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SECARB Offshore

Reservoir Properties and Storage Resource in the Central Gulf of Mexico

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Introduction

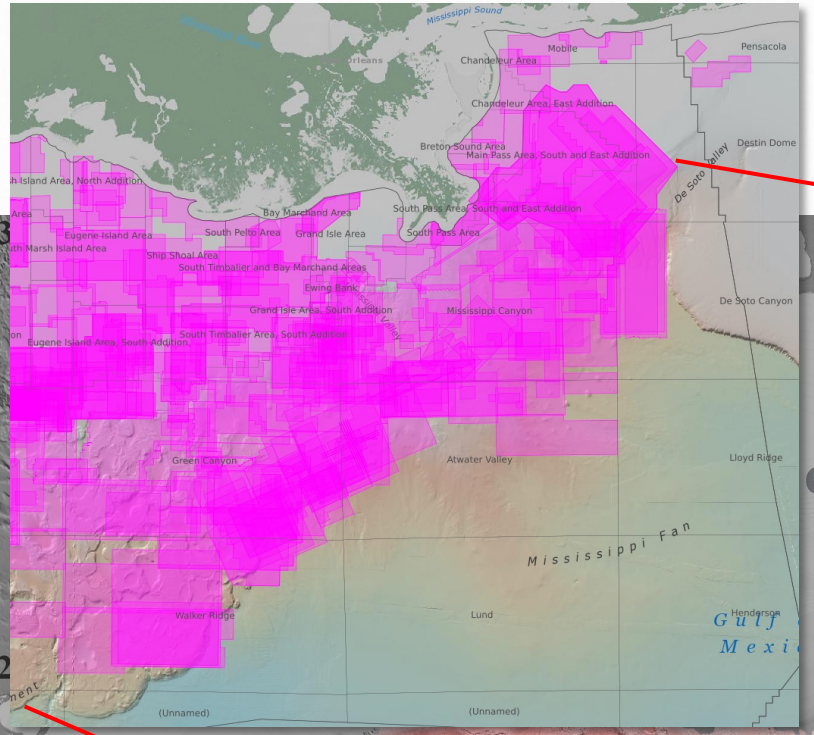
- What are key reservoir properties in the Central Gulf of Mexico?
- What are total storage resources in this region?

Objectives

- Geological Characterization based on 3D seismic, geophysical well logs, and reservoir data (Stratigraphy, sedimentation, structure, hydrodynamic analysis).
- Analyze reservoir properties, storage volumetrics, potential storage mechanisms, migration pathways, and reservoir integrity to develop geologic screening criteria.
- Understand temperature pressure regime and implications for geologic CO_2 storage and enhanced recovery.
- Determine regional storage resources using NETL static method.

Project Area

Focus area with 3D seismic coverage

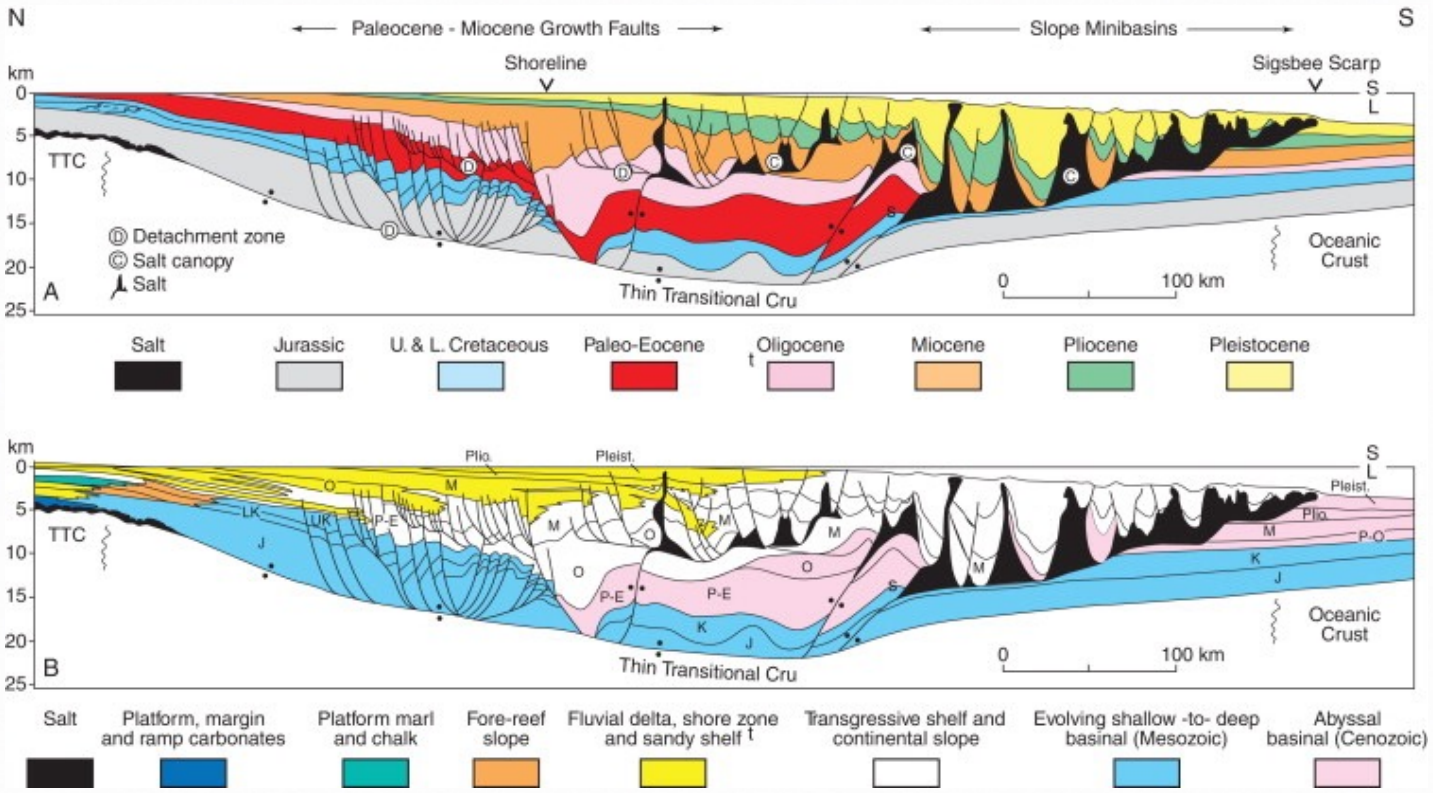


Priority regions:

