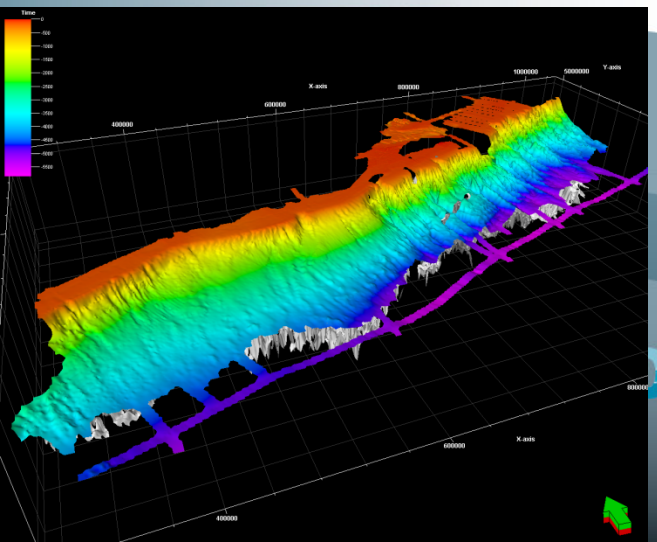
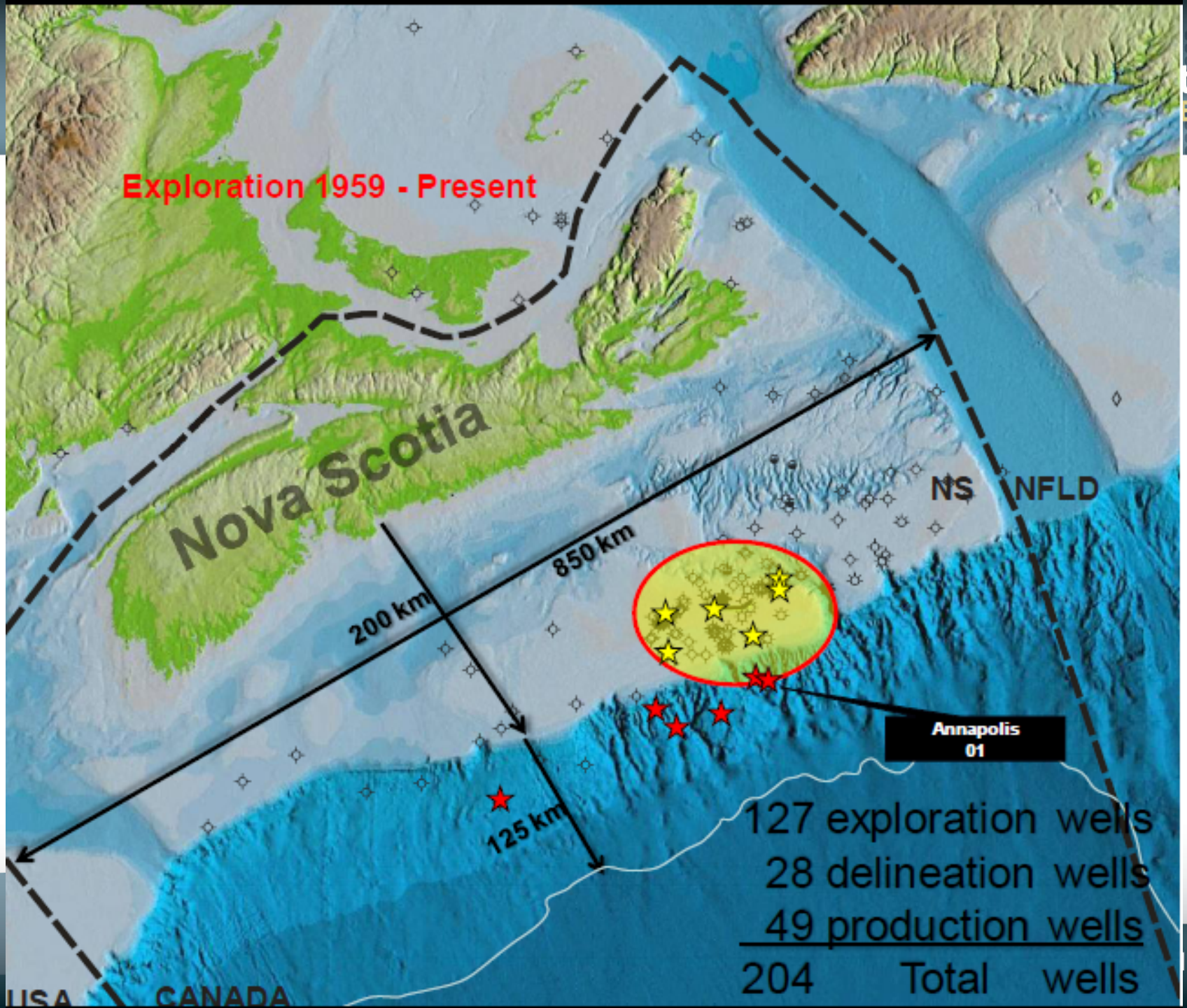
Nova Scotia
OFFSHORE

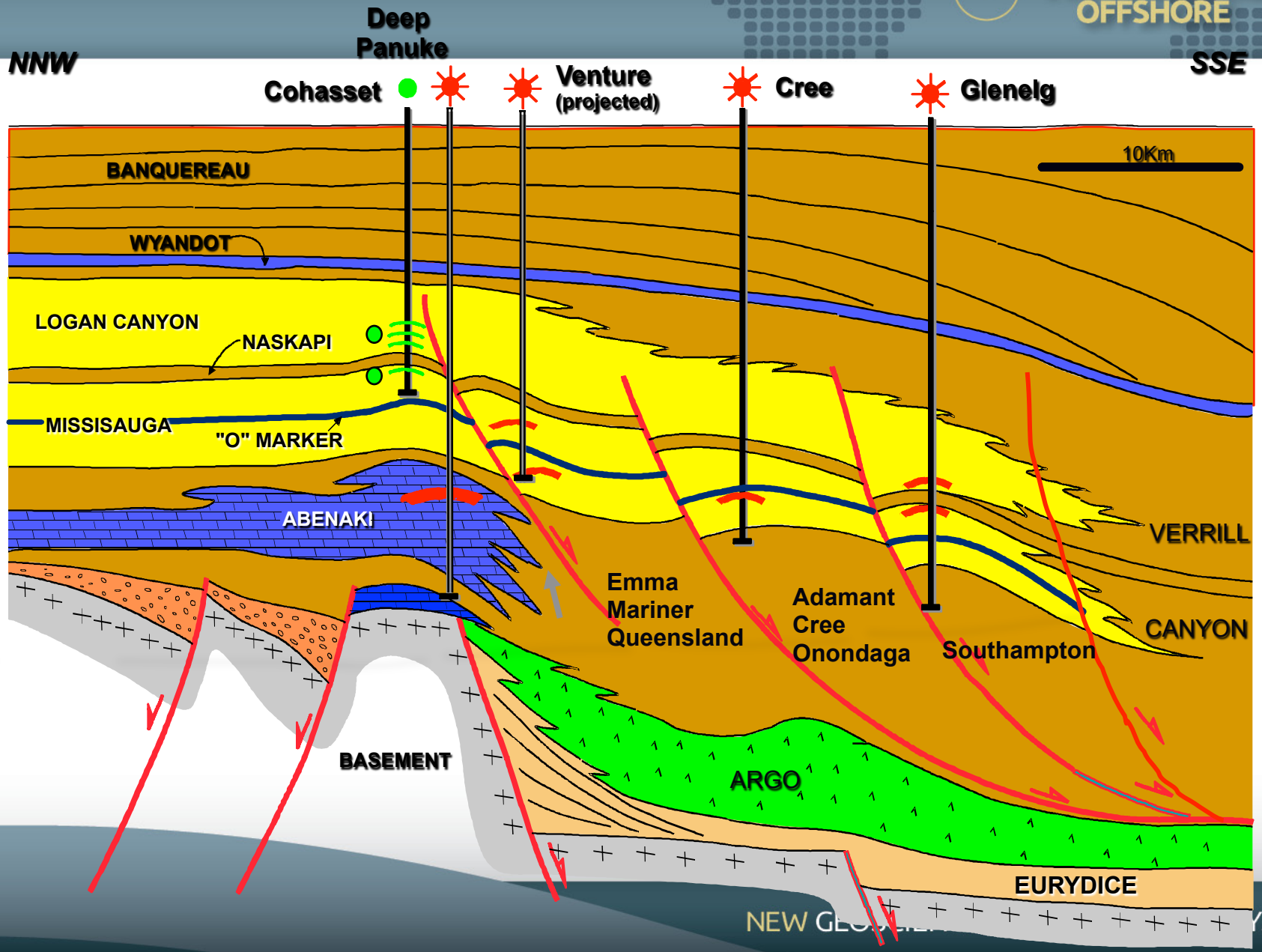
Play Fairway Analysis
Reservoir De-risking Seminar

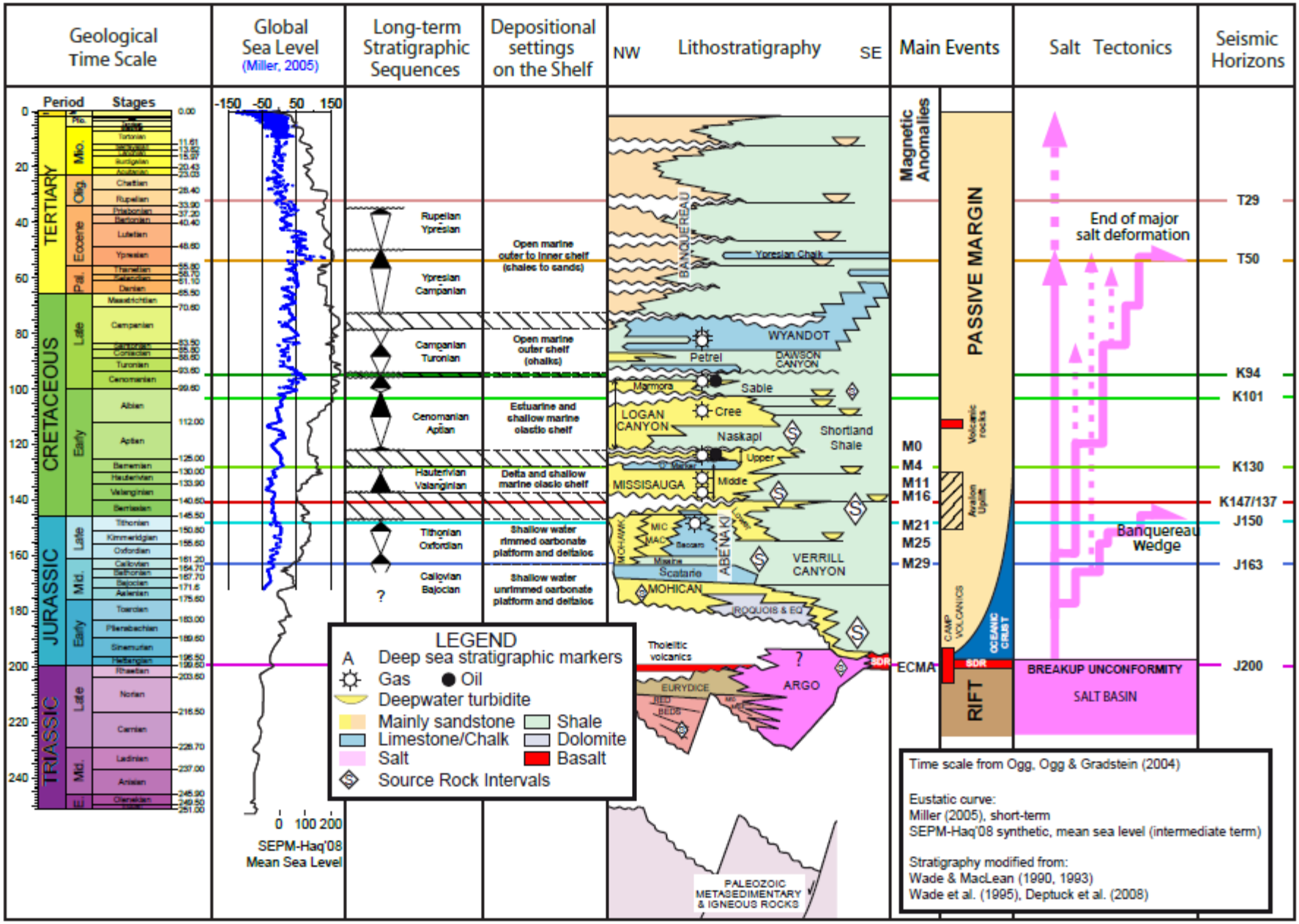


Offshore Energy Technical Research Association

NEW GEOSCIENCE. NEW OPPORTUNITY.


