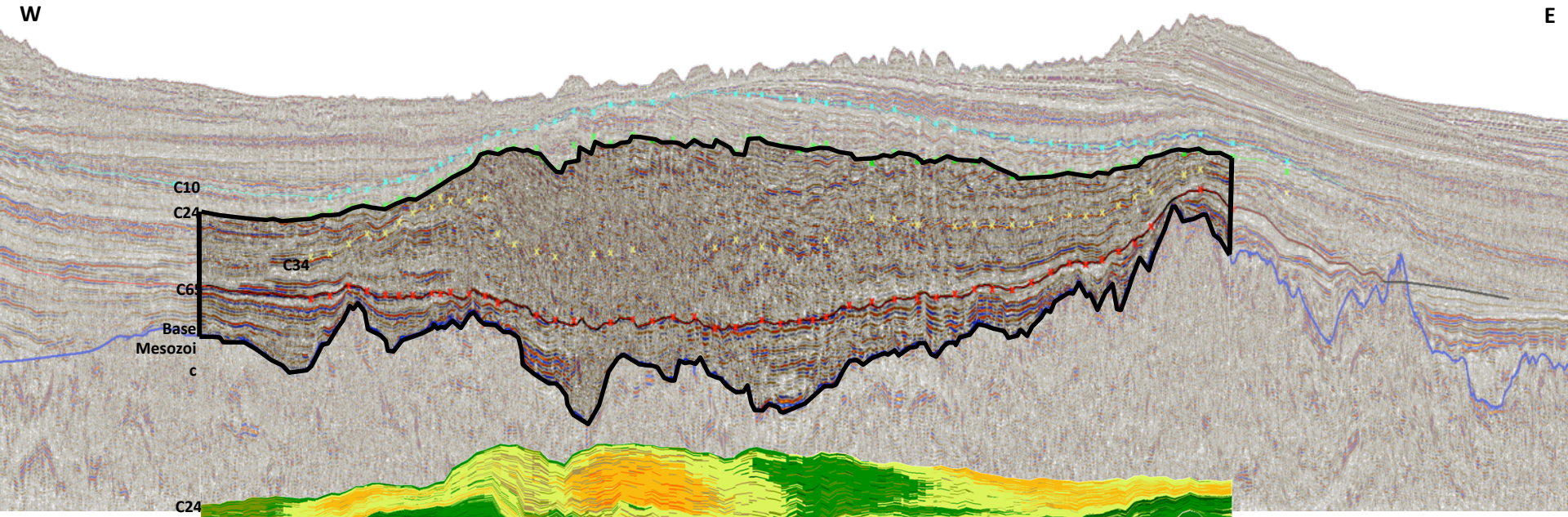
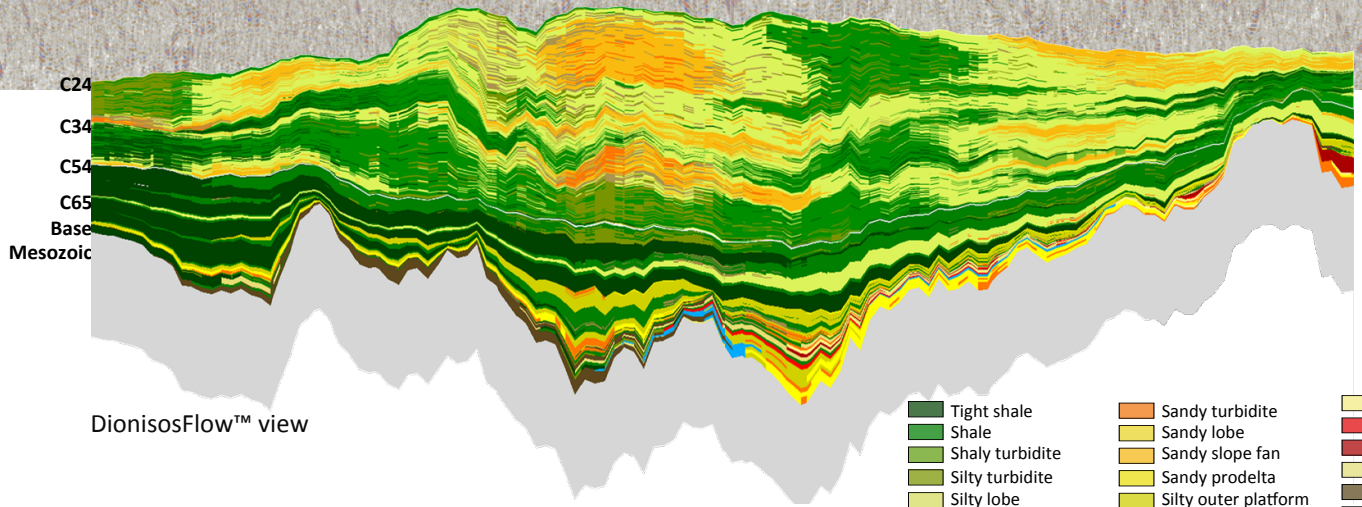
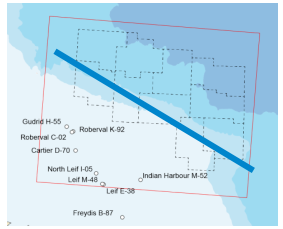
What is the play potential of the area?