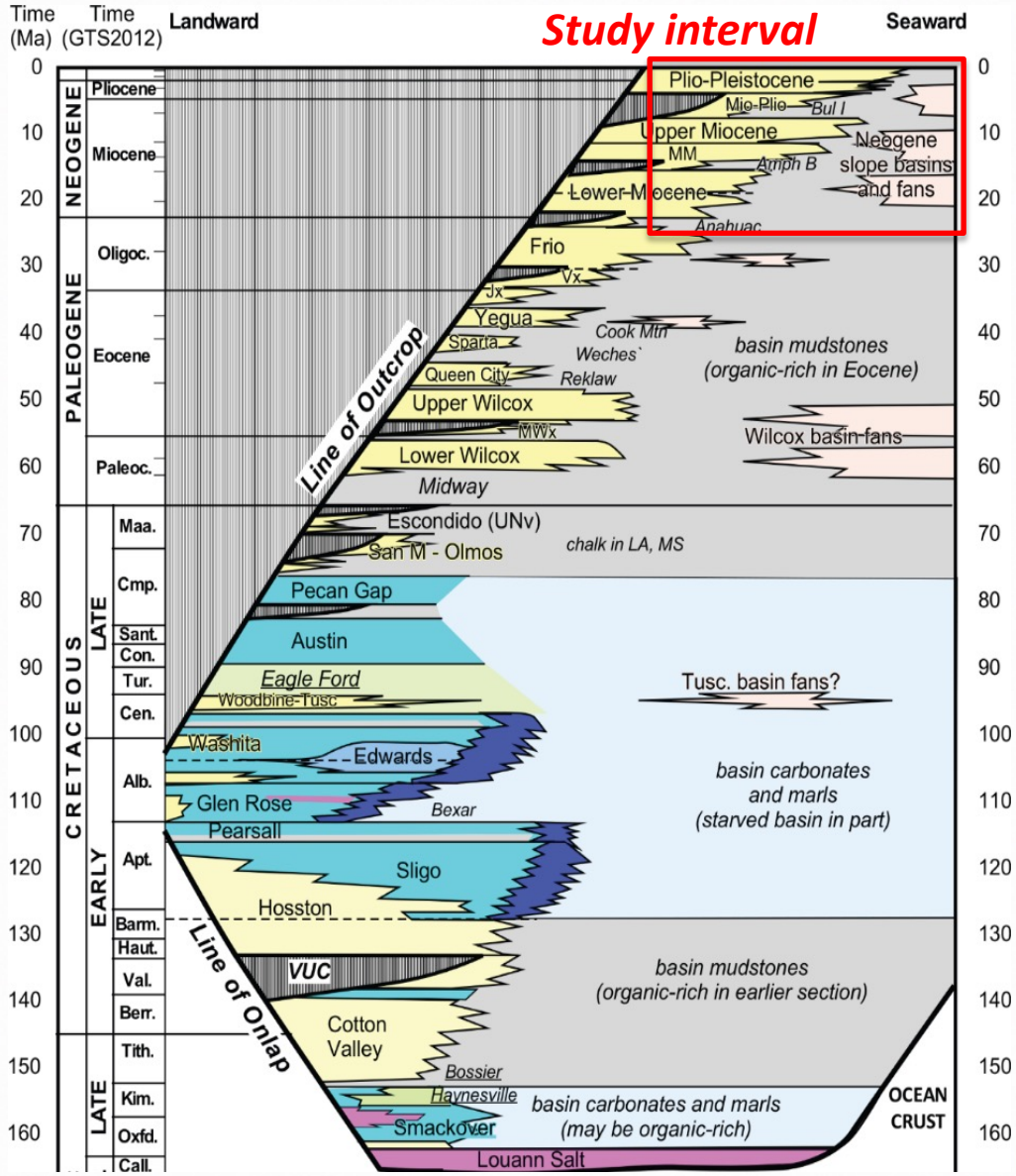
Cognac
Petronius
Mars-Ursa
Tubular Bells
Mensa
Thunderhorse