Exploration 1959 - Present
Nova Scotia
NS
NFLD
850 km
200 km
125 km
Annapolis
01
127 exploration wells
28 delineation wells
49 production wells
204 Total wells
USA
CANADA


NNW
SSE
Deep Panuke
Cohasset
Venture (projected)
Cree
Glenelg
10Km
BANQUEREAU
WYANDOT
LOGAN CANYON
NASKAPI
MISSISAUGA
"O" MARKER
ABENAKI
VERRILL
CANYON
Emma
Mariner
Queensland
Adamant
Cree
Onondaga
Southampton
BASEMENT
ARGO
EURYDICE


Geological Time Scale
Period
Stages
TERTIARY
CRETACEOUS
JURASSIC
TRIASSIC
Global Sea Level (Miller, 2005)
-150 -50 50 150
0 100 200
SEPM-Haq'08 Mean Sea Level
Long-term Stratigraphic Sequences
Rupelian Ypresian
Ypresian Campanian
Campanian Turonian
Cenomanian Aptian
Hauterivian Valanginian
Tithonian Oxfordian
Callovian Bajocian
Depositional settings on the Shelf
Open marine outer to inner shelf (shales to sands)
Open marine outer shelf (chalks)
Estuarine and shallow marine clastic shelf
Delta and shallow marine clastic shelf
Shallow water rimmed carbonate platform and deltaics
Shallow water unrimmed carbonate platform and deltaics
NW
Lithostratigraphy
SE
BANQUEREAU
Ypresian Chalk
WYANDOT
Petrel
DAWSON CANYON
Marmora
Sable
Cree
LOGAN CANYON
Naskapi
Shortland Shale
Upper
Middle
MISSISAUGA
MIC MAC
Baccaro
Mesozoic
Scotia
ABENAKI
VERRILL CANYON
MOHICAN
ROQUOIS & EQ
Tholeiitic volcanics
EURYDICE
RED BEDS
ARGO
SDR
PALEOZOIC METASEDIMENTARY & IGNEOUS ROCKS
LEGEND
Deep sea stratigraphic markers
Gas
Oil
Deepwater turbidite
Mainly sandstone
Shale
Limestone/Chalk
Dolomite
Salt
Basalt
Source Rock Intervals
Main Events
Magnetic Anomalies
M0
M4
M11
M16
M21
M25
M29
ECMA
PASSIVE MARGIN
Volcanic rocks
Avalon Uplift
CAMP VOLCANICS
OCEANIC CRUST
RIFT
Salt Tectonics
End of major salt deformation
Banquereau Wedge
BREAKUP UNCONFORMITY
SALT BASIN
Seismic Horizons
T29
T50
K94
K101
K130
K147/137
J150
J163
J200
Time scale from Ogg, Ogg & Gradstein (2004)
Eustatic curve:
Miller (2005), short-term
SEPM-Haq'08 synthetic, mean sea level (intermediate term)
Stratigraphy modified from:
Wade & MacLean (1990, 1993)
Wade et al. (1995), Deptuck et al. (2008)

Hydrocarbon occurrences

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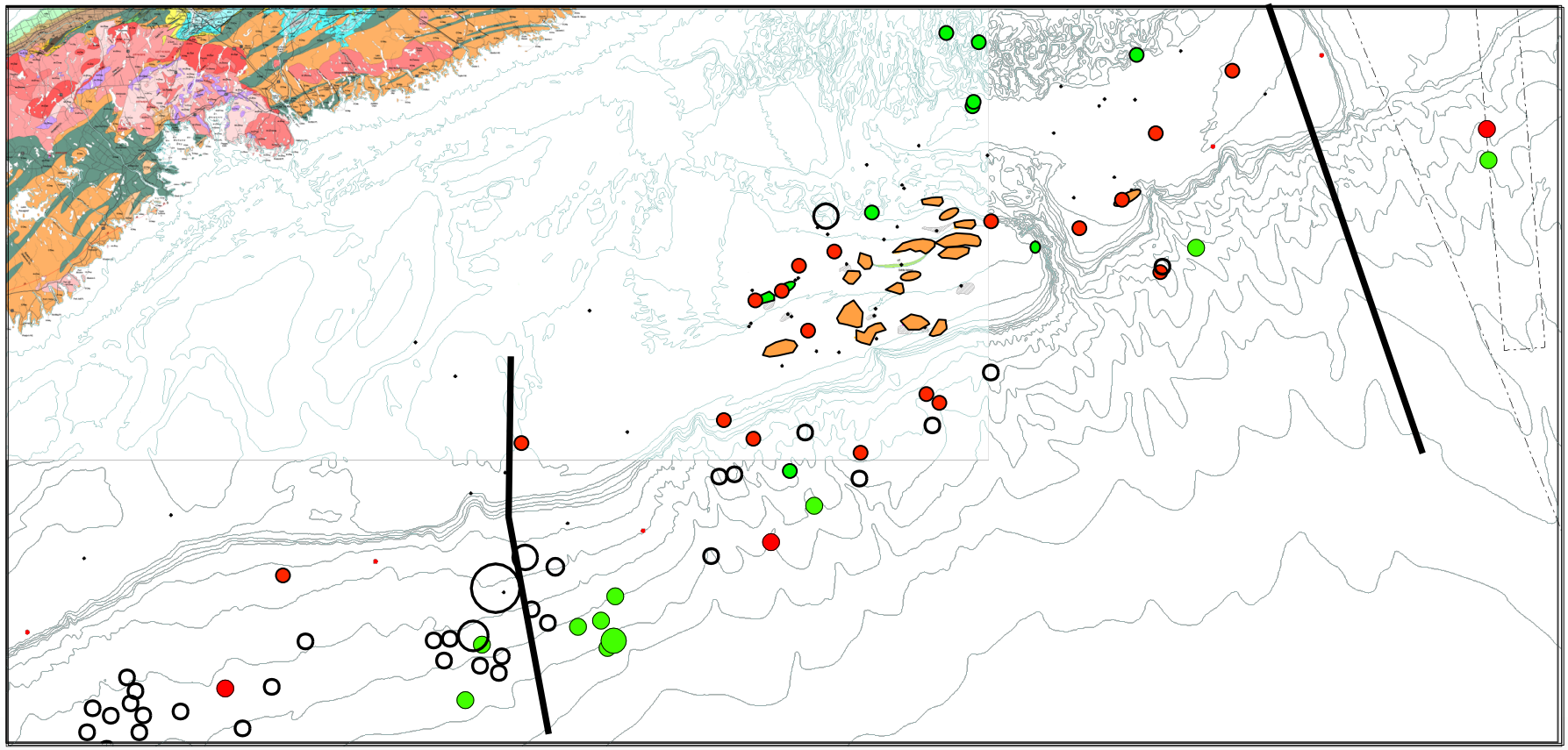
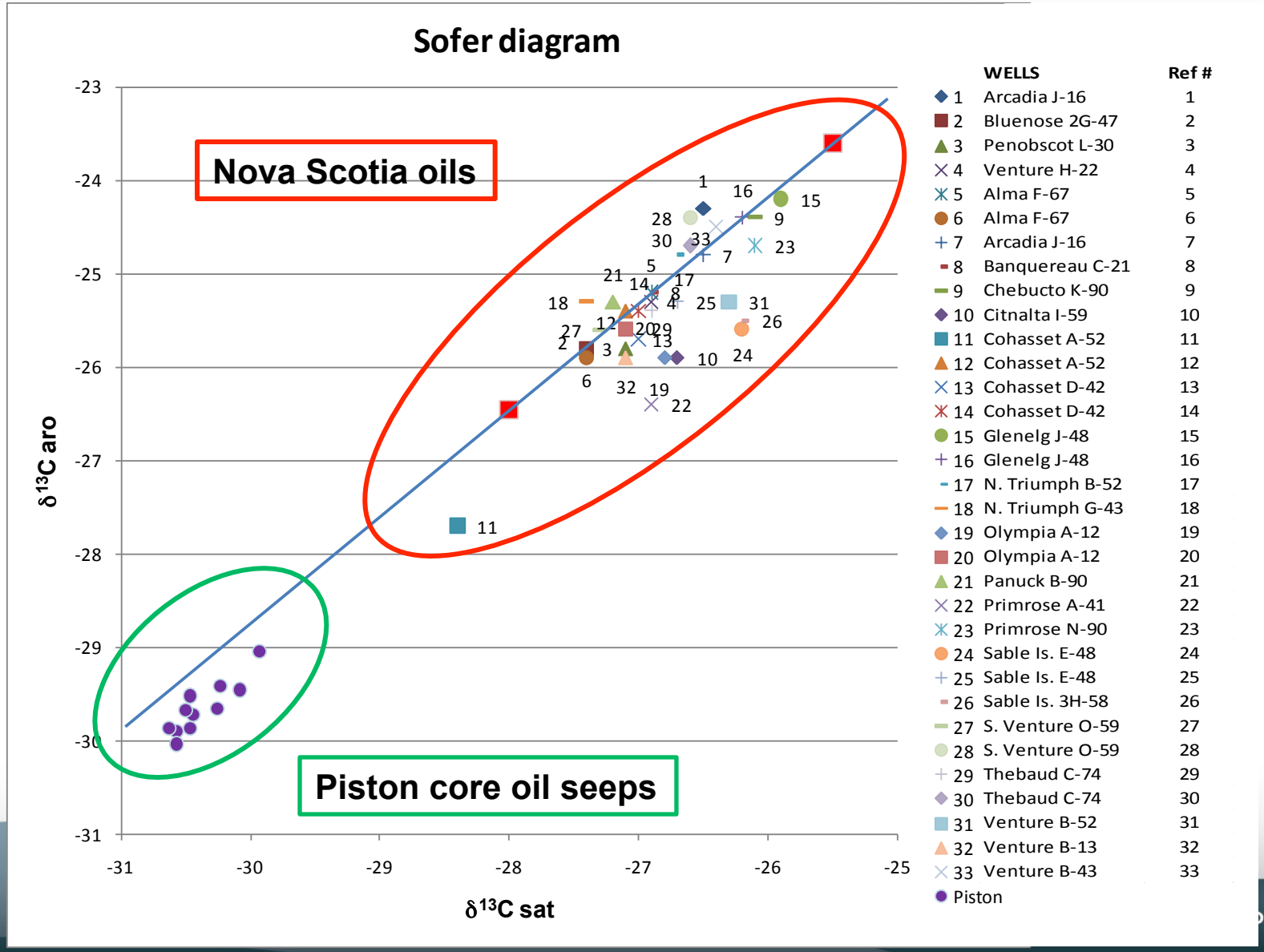
FIELDS SHOWS PISTONS DHI



Isotope distribution - oils



Lower Jurassic source rock indications

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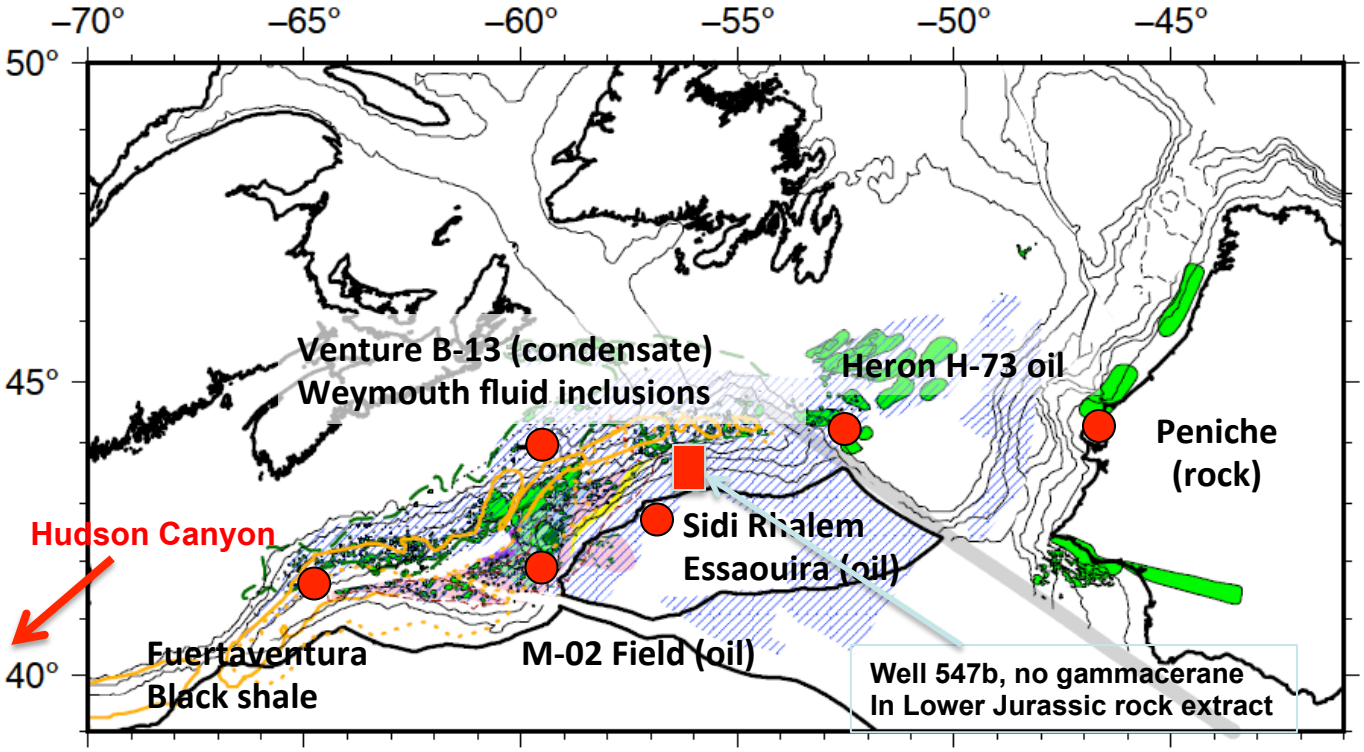
Salt distribution

ECMA reconstruction (end of rifting)
(Sinemurian/Pliensbachian limit, 190 Ma)

● Gammacerane



North America

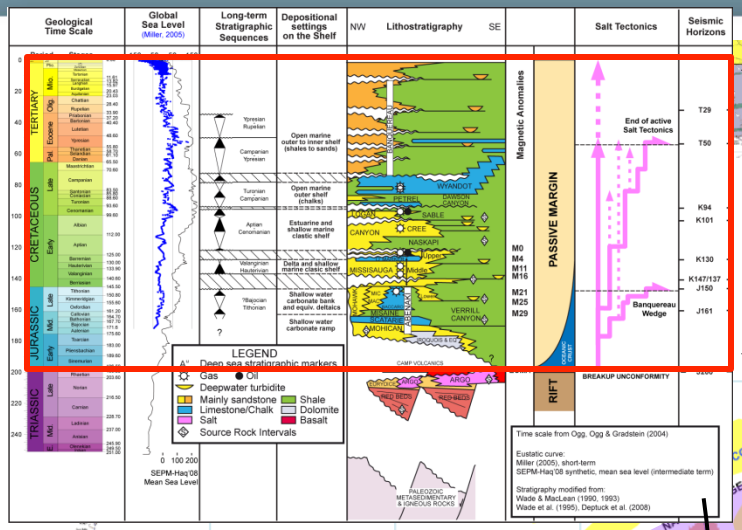
- Outlines of salt structures (Beicip, Davison, Edwards, Wade et McLean)
- Extent of halite (Labails)
- Autochtonous salt (Albertz)
- Salt and fault (Beicip, preliminary)