A comprehensive, calibrated forward stratigraphic modelling approach





DionisosFlow™ view



- Tight shale
- Shale
- Shaly turbidite
- Silty turbidite
- Silty lobe
- Silty slope
- Sandy turbidite
- Sandy lobe
- Sandy slope fan
- Sandy prodelta
- Silty outer platform
- Shaly platform
- Shoreface sand
- Alluvial plain channel
- Continental sand
- Shaly alluvial plain
- Alluvial fan
- Shaly deep lacustrine
- By-pass

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Model results: Lithofacies Maps

- **Gravity gliding -** Basin floor sandy channels and turbidites with coarser material trapped in the gravity gliding system (accommodation)
- **Deltaic passive margin -** Basin floor sandy channels and turbidites, fed by the paleo-Churchill river
- **Post-Rift -** Basin floors silty distal channels
- Late syn-rift - Prodelta and channels aggrading towards the north

Lithofacies Discrimination

- Tight shale
- Shale
- Shaly turbidite
- Silty turbidite
- Silty lobe
- Silty slope
- Sandy turbidite
- Sandy lobe
- Sandy slope fan
- Sandy prodelta
- Silty outer platform
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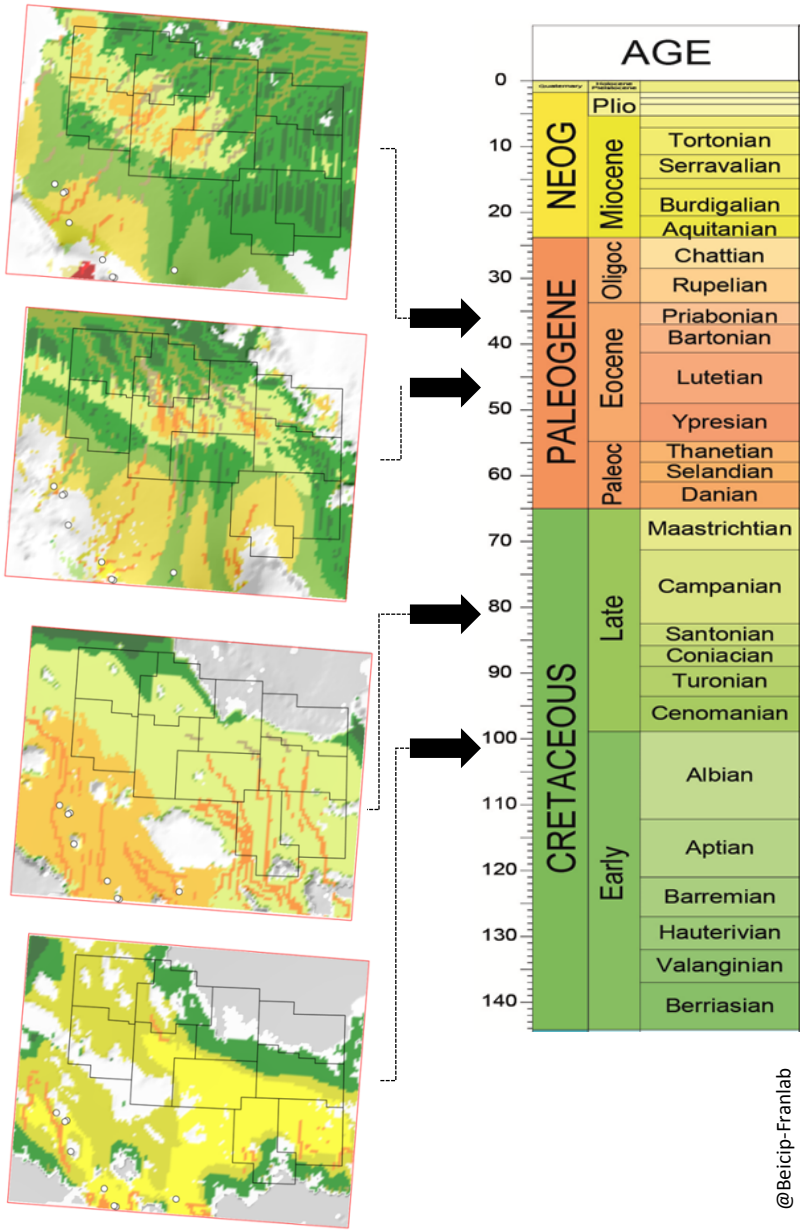
- Shaly deep lacustrine
- By-pass
- Pre-rift