Bathymetric map

Shelf-Slope Transect

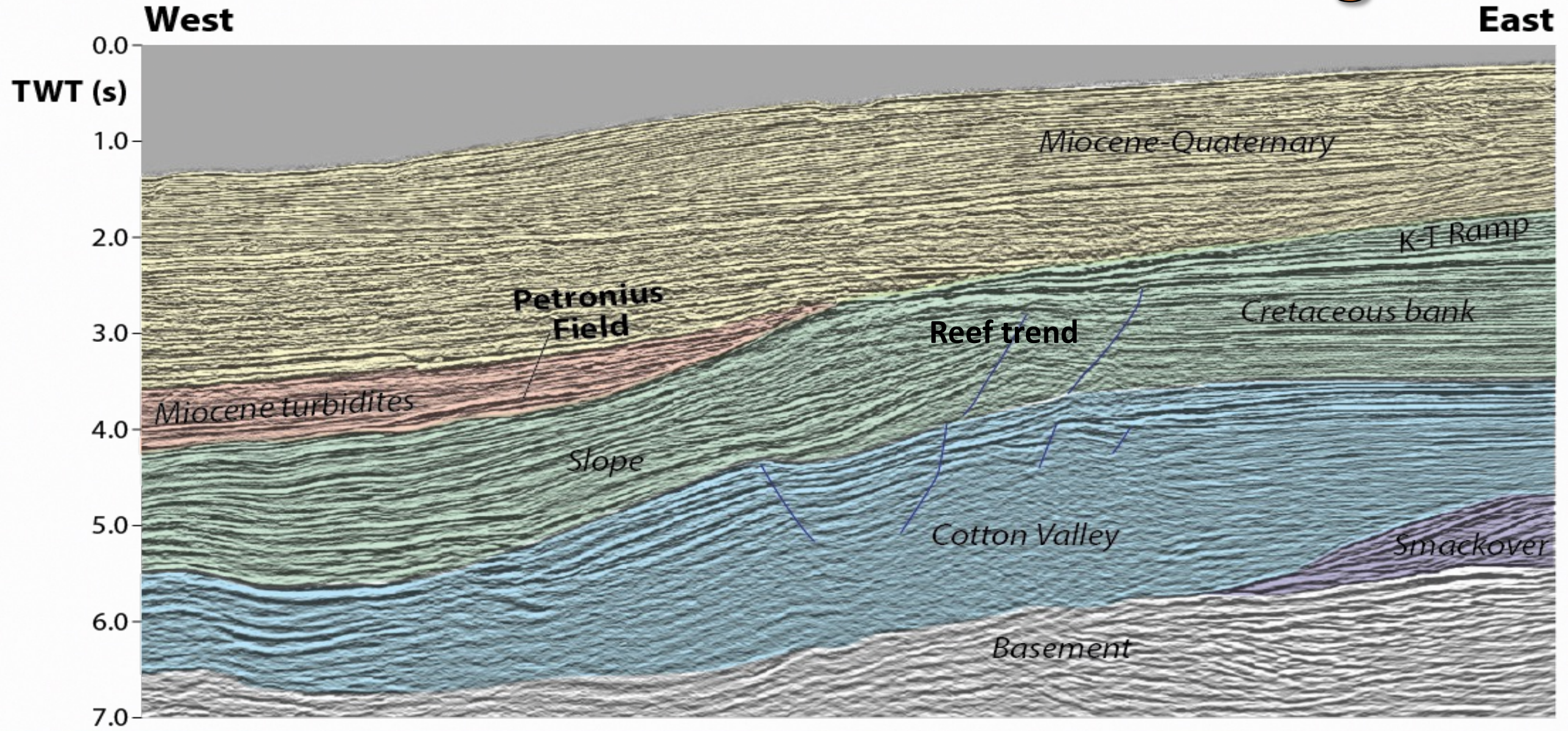


Galloway (2008)

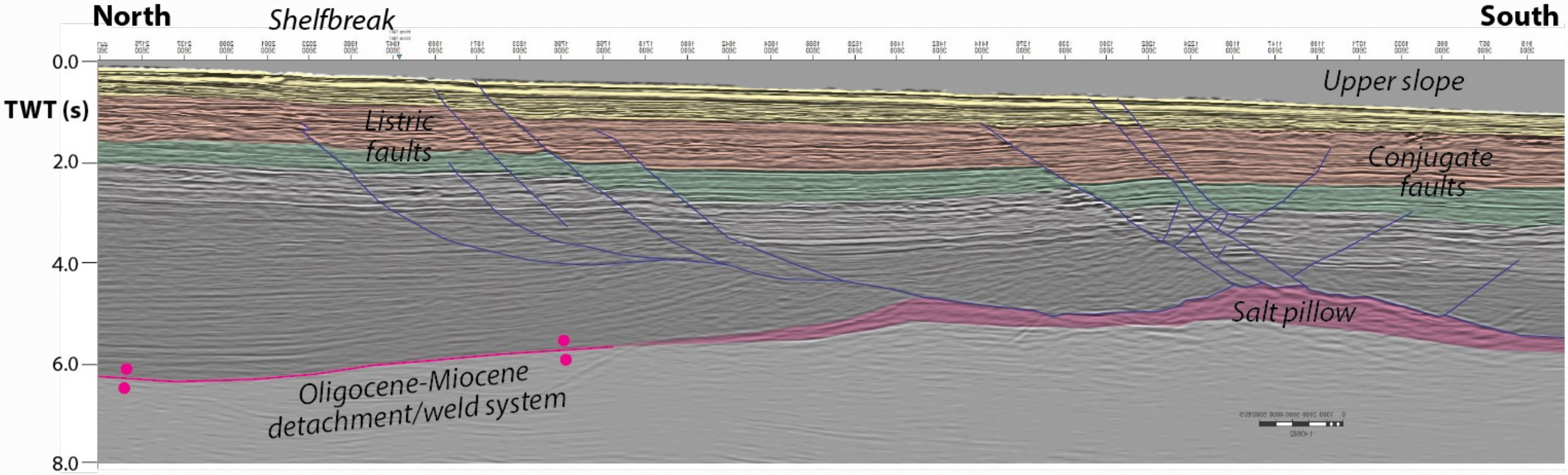


Ewing and Galloway (2019)

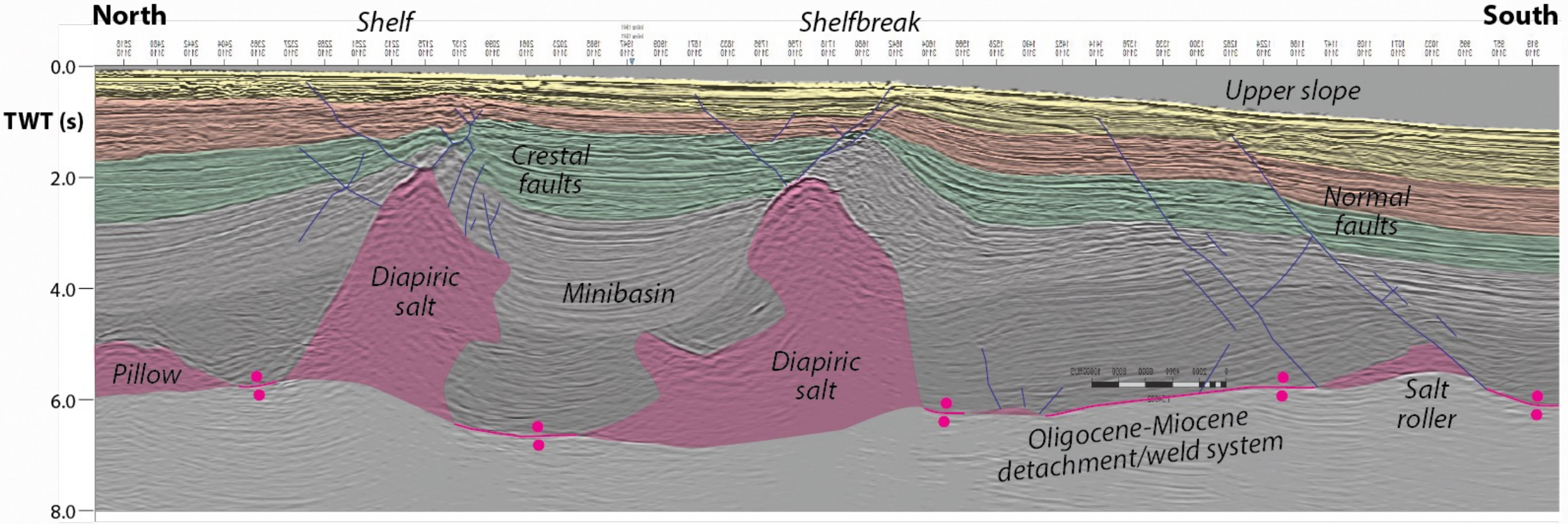
Petronius Field and Cretaceous Bank Margin