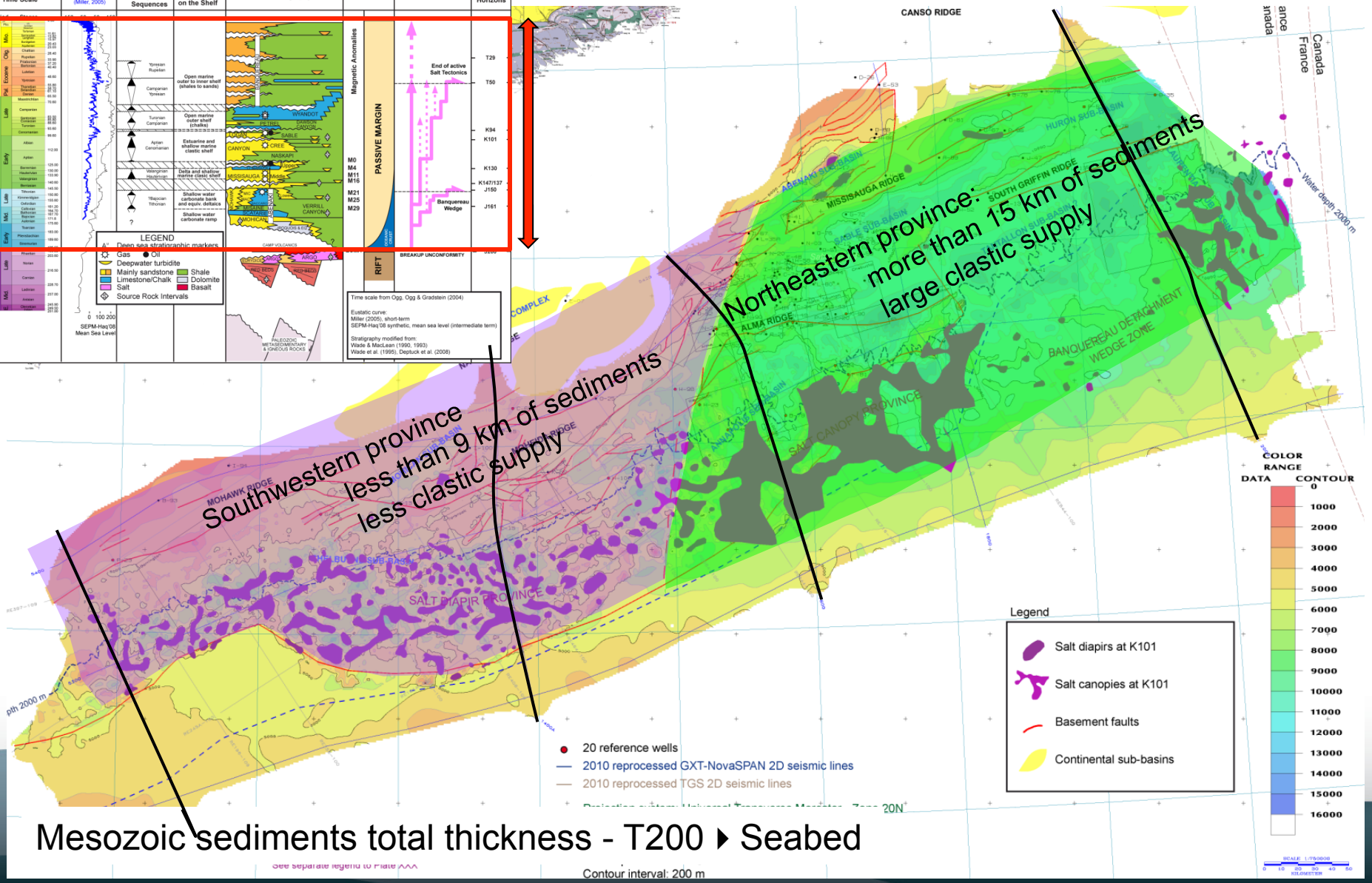
Africa, Meseta and Iberia

- Outlines of salt structures (Tari & Molnar, Maillard, Davison, Matias)
- Rafts and isolated diapirs (T&M)
- Diapiric salt and turtle structures (T&M)
- Canopy salt (T&M)
- Toe–thrust zone (T&M)
- Allochtonous salt (Hafid)
- Salt pillow (Hafid)
- Extent of halite (Labails)
- Extent of halite (Nemcok)

2 very different petroleum provinces

Nova Scotia OFFSHORE

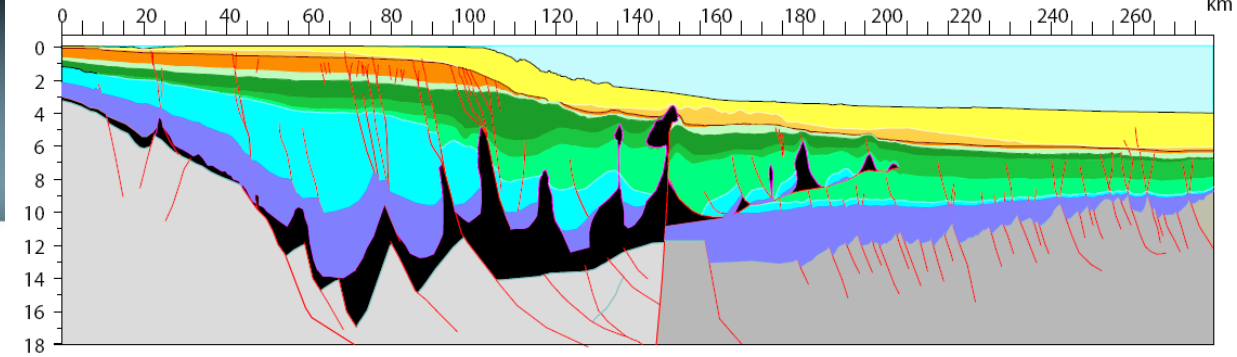




Mesozoic sediments total thickness - T200 ▸ Seabed

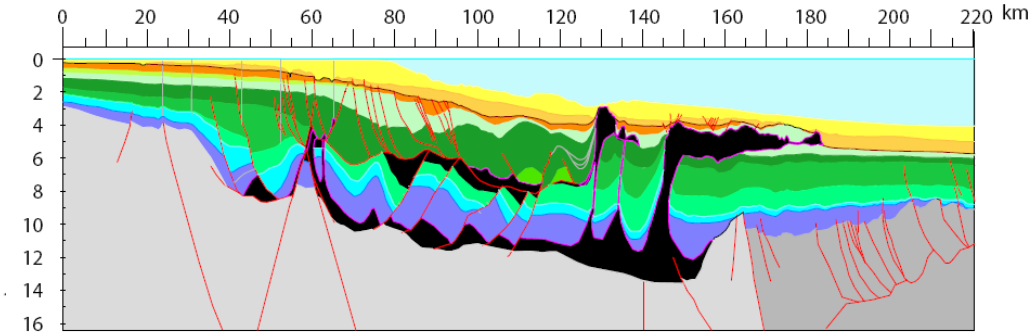
Offshore novascotia

High sedimentation rate ➔ Salt tongues and canopies

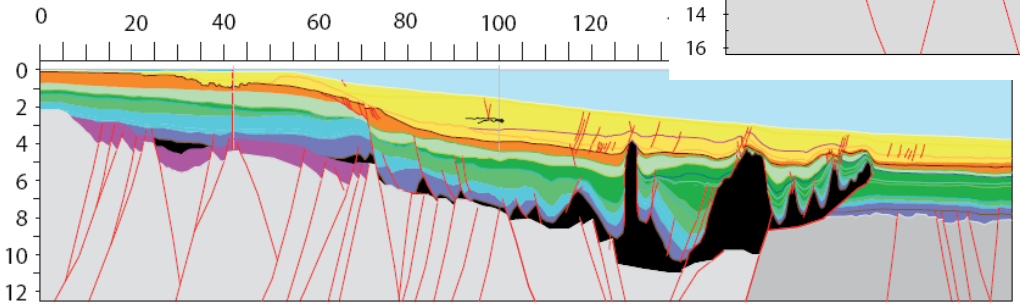


Vertical exaggeration 4

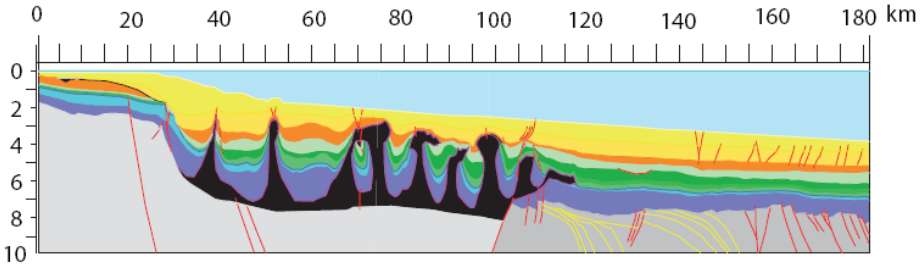
NovSPAN 1600



NovSPAN 1400

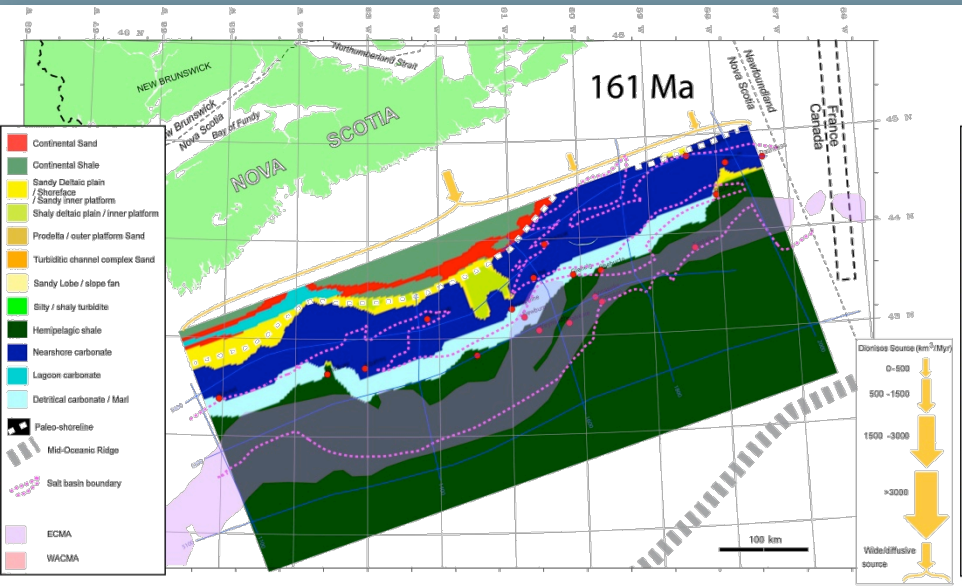


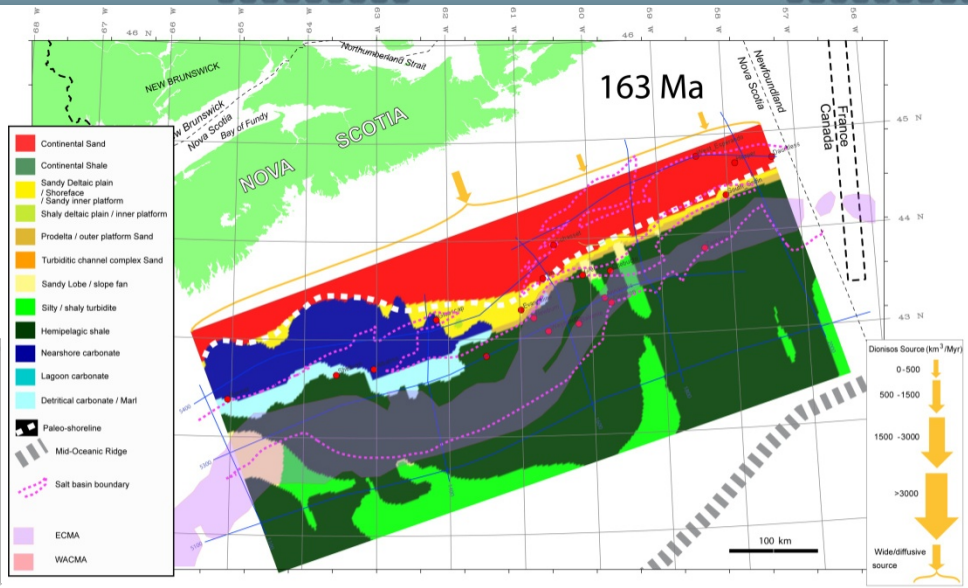
NovSPAN 1100



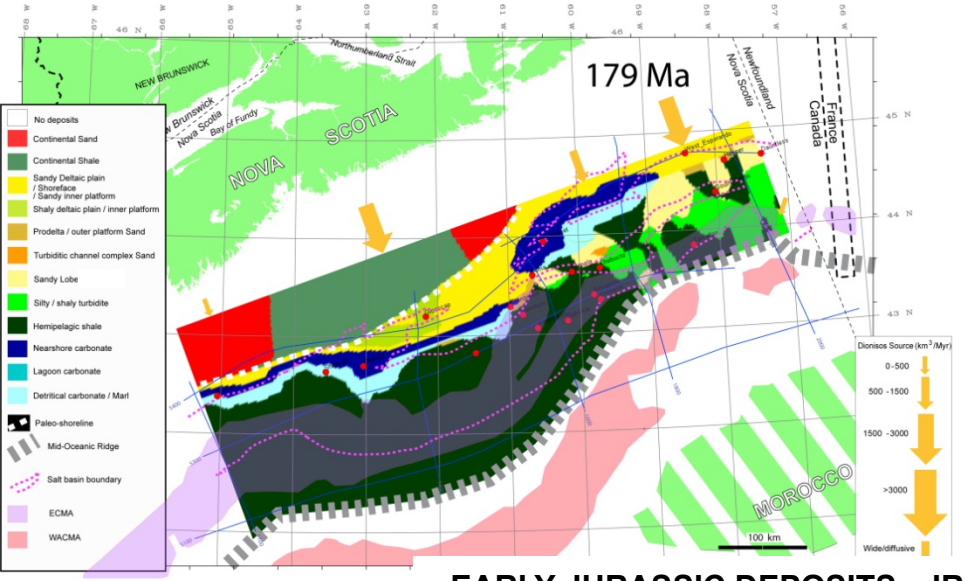
Low sedimentation rate ➔ vertical diapirs

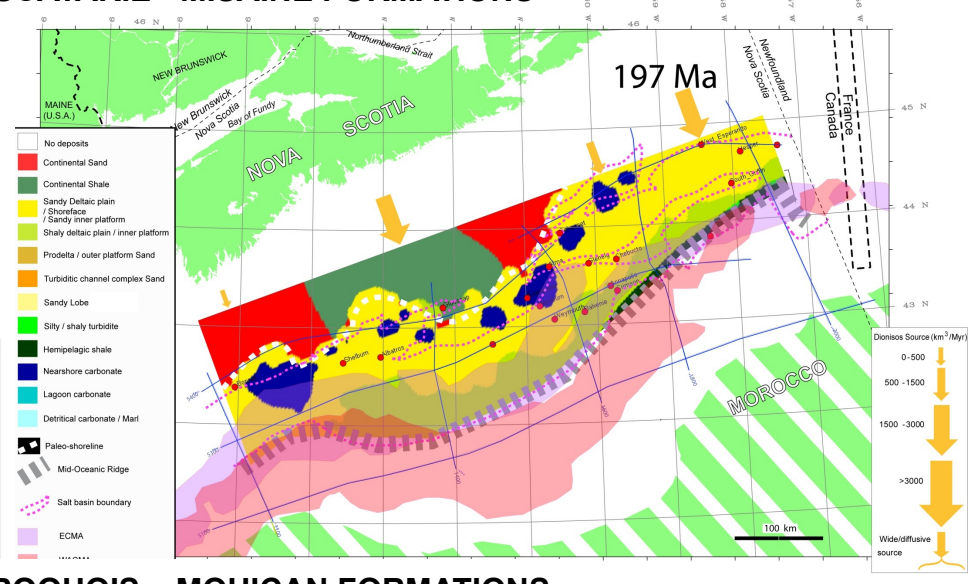
Jurassic modeling results : GDE maps dress-up for key stratigraphic intervals