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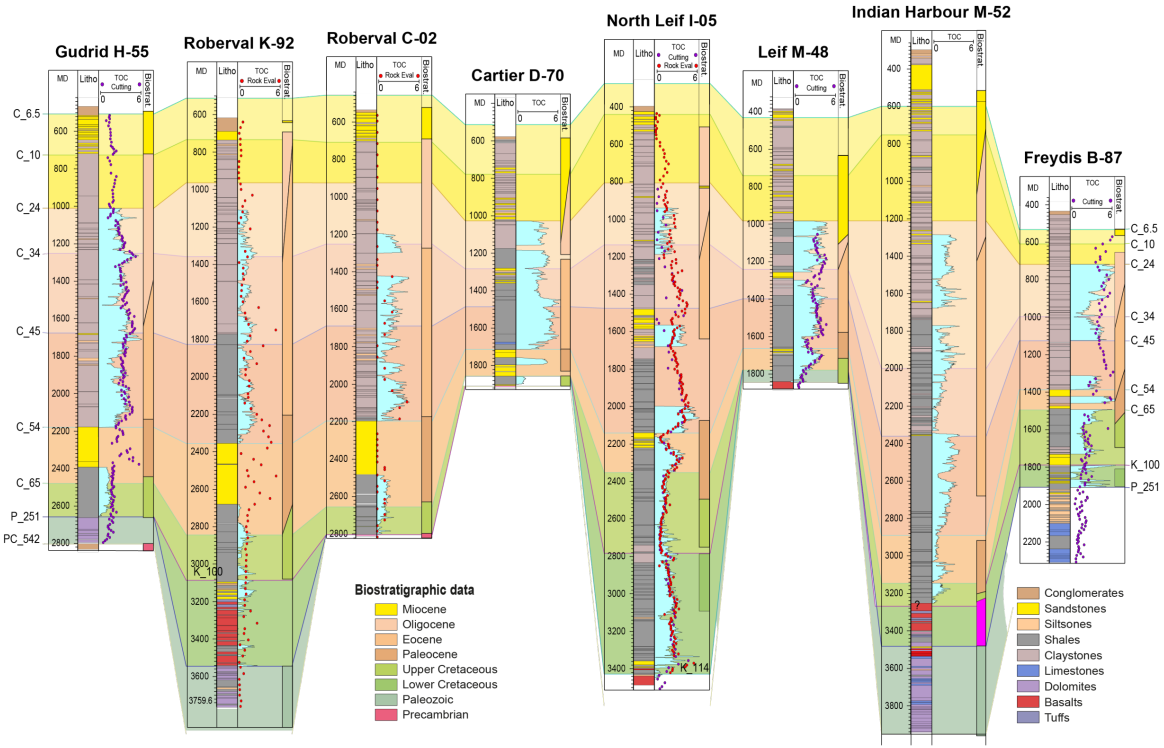
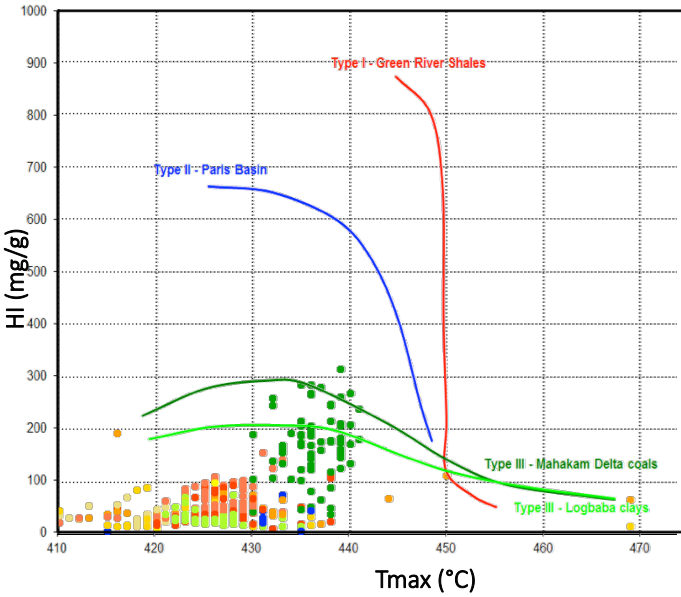
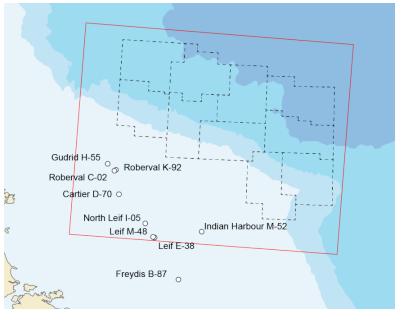
Source rock definition at well





RockEval data from:
- Roberval C-02
- Roberval K-92
- North Leif I-05

- Late Miocene
- Early Miocene
- Oligocene
- Late Eocene
- Early Eocene
- Paleocene
- Upper Cretaceous
- Lower Cretaceous



- SR samples are scarce in the Tertiary (from the proximal parts of the basin)
  - More potential in distal areas
- SR samples in the Cretaceous are representative of a continental syn-rift infill (type III)
  - But presence of demonstrated marine, type II source rock in North Leif (depocenters)
  - SR of type II / III inferred in distal areas
- Stratigraphic modelling helped to resolve the lateral deposition and condition of these SR