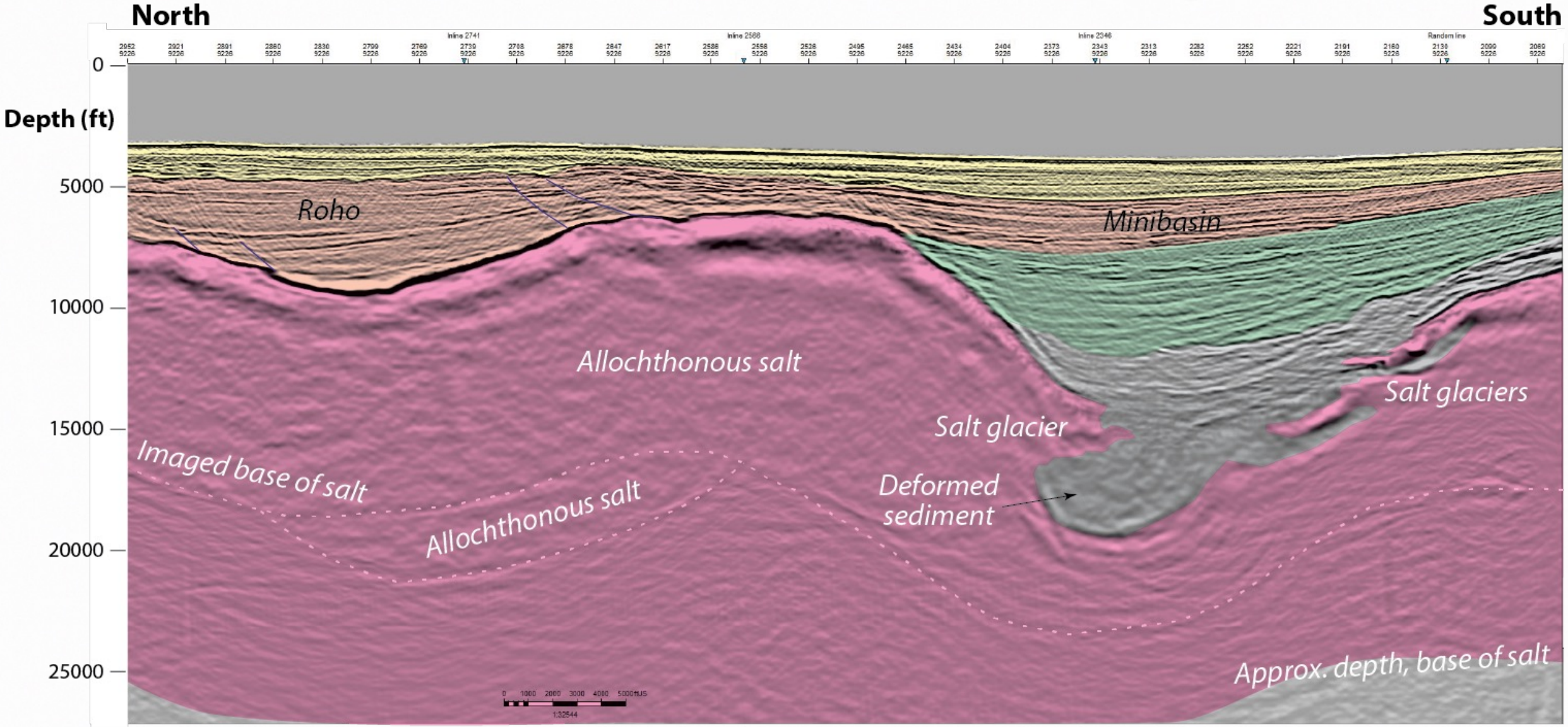
Half Grabens and Salt Pillows, Ewing Bank shelfbreak