CALLOVIAN TRANSGRESSION - SCATARIE - MISAINE FORMATIONS





EARLY JURASSIC DEPOSITS – IROQUOIS – MOHICAN FORMATIONS

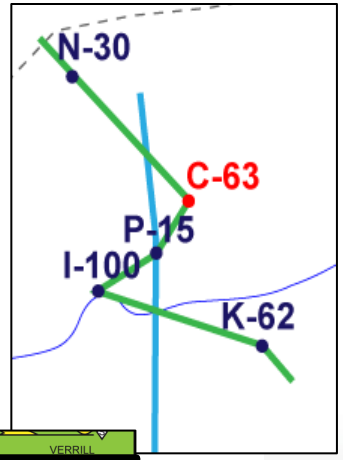
Stratigraphy of the Middle Jurassic

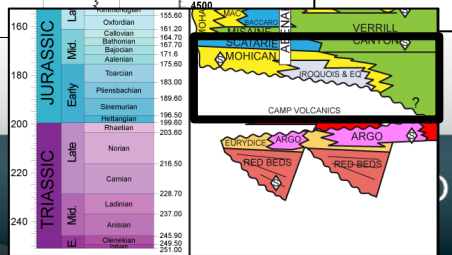
Nova Scotia OFFSHORE

South — North

Acadia-K-62 | Mohican-I-100 | Moheida-P-15 | Glooscap-C-63 | Naskapi-N-30

MISAINE
SCATARIE
MOHICAN
IROQUOIS
BREAKUP UNC.
SALT
EURYDICE
GLOOSCAP VOLCANICS
BASEMENT





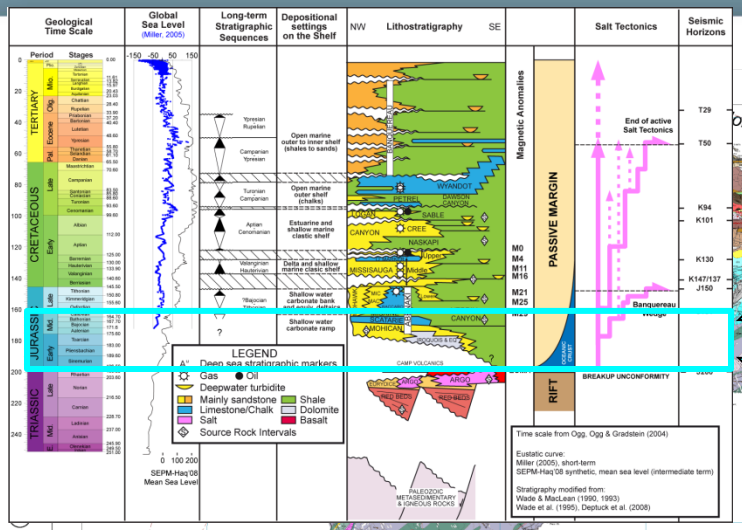
Depositional architecture for each sequence

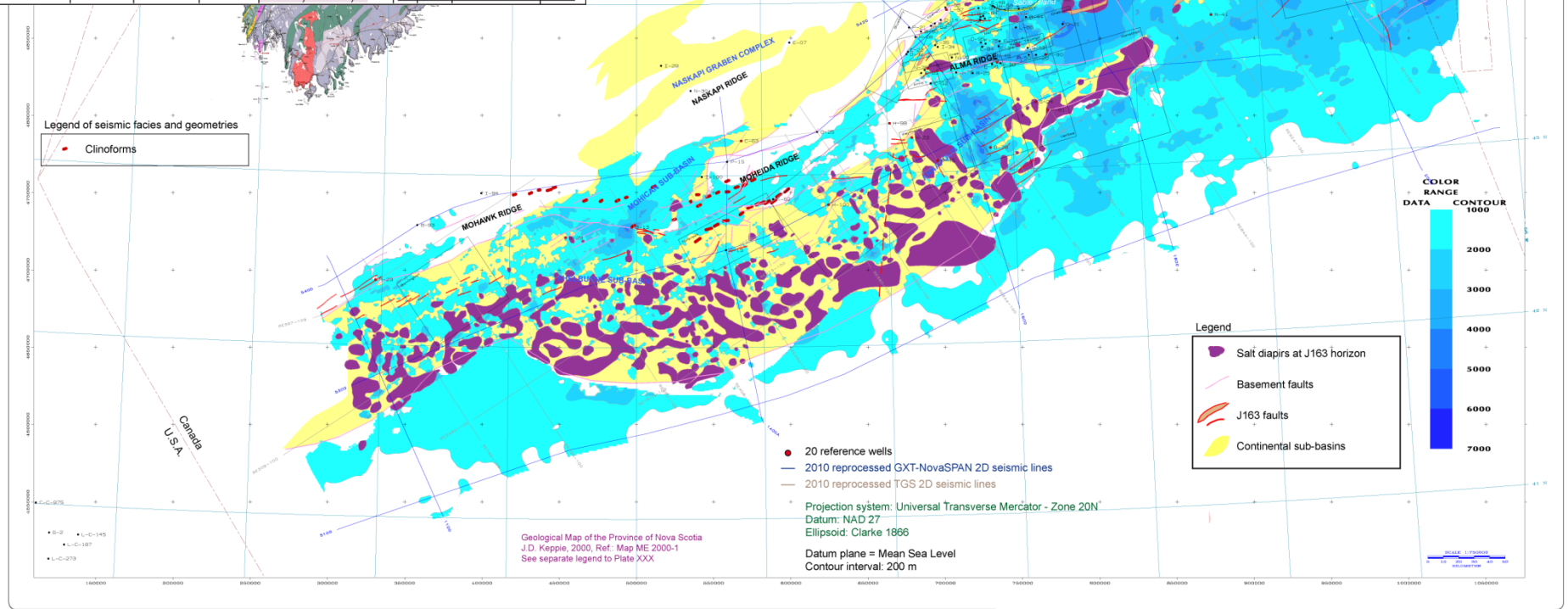
1. Prograding clastics, ending up with shallow marine carbonates
2. Expansion of shallow marine carbonate through time (1st order transgression)

NEW ... ORTUNITY.