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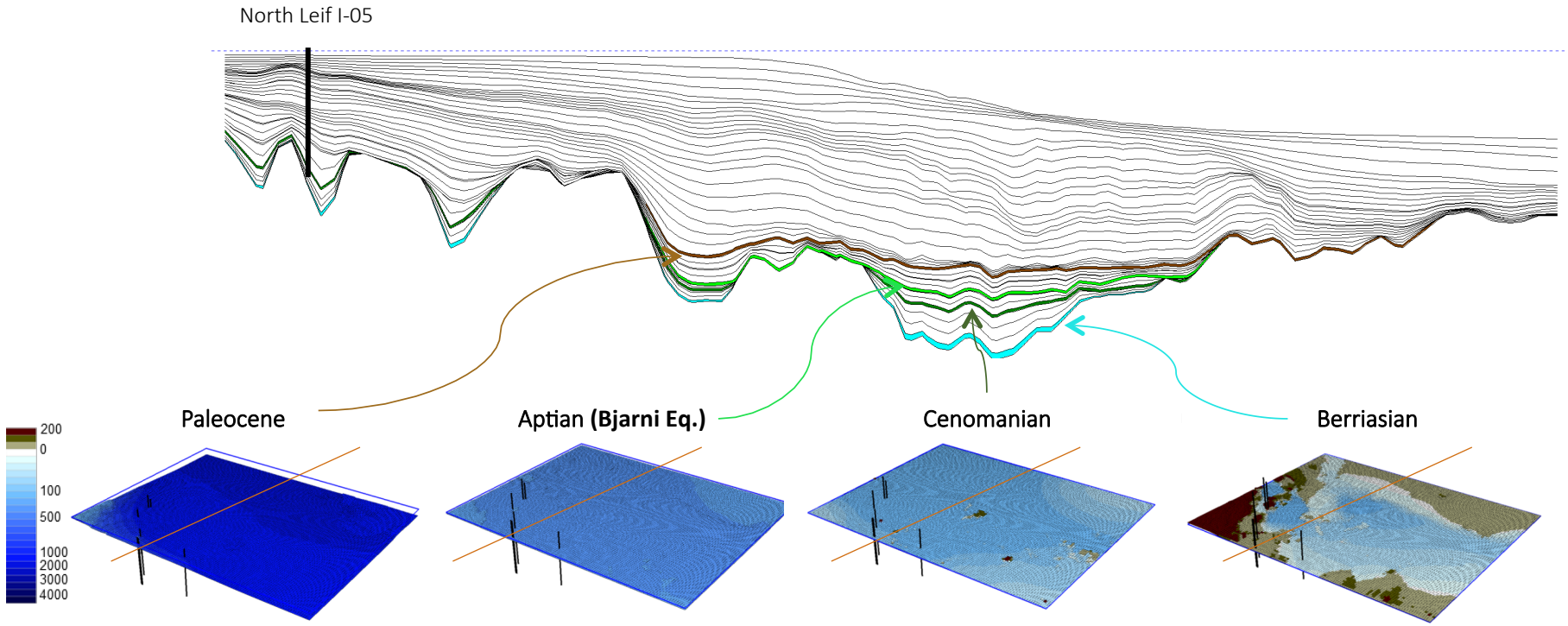
Source rock lateral extension



Paleogeography, flow energy, pelagic deposition

Source Rock	Level of Certainty	Kerogen Type	Distribution	Gross (m)	Net (m)	TOC0 %	HI0 mg/g	SPI* Ton/m²
Paleocene (basin)	*Hypothetical SR*	Org.facies B - Type II / III	Regional marine	50 - 400	100	1.6%	450	**1.8**
Cenomanian (basin)	*Hypothetical SR*	Org.facies B - Type II / III	Regional marine	50 - 500	100	1.9%	450	**2.2**
Aptian (Bjarni Eq.)	*Known SR*	Org.facies B - Type II	Regional marine	50 - 550	100	3.5%	550	**4.3**
Berriasian	*Speculative SR*	Org.facies C - Type I	Local syn-rift pods	50 - 250	100	3.5%	650	**5.6**