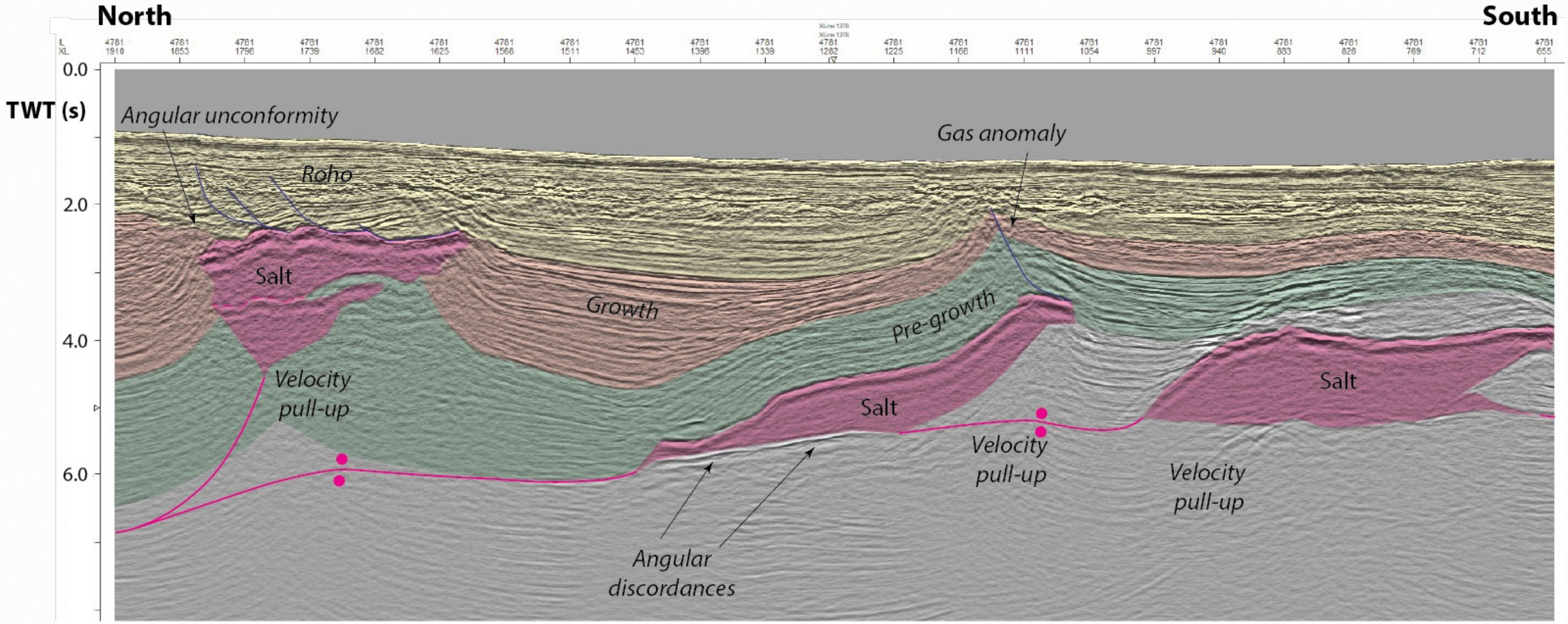
Diapiric Salt Bodies, Ewing Bank Shelfbreak