T200 ▸ J163 isopach map

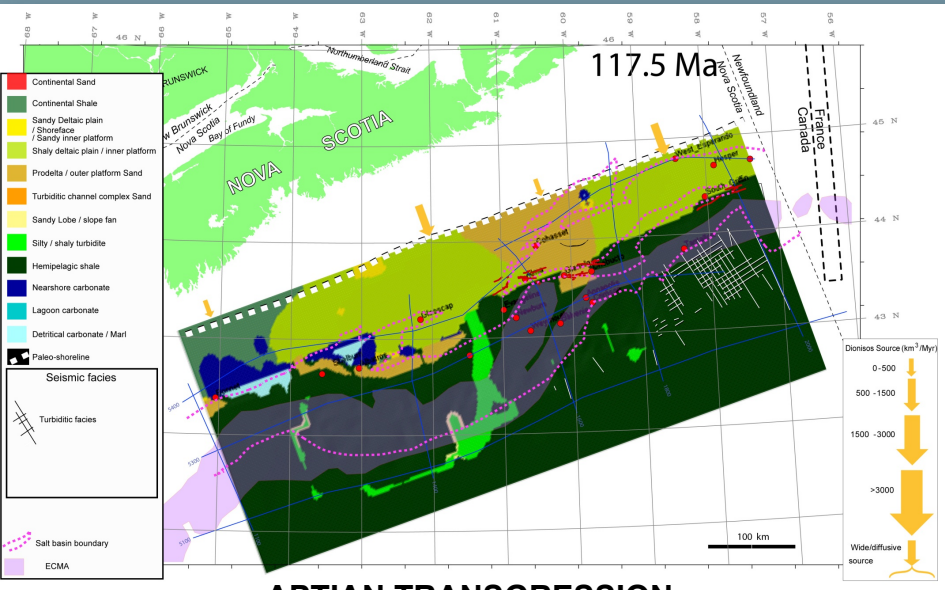
Nova Scotia OFFSHORE



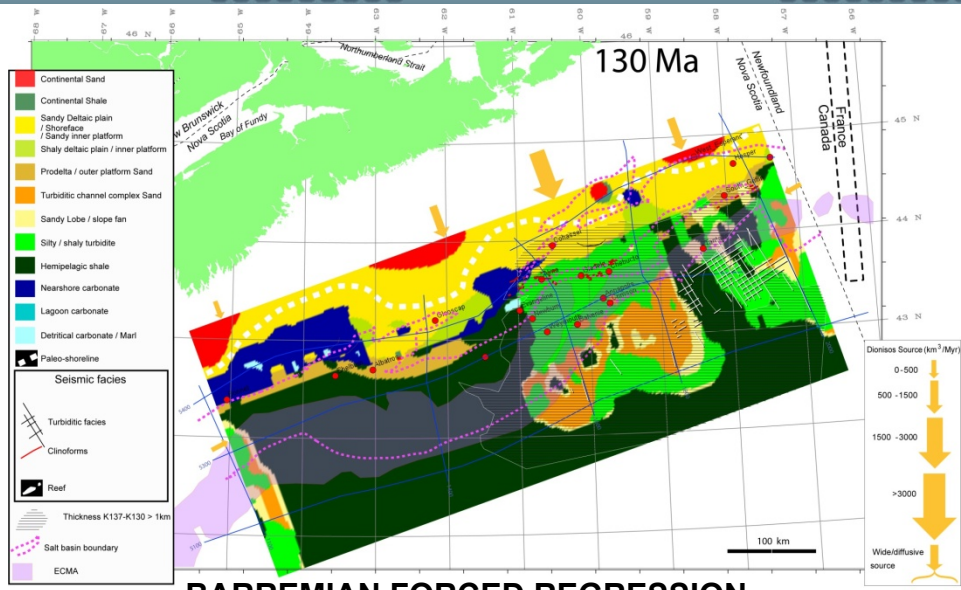


Cretaceous modeling results : GDE maps for key stratigraphic intervals

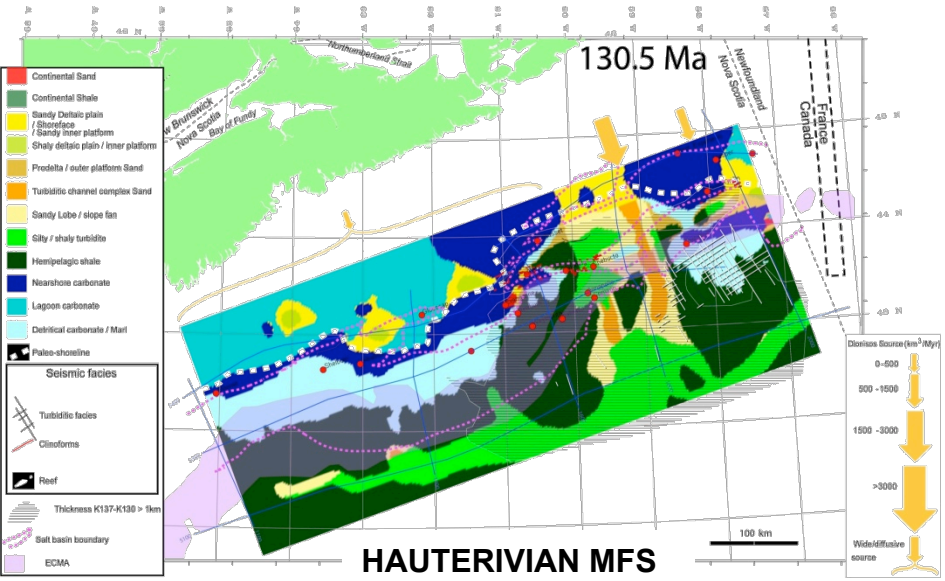
Nova Scotia OFFSHORE



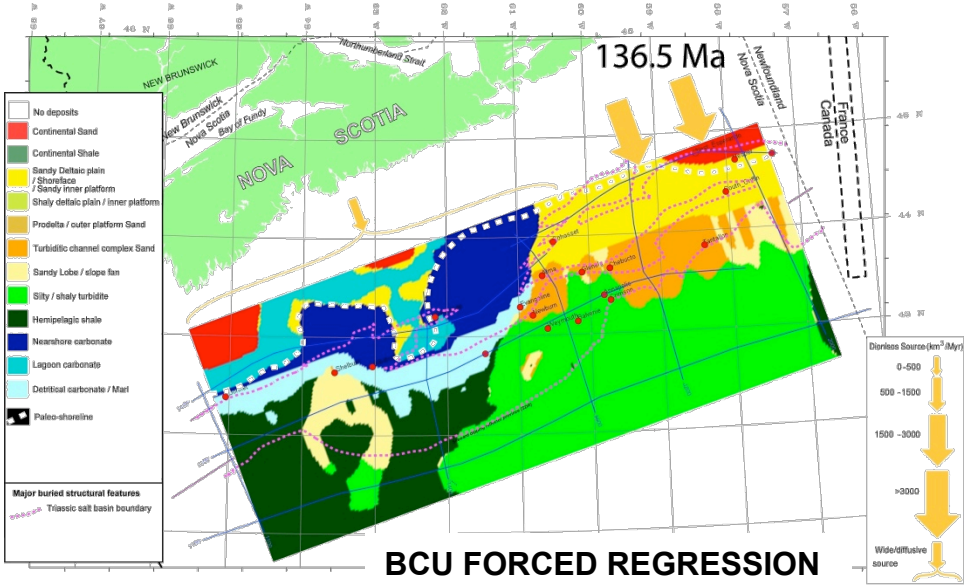
APTIAN TRANSGRESSION



BARREMIAN FORCED REGRESSION



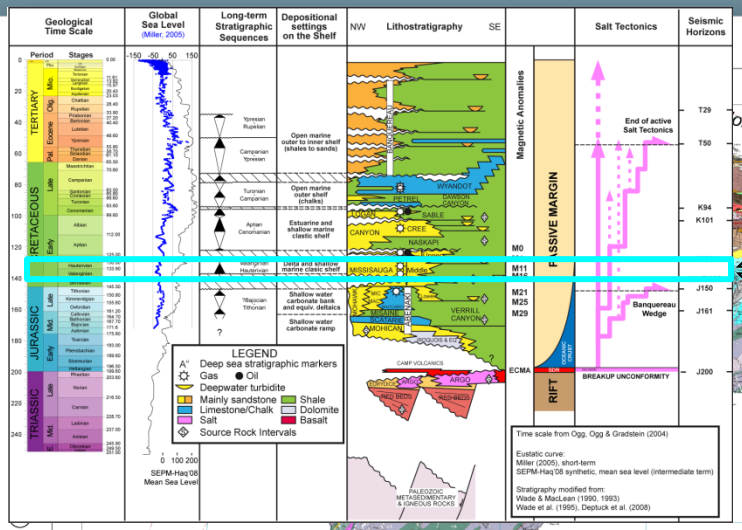
HAUTERIVIAN MFS



BCU FORCED REGRESSION

Middle Missisauga seismic facies and geometries

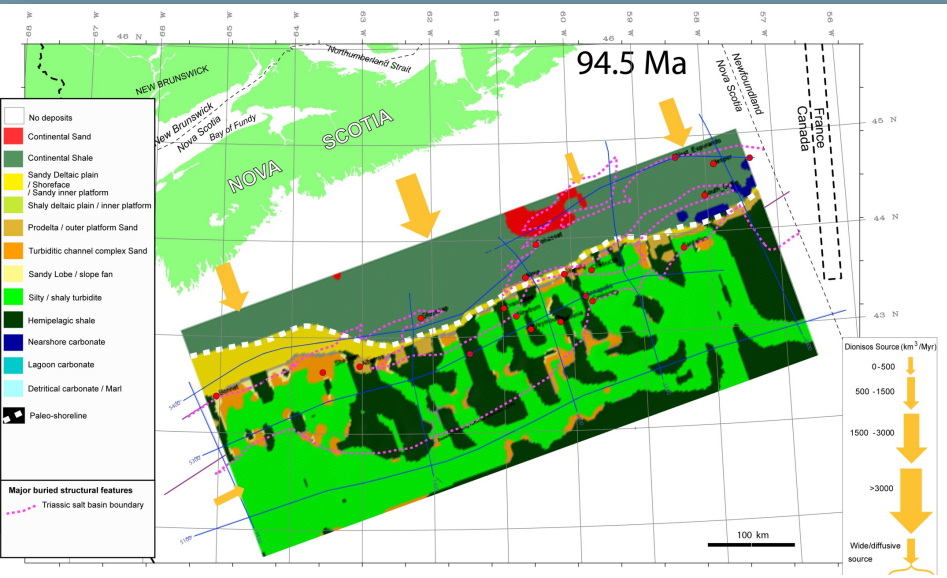
Nova Scotia OFFSHORE



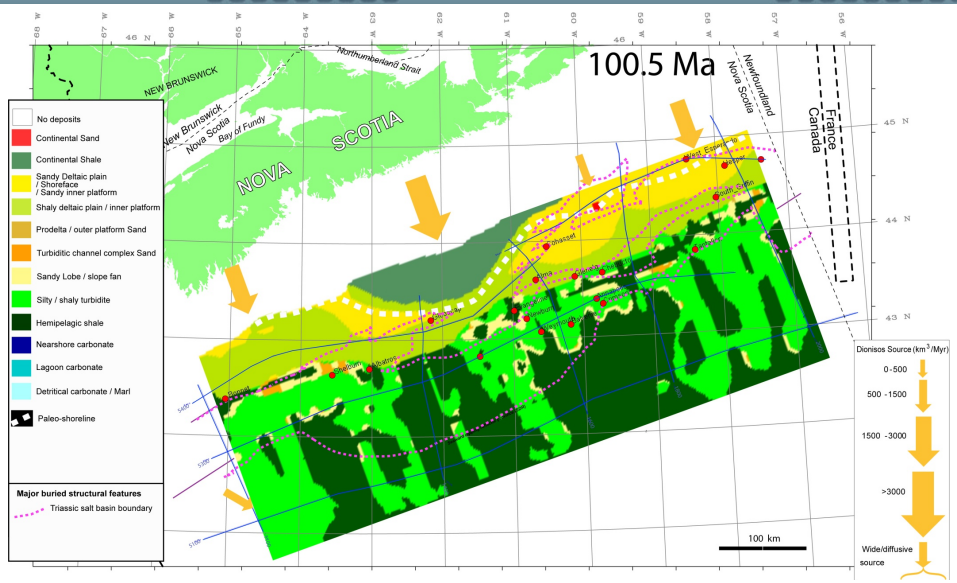
K137 ▸ K130 thickness map

J150 ▸ K137 isopach map

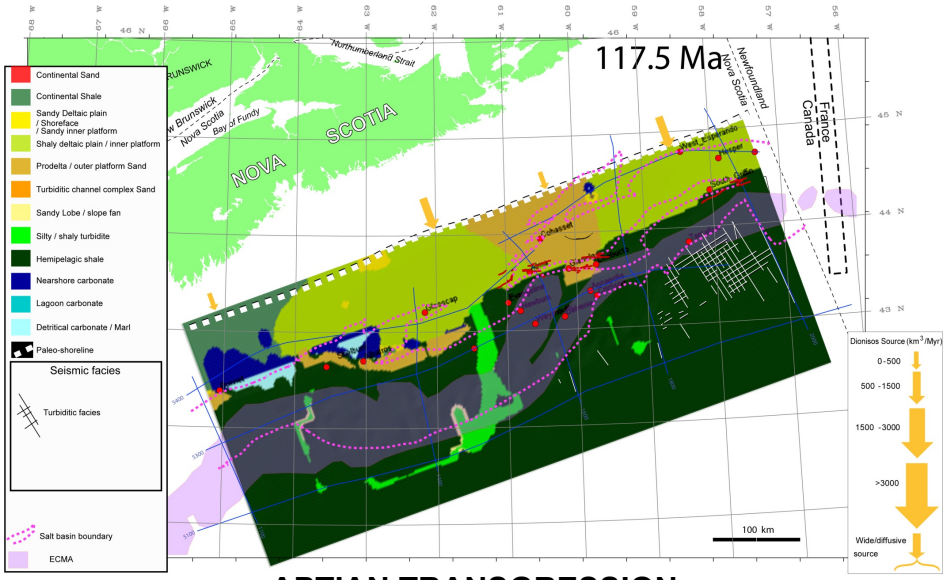
Cretaceous modeling results : GDE maps dress-up for key stratigraphic intervals