** SPI : Source Rock Potential Index (Ton/m²)*

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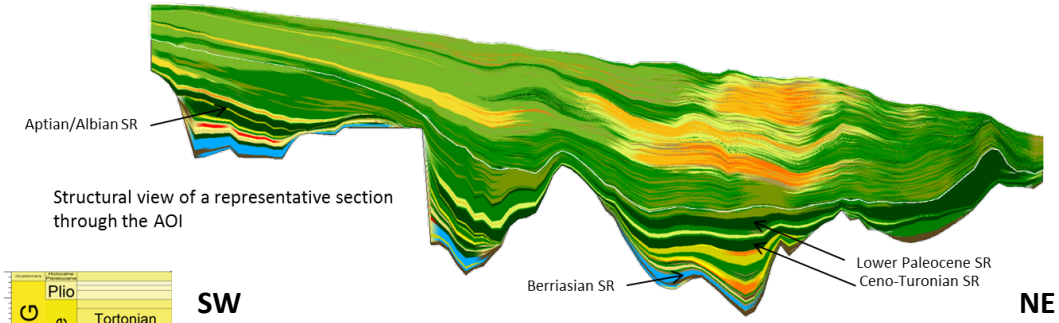
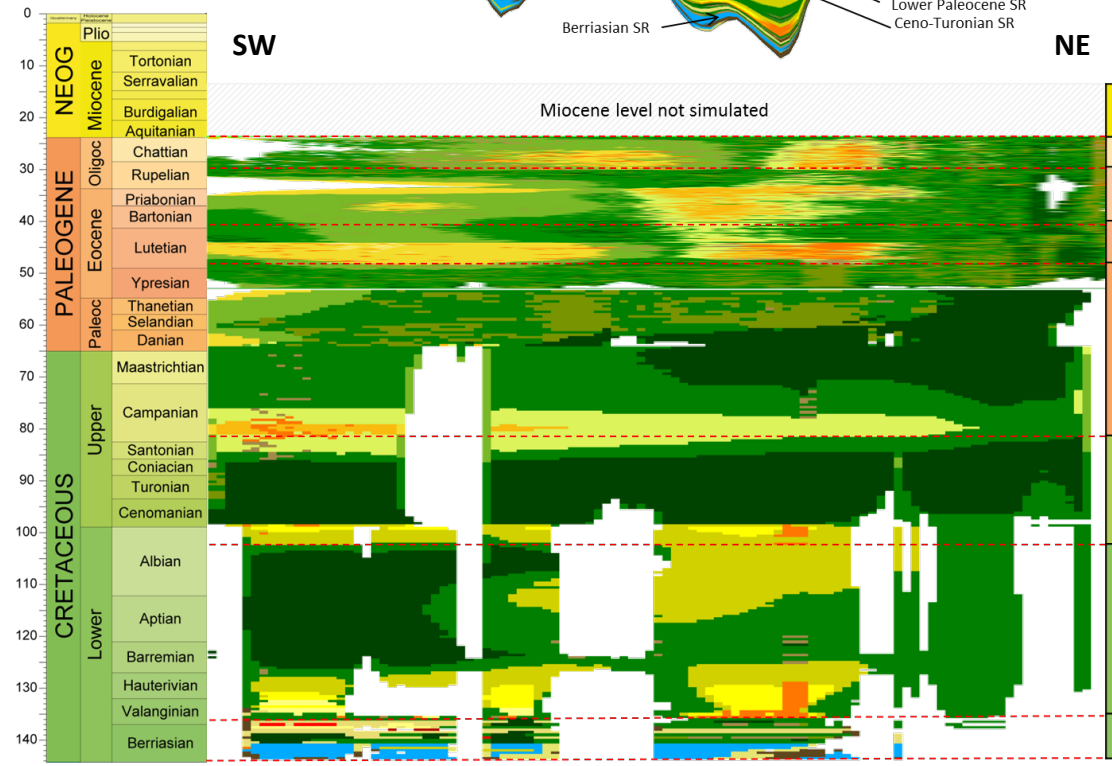
Play definition



Structural view of a representative section through the AOI

8 plays



Cretaceous and Cenozoic Wheeler diagram of the same representative section through the AOI