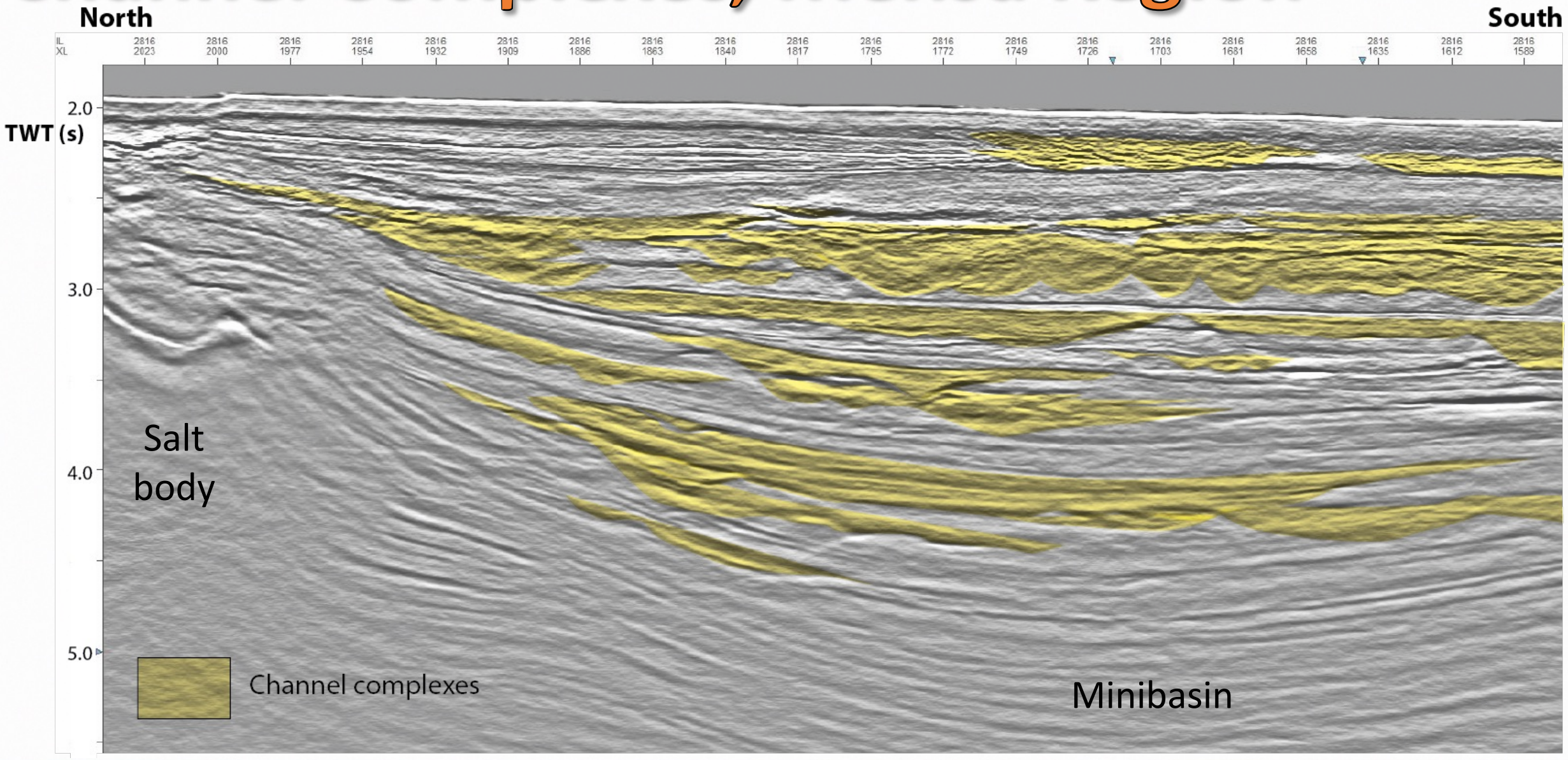
Roho and Minibasin, Green Canyon Area



Mars-Ursa Minibasin Complex



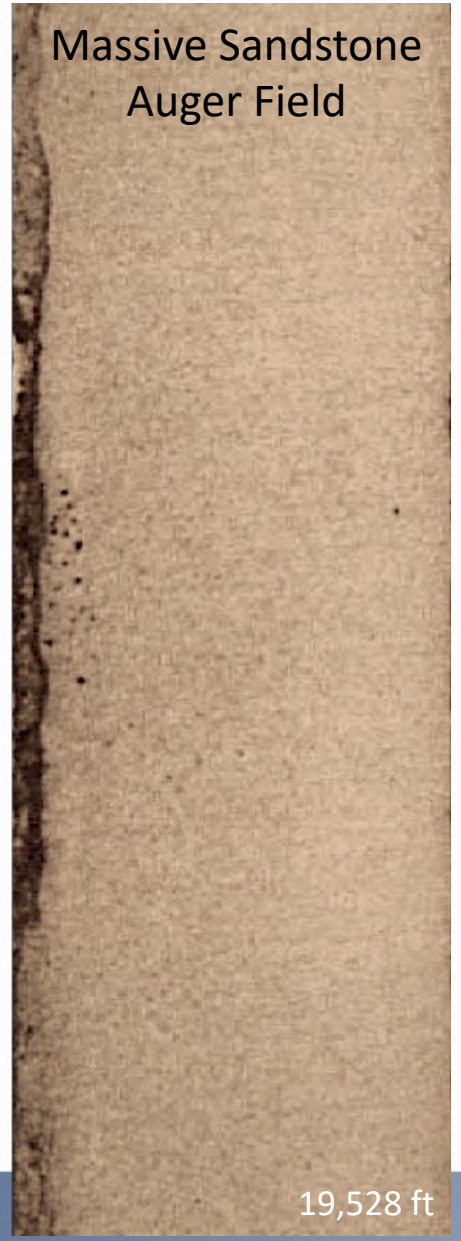
Channel Complexes, Mensa Region



Core Photos

Conglomerate
Thunderhorse Field

Massive Sandstone
Auger Field



Graded Sandstone