TOP CENOMANIAN



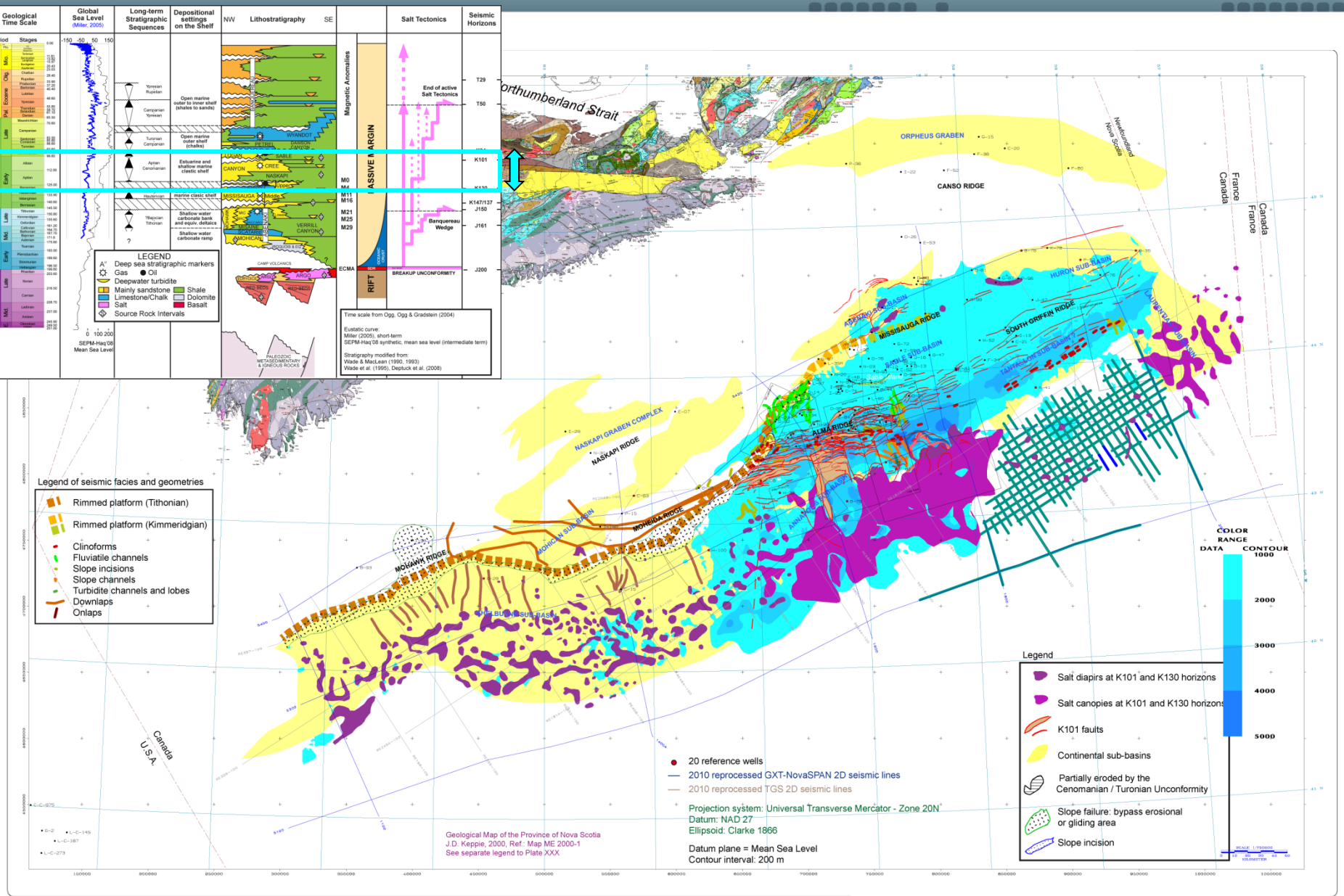
CENOMANIAN DEPOSITS



APTIAN TRANSGRESSION

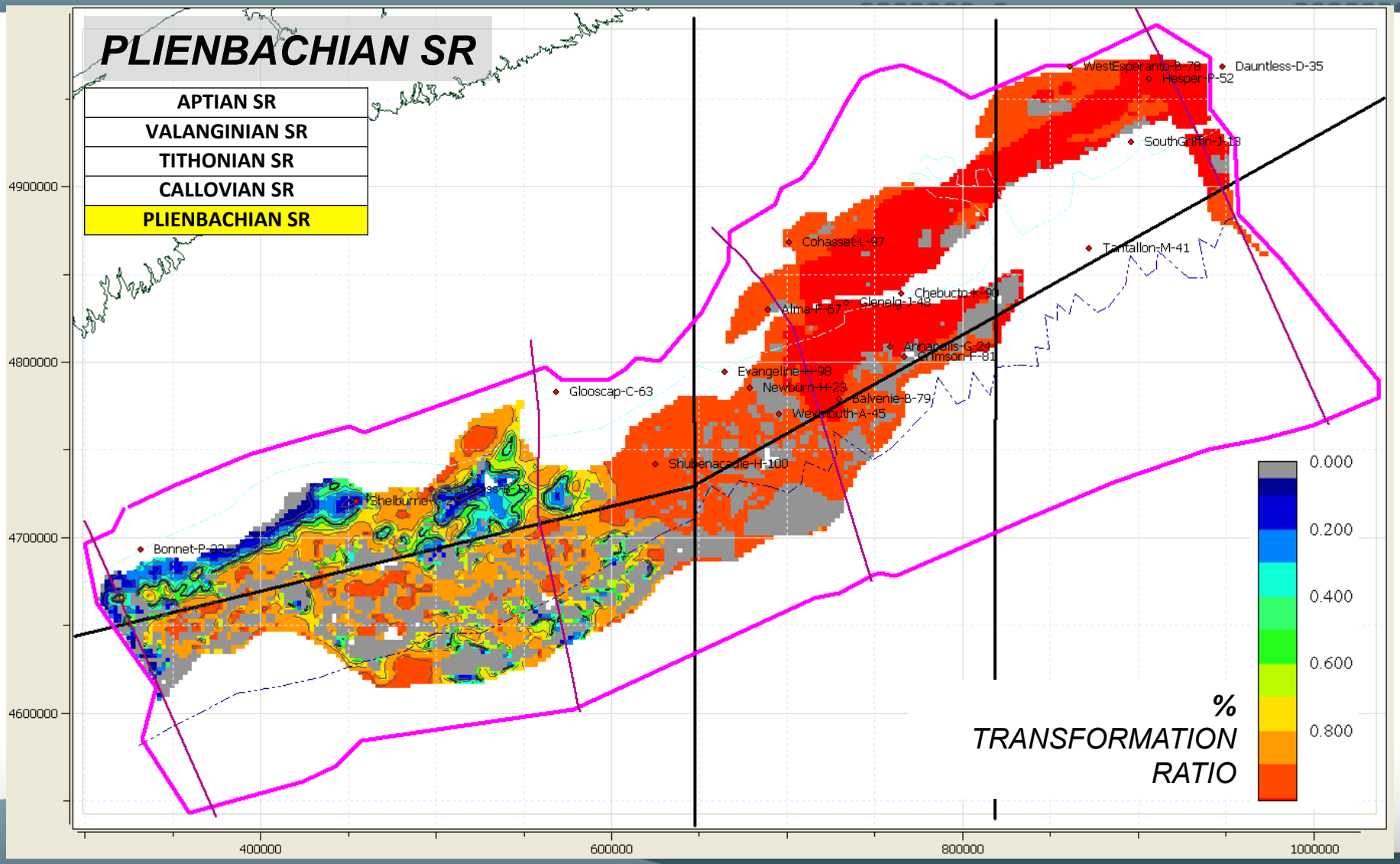
K130 ▸ K101 isopach map

Nova Scotia OFFSHORE



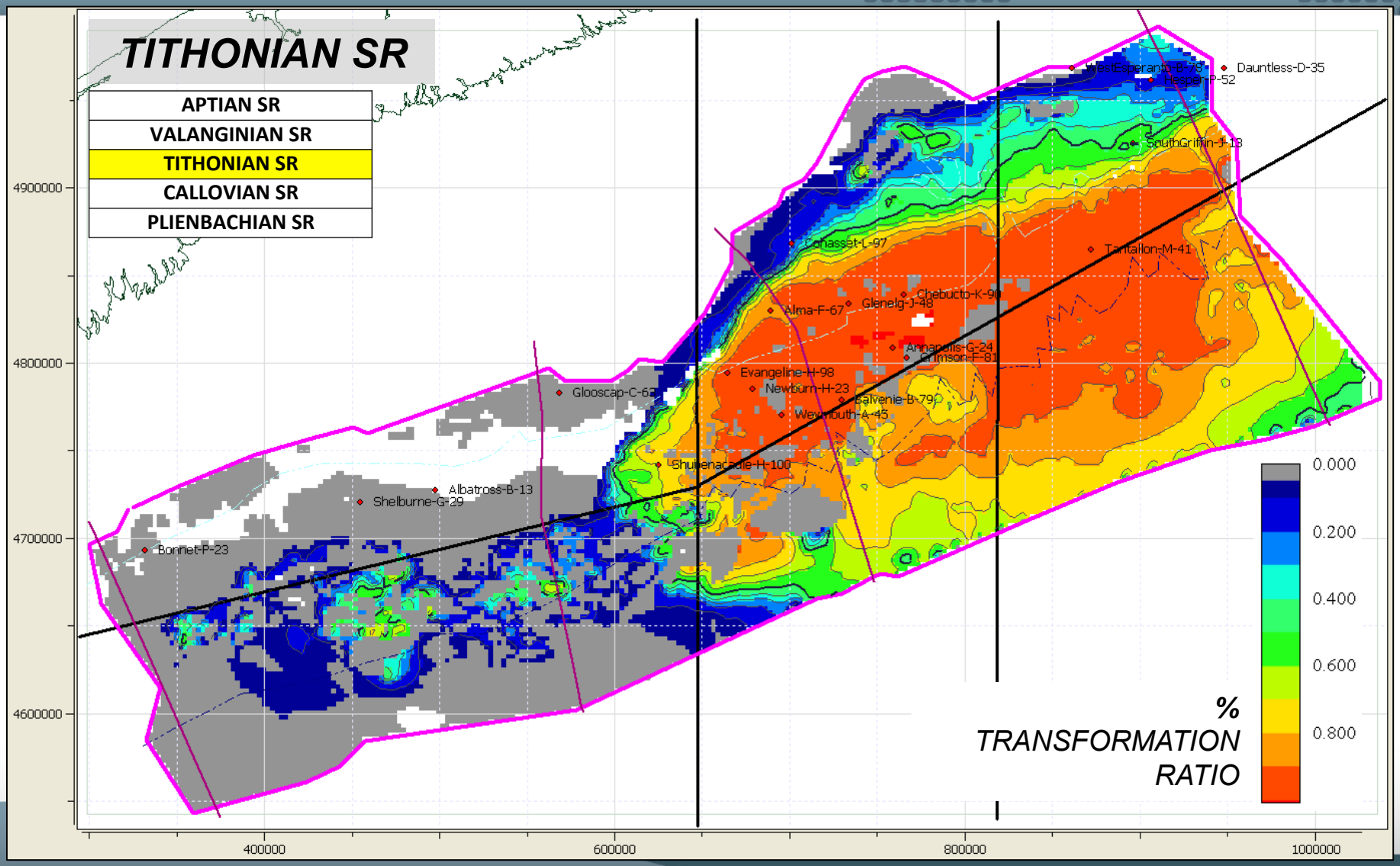
Source Rocks Modeling – Transformation Ratio

Nova Scotia OFFSHORE



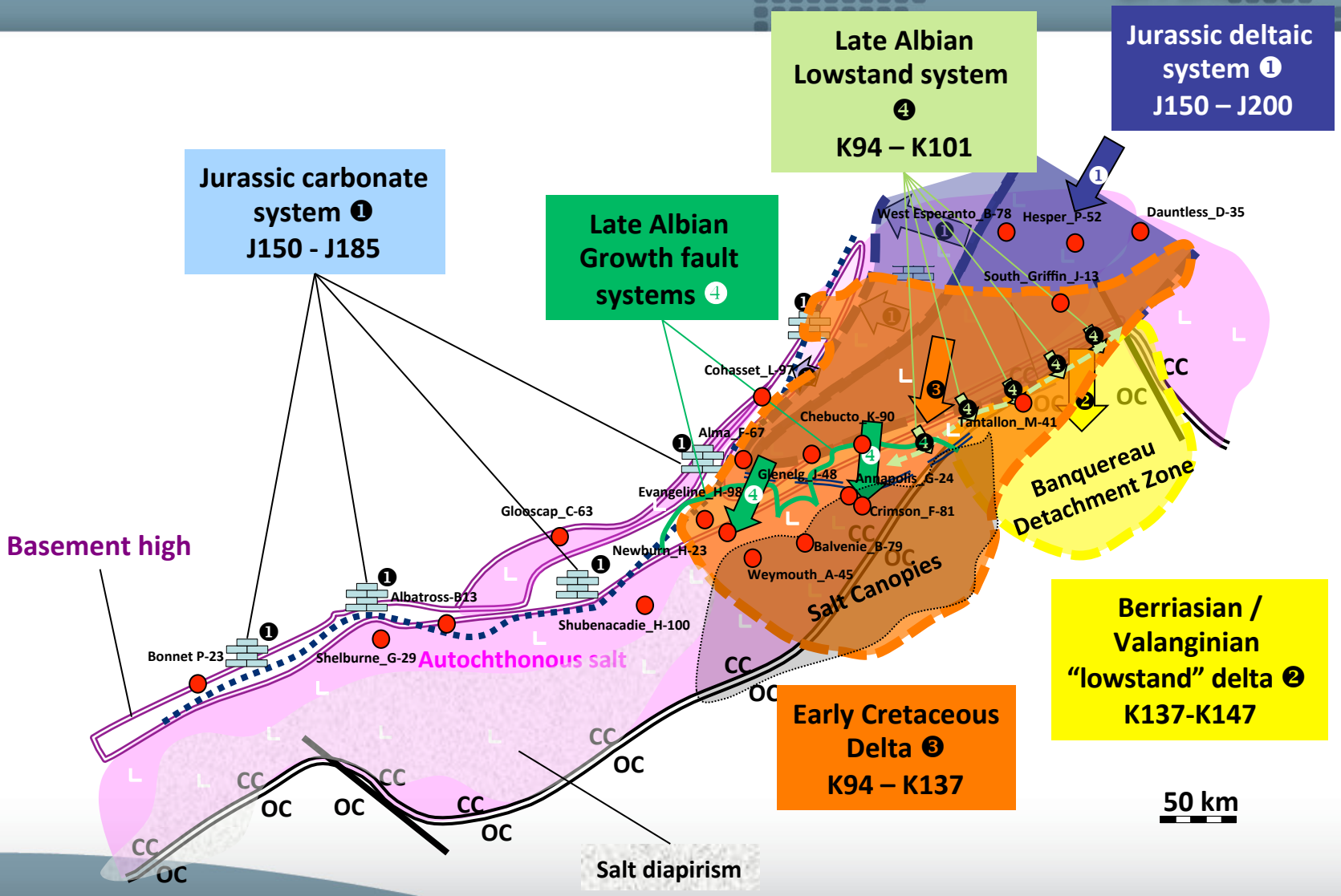
Source Rocks Modeling – Transformation Ratio

Nova Scotia OFFSHORE



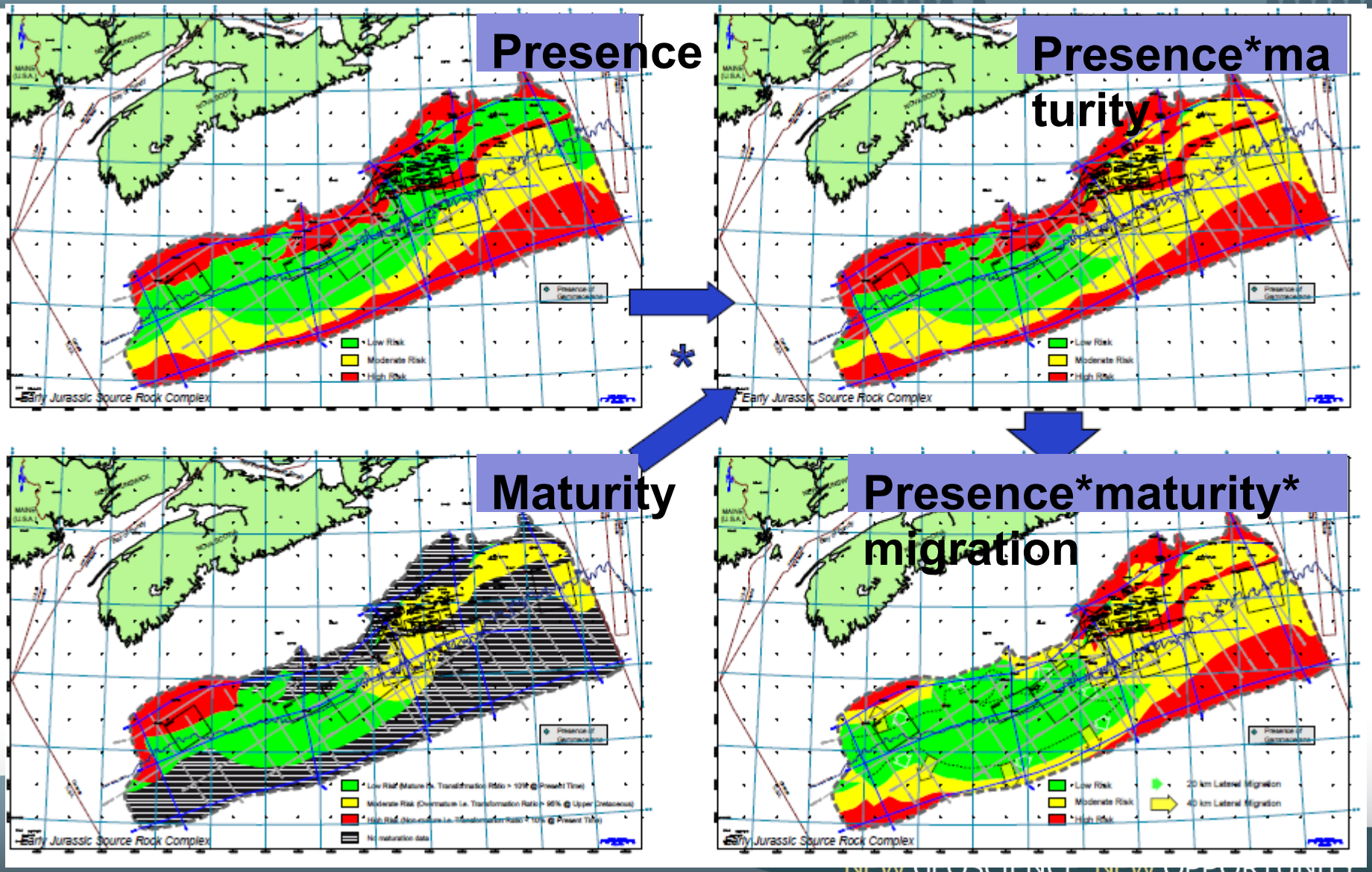
Jurassic and Cretaceous systems

Nova Scotia OFFSHORE

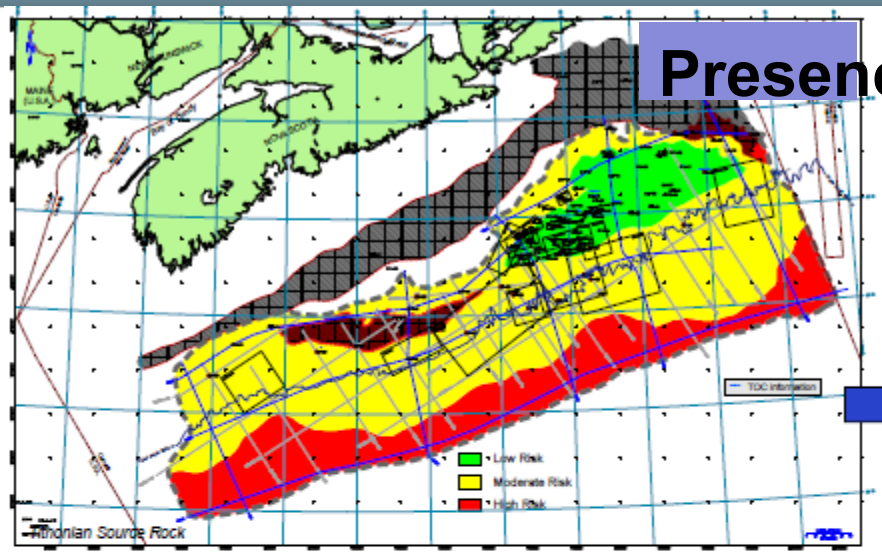


11-11-22

Early Jurassic source



Tithonian source



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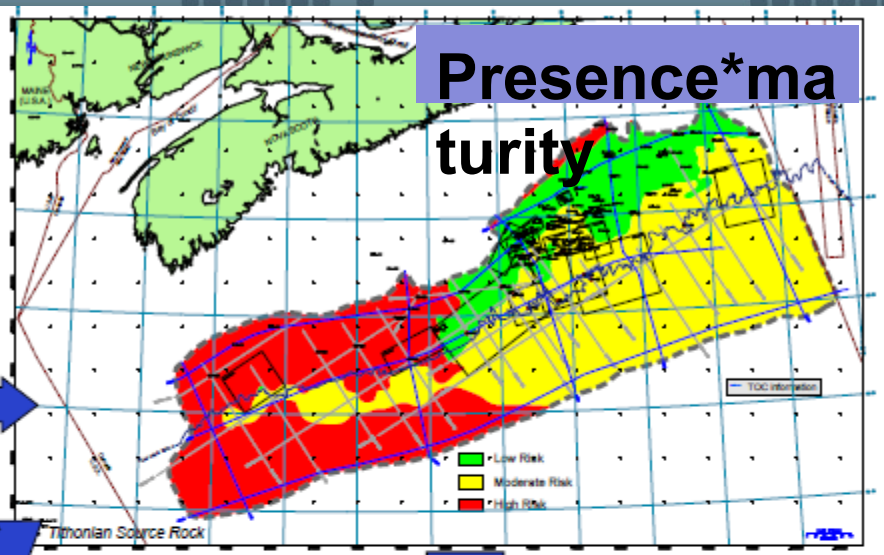
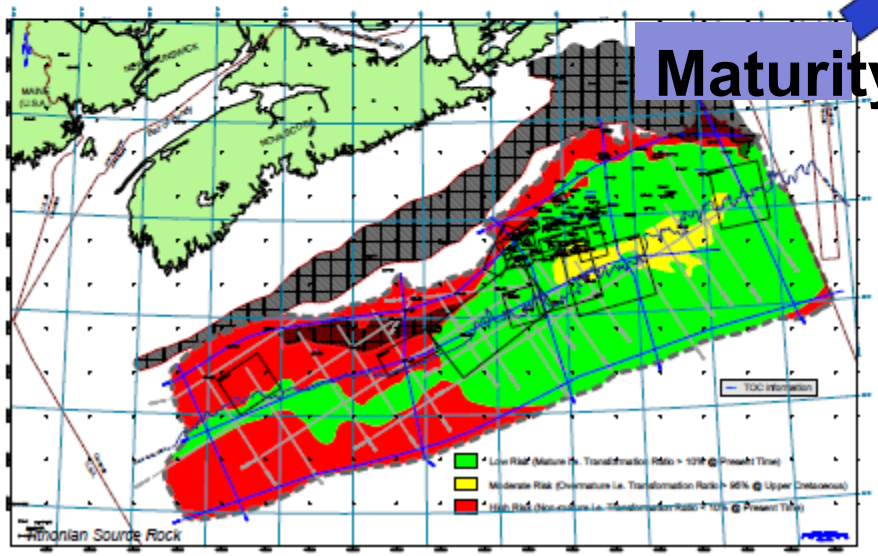
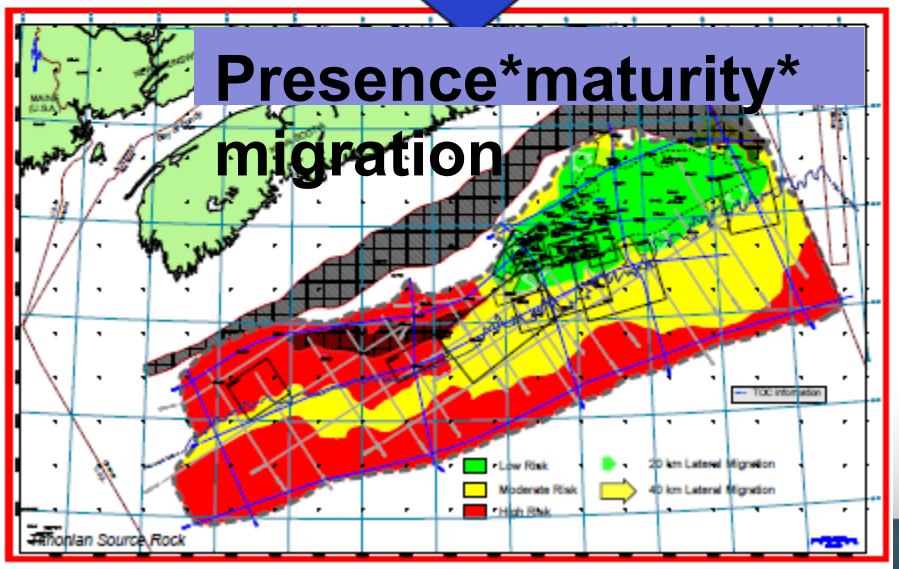