Plays	Source Rock	Reservoir	Seal
Miocene	Lower and Upper Cretaceous Paleocene and late Eocene	Mokami eq.	Mokami eq.
Oligocene		Mokami eq.	Mokami eq.
Upper Eocene	Lower and Upper Cretaceous Paleocene	UP. Kenamu eq.	Lo. Mokami eq.
Mid Eocene		Lo. Kenamu eq.	Up. Mokami eq.
Upper Senonian / Paleocene		Cartwright eq.	Lo. Kenamu eq.
Albian / Cenomanian / Turonian	Lower and Upper Cretaceous	UP. Bjarni eq.	Markland eq.
Lower Cretaceous	Lower Cretaceous (lacustrine and marine)	Bjarni eq.	Bjarni eq.
Berriasian			

- Tight shale
- Shale
- Shaly turbidite
- Silty turbidite
- Silty lobe
- Silty slope
- Sandy turbidite
- Sandy lobe
- Sandy slope fan
- Sandy prodelta
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- Alluvial plain channel
- Continental sand
- Shaly alluvial plain
- Alluvial fan
- Shaly deep lacustrine
- By-pass

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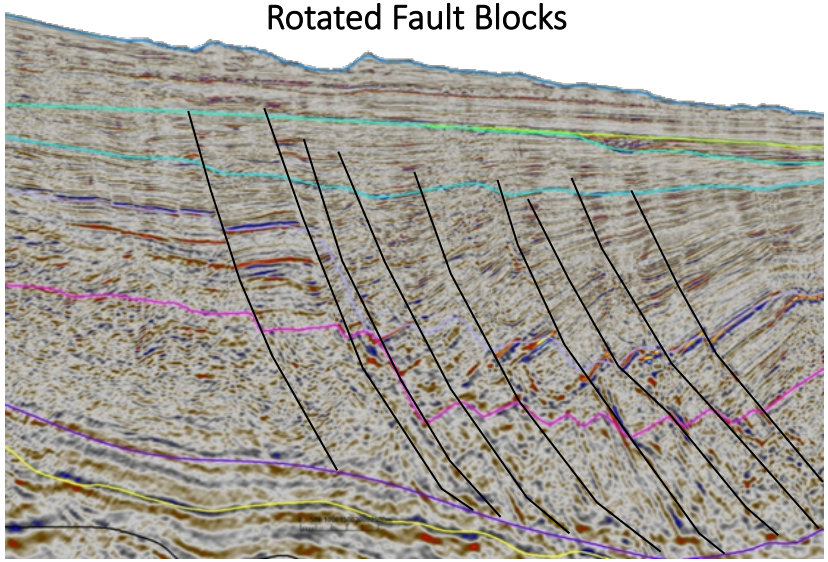
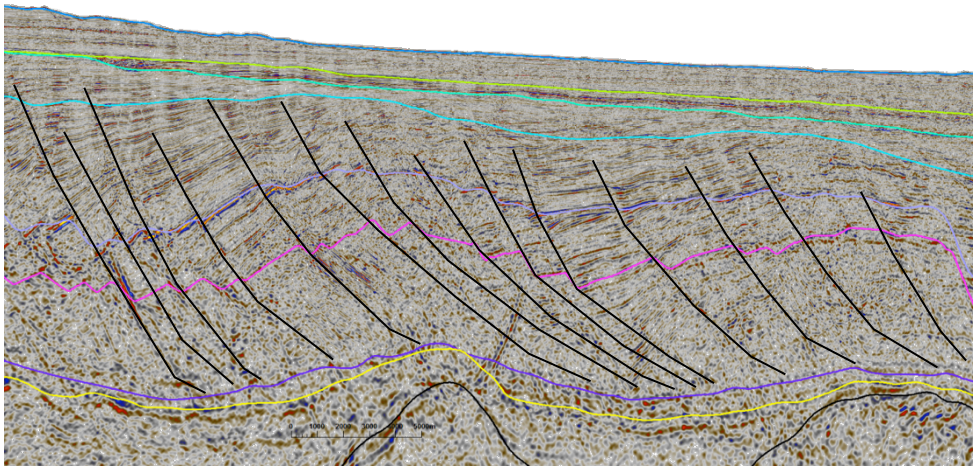
Play & Traps