Green Canyon 184

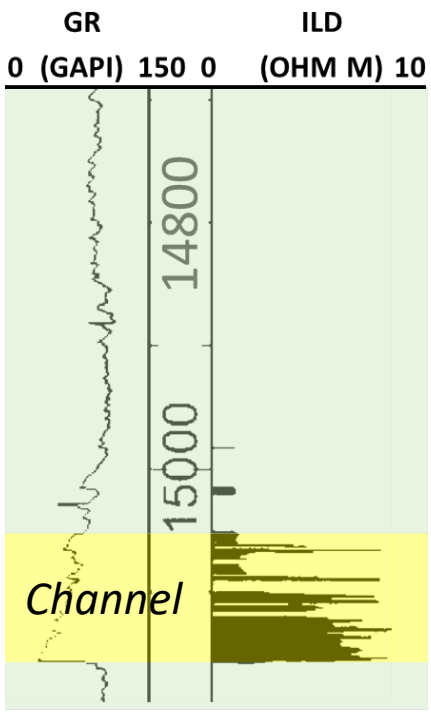
Rippled, Convoluted
Sandstone, GC 18

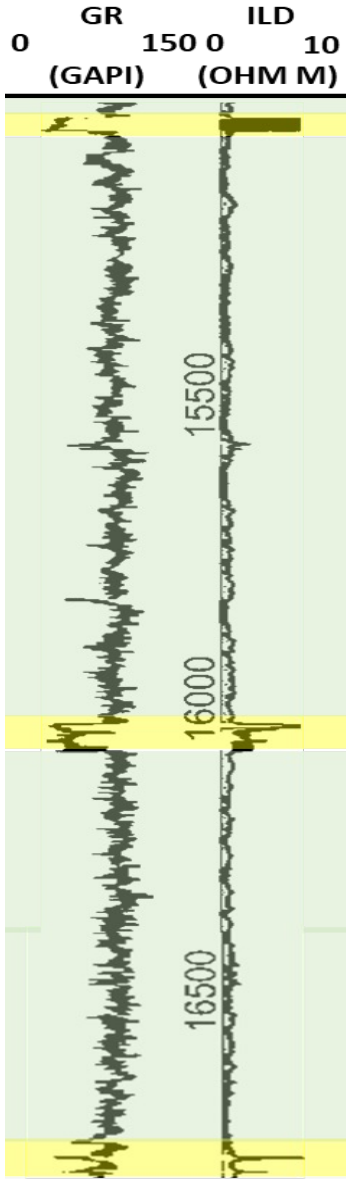
Convolute Mudstone
Thunderhorse Field

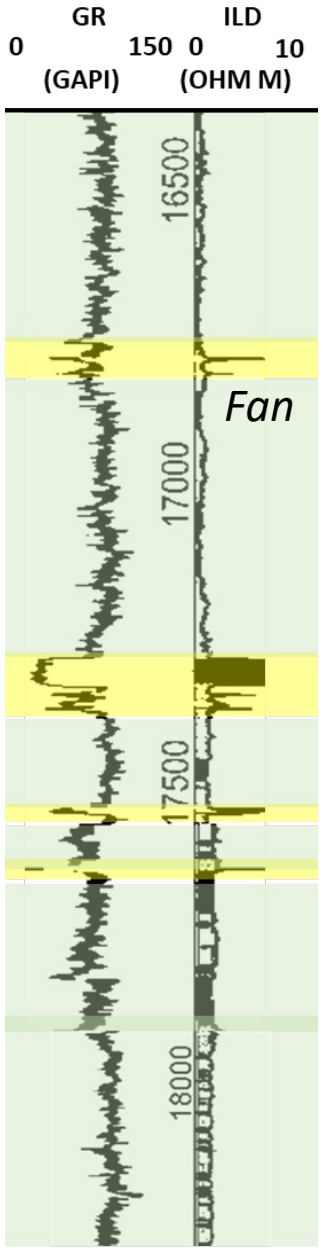
Core diameter = 10 cm
various sources

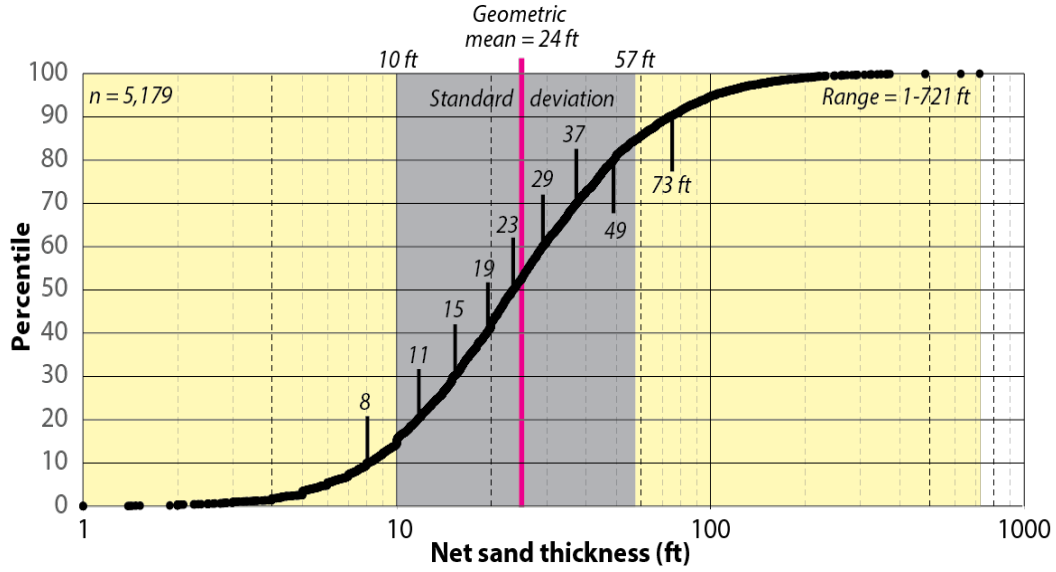