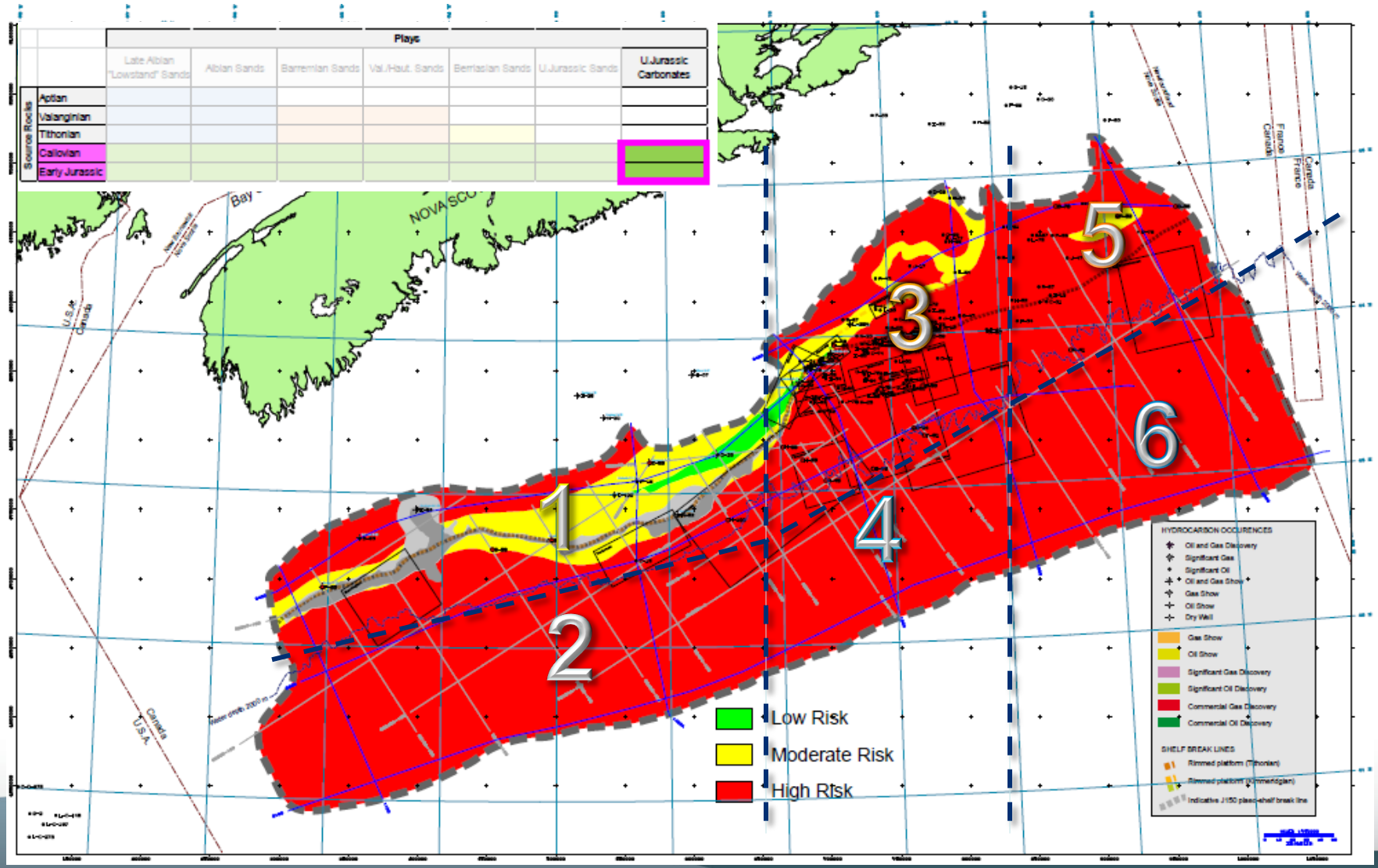




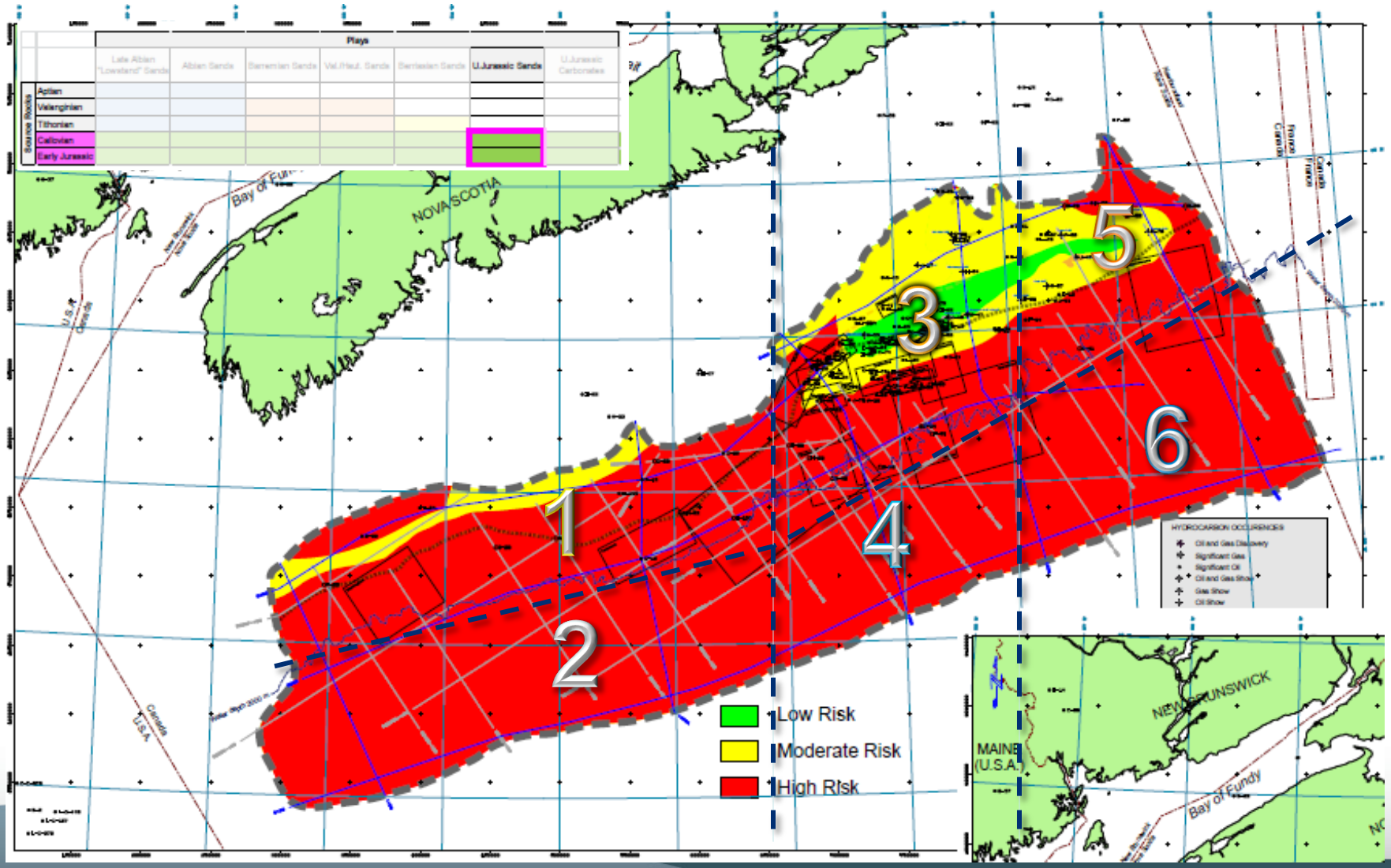
Upper Jurassic carbonate play

Nova Scotia OFFSHORE

Source Rocks	Plays: Late Albian "Lowstand" Sands	Albian Sands	Barremian Sands	Val./Haut. Sands	Berriasian Sands	U.Jurassic Sands	U.Jurassic Carbonates
Aptian							
Valanginian							
Tithonian							
Callovian							
Early Jurassic							