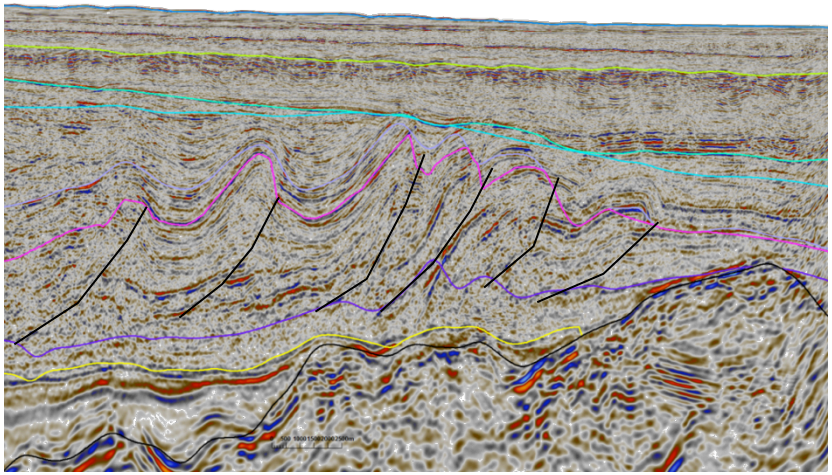
Rotated Fault Blocks



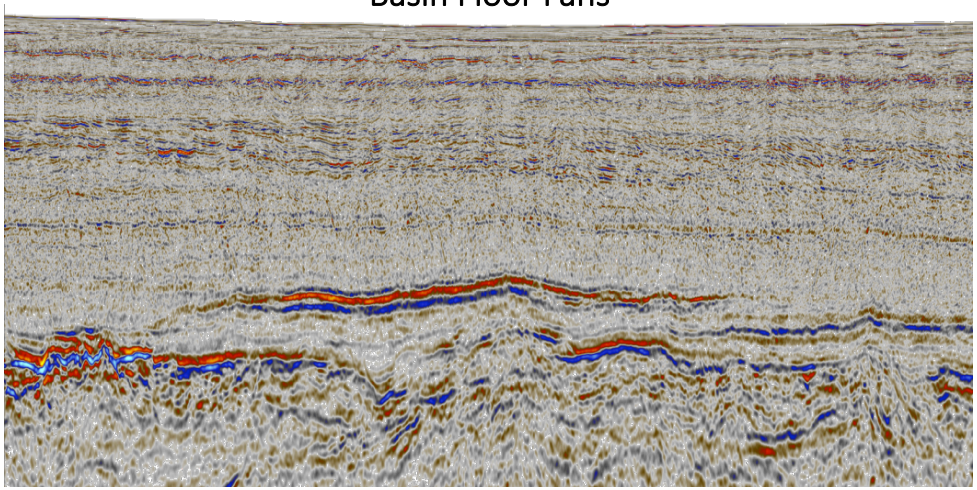
Rollover Anticlines



Toe Thrusts



Basin Floor Fans



Far Angle Stack - Depth

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Conclusions

- Test the prospectivity of the Chidley deep basin through a reassessment of the potential play in the Cretaceous and Tertiary strata
- The workflow used integrates 3D numerical forward stratigraphic modelling
- Results includes:
  - 3D assessment of the prospectivity of the area: Several good potential reservoirs, source rocks and seals have been identified, defining 8 potential Plays
- Next step: Test the petroleum system by using basin modelling

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Thank You

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Newfoundland Labrador

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