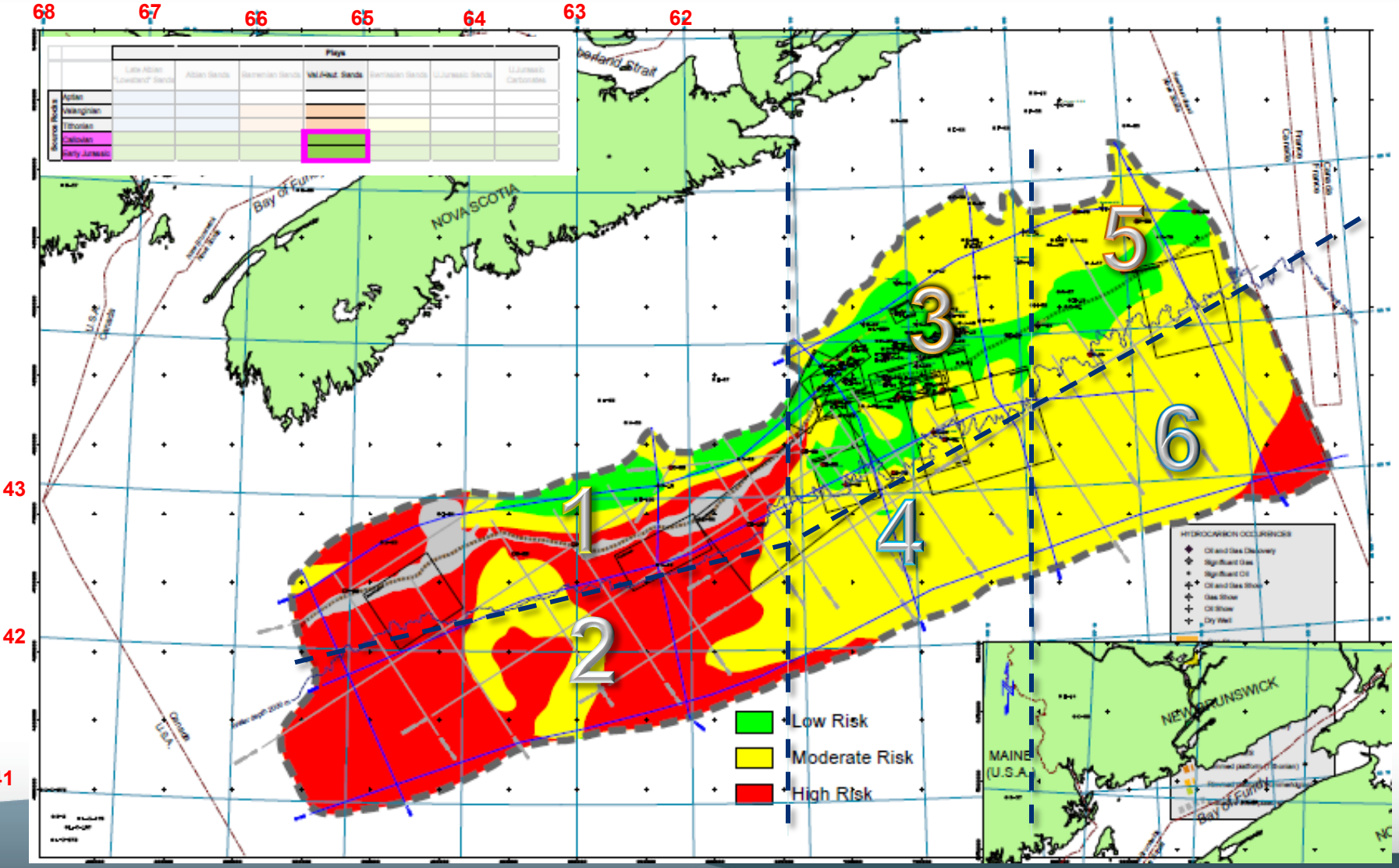


Upper Jurassic sands play

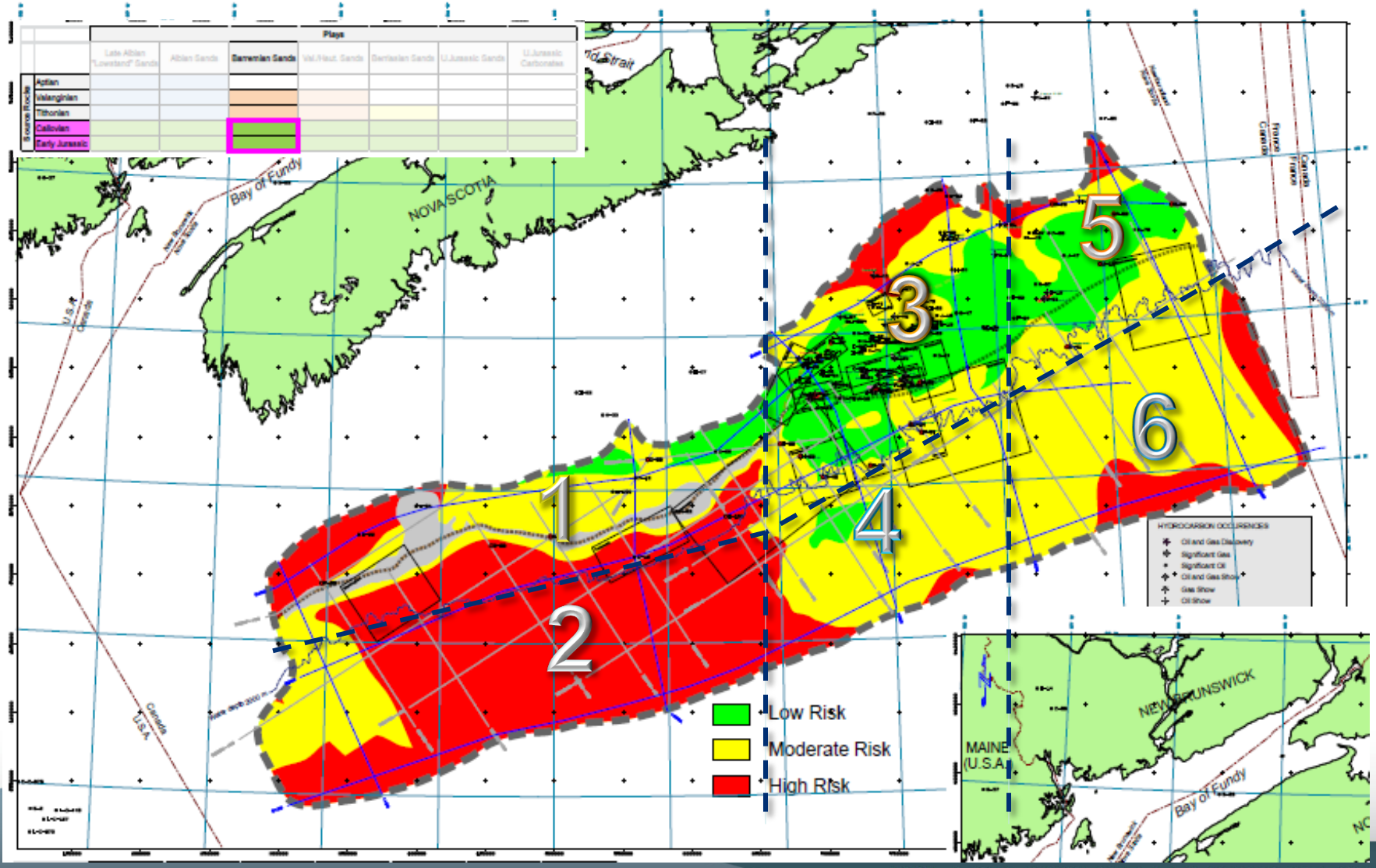


Valanginian-Hauterivian sands play (1)

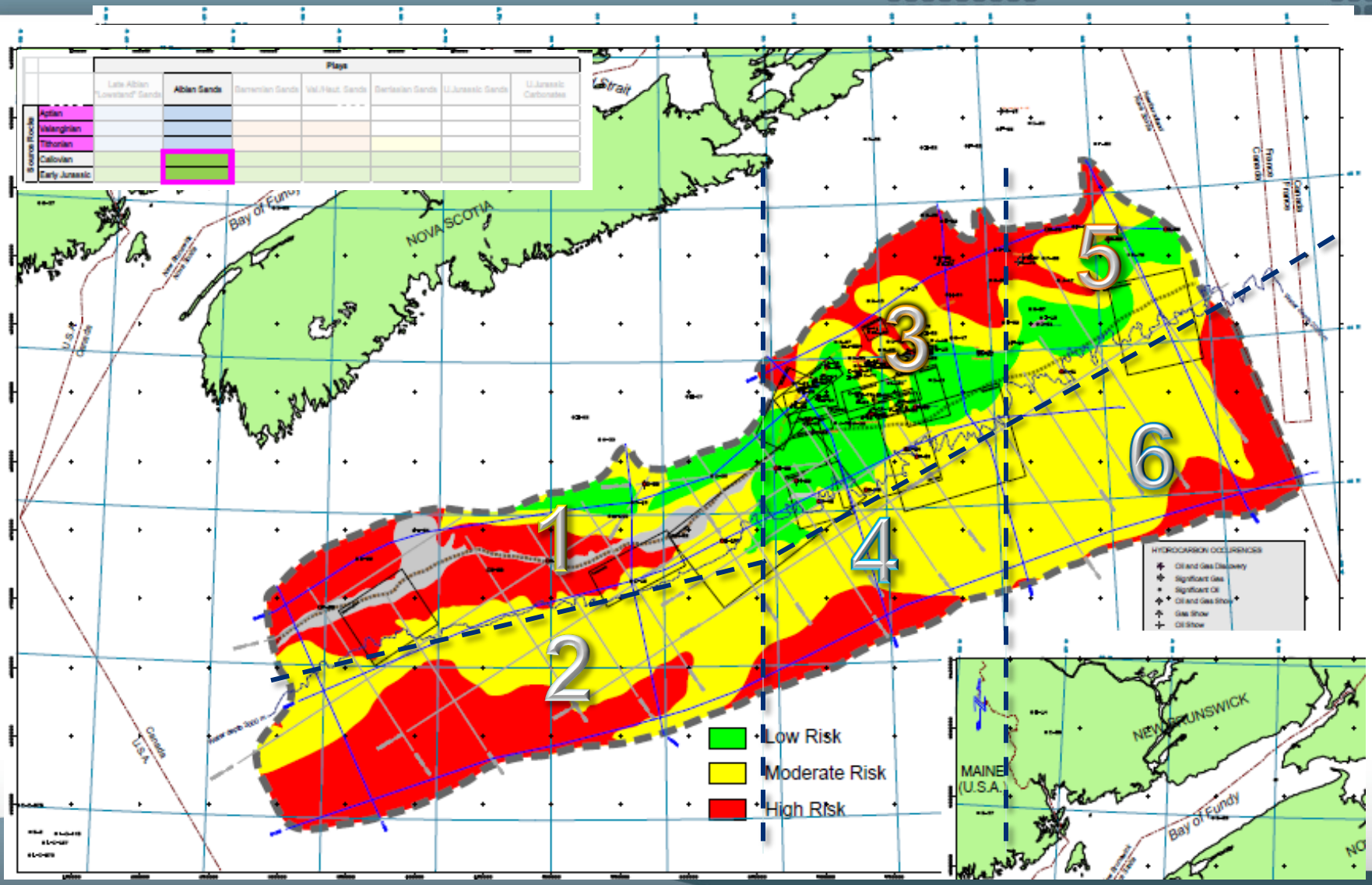
Nova Scotia OFFSHORE



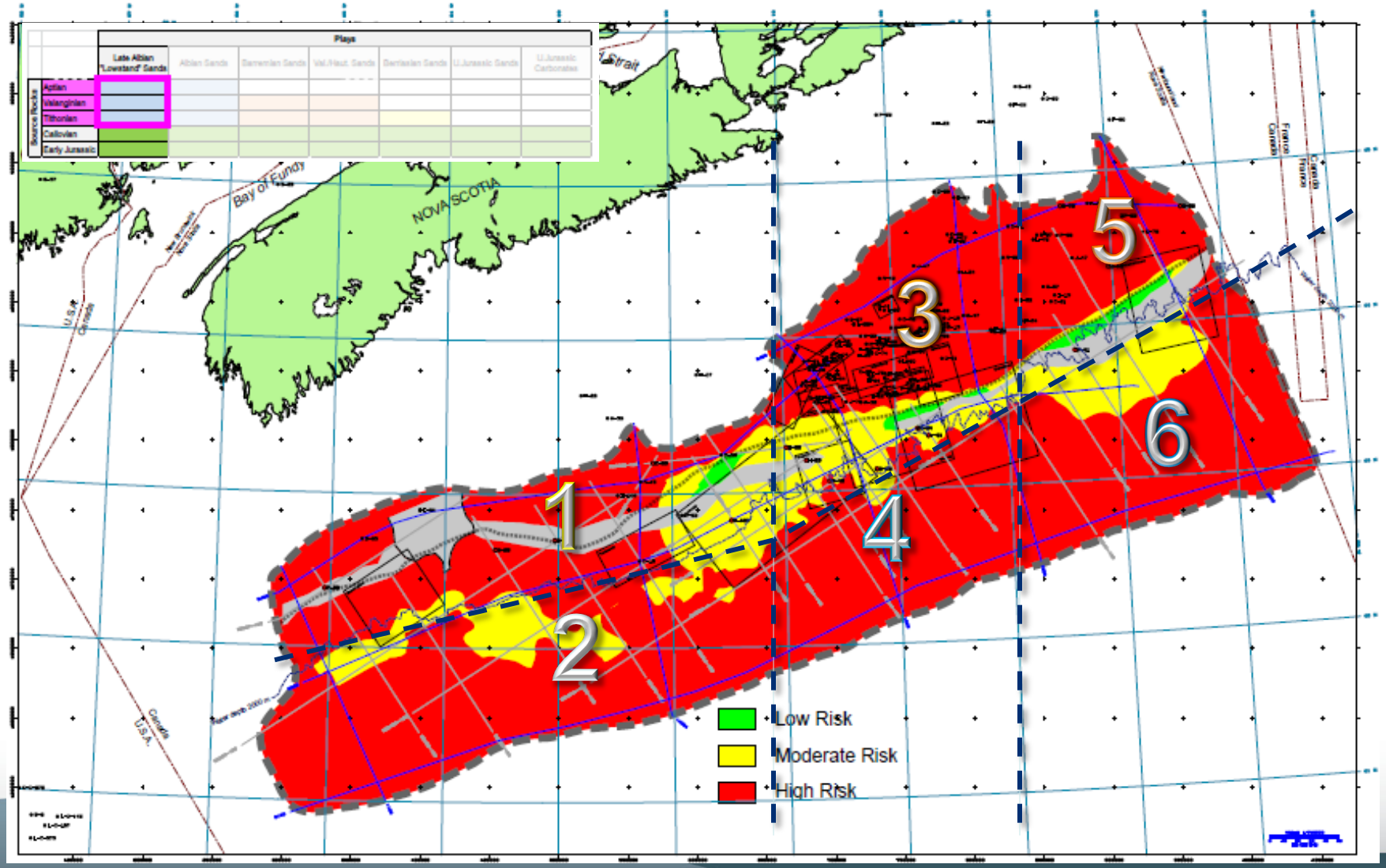
Barremian sands play (1)



Albian sands play (1)

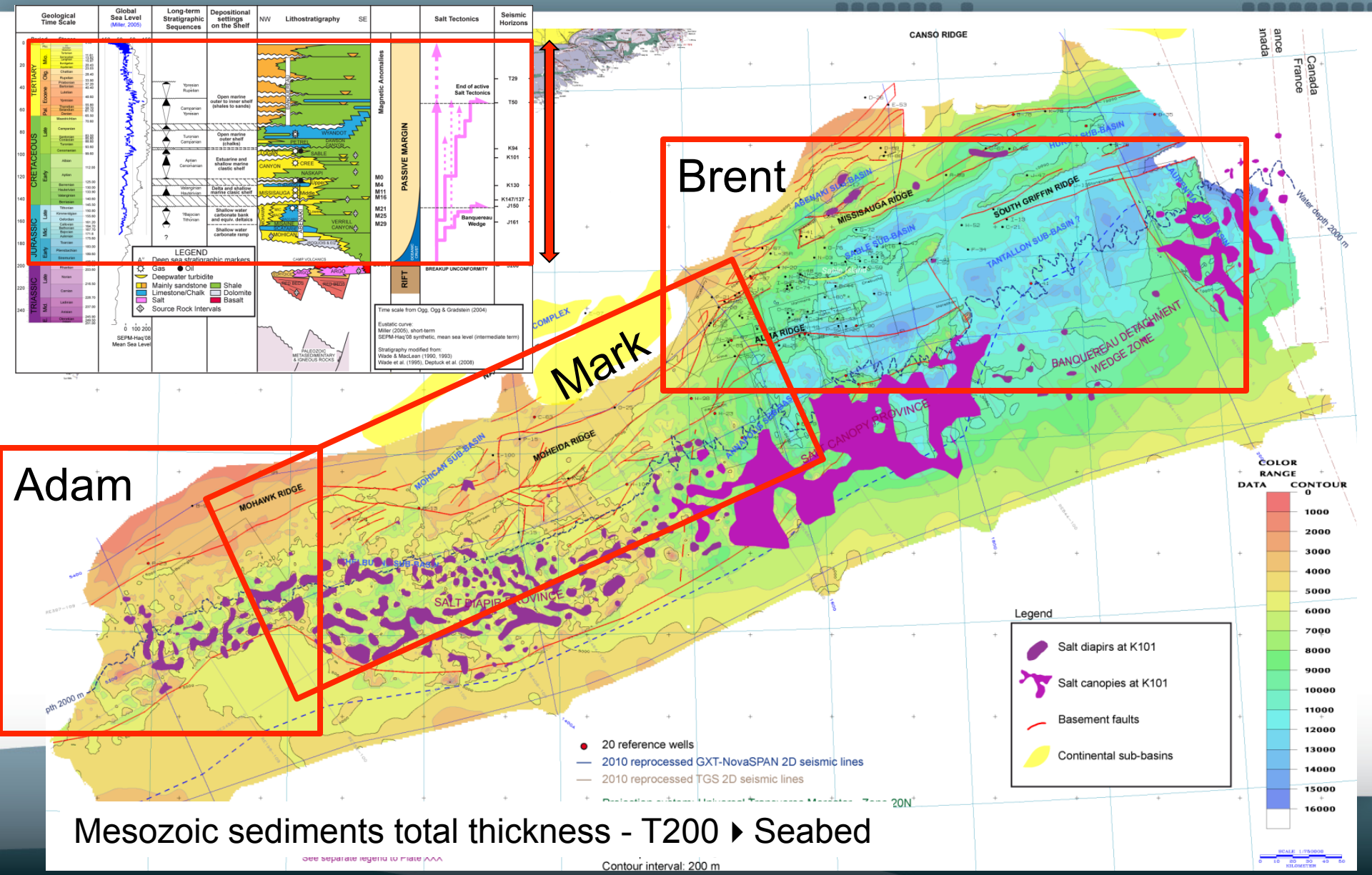


Late Albian Lowstand sands play (2)



2 very different petroleum provinces

Nova Scotia OFFSHORE



Mesozoic sediments total thickness - T200 ▸ Seabed