Net Sand Thickness

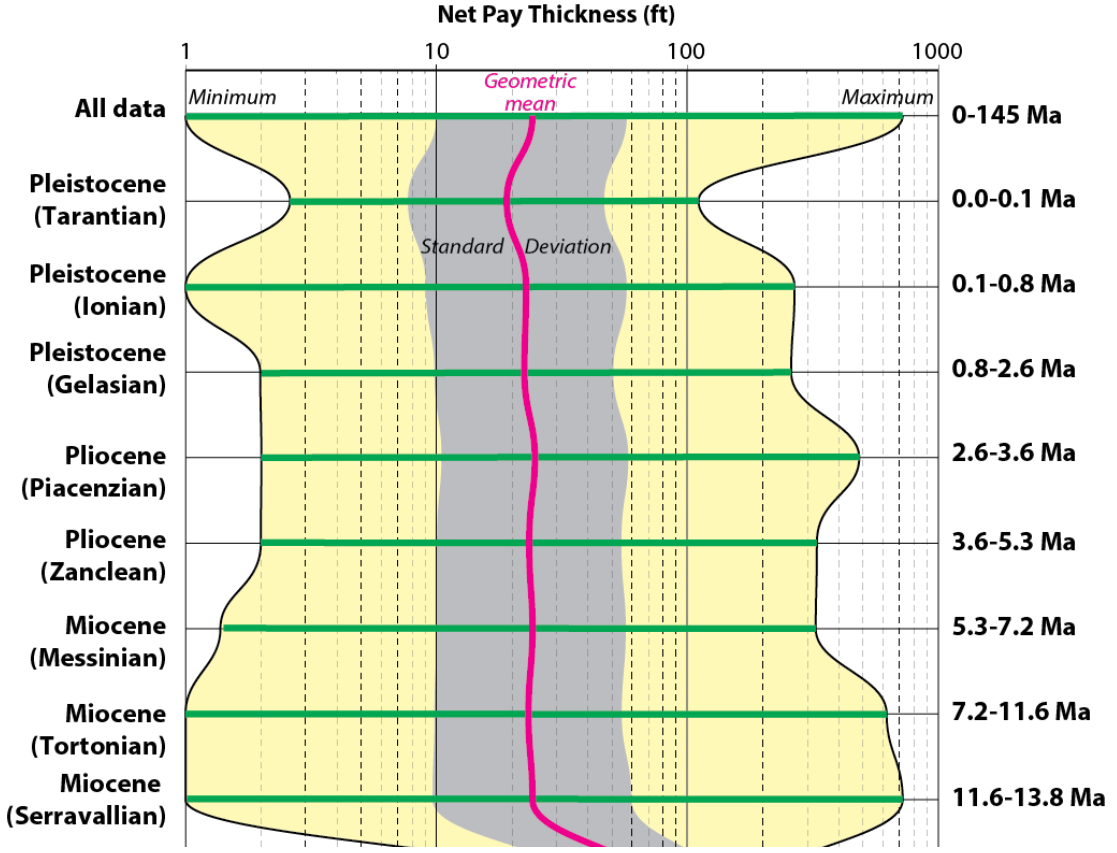
Well logs
Mississippi
Canyon Area





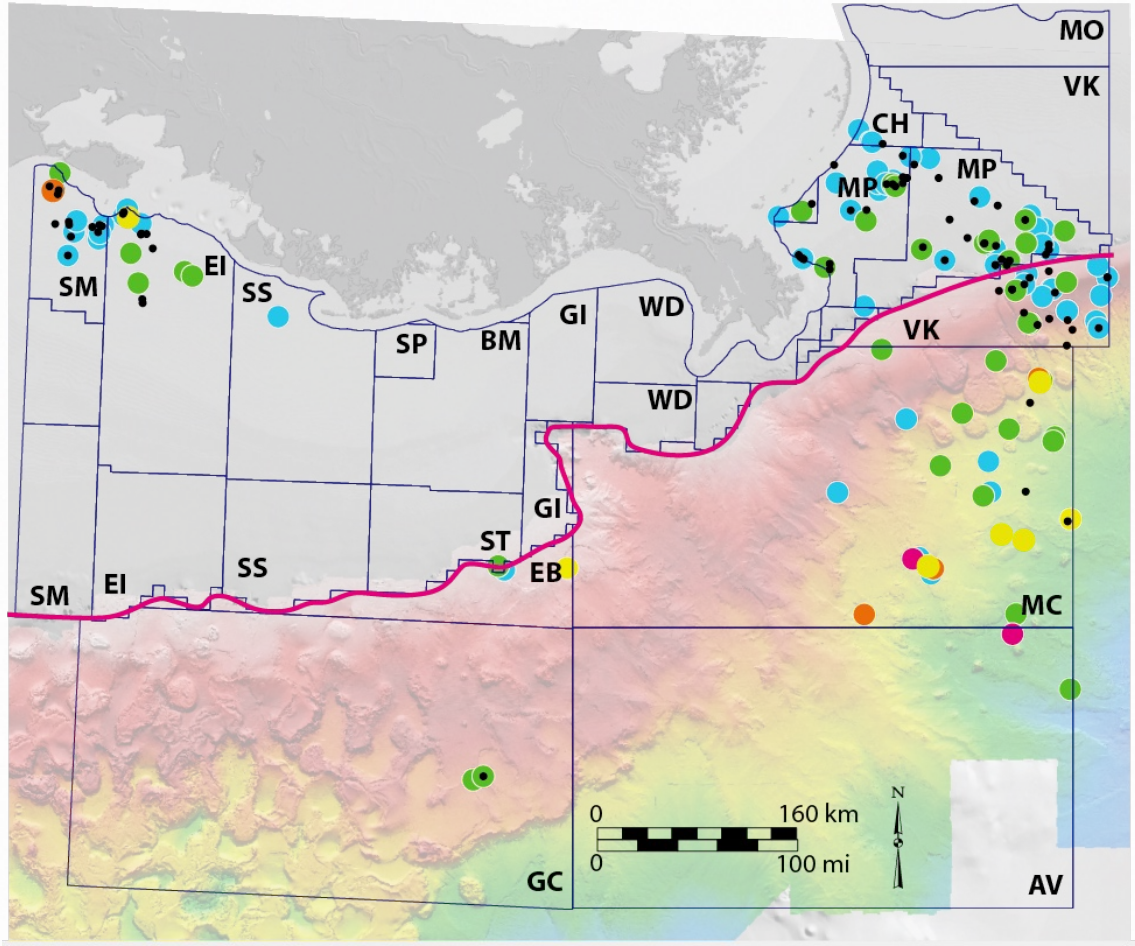




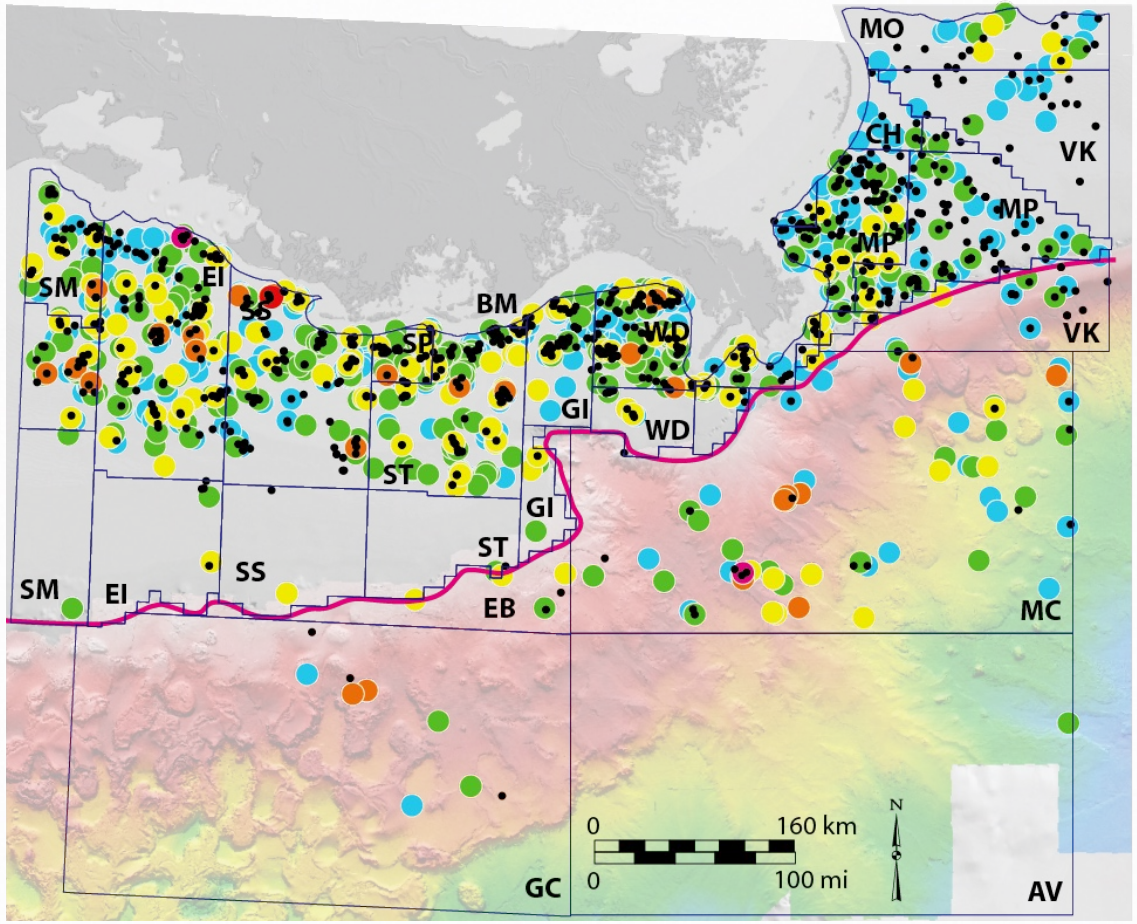


Net Sand Thickness

Miocene: Serravallian (13.82–11.63 Ma)



Miocene: Tortonian-Messinian (11.63–5.33 Ma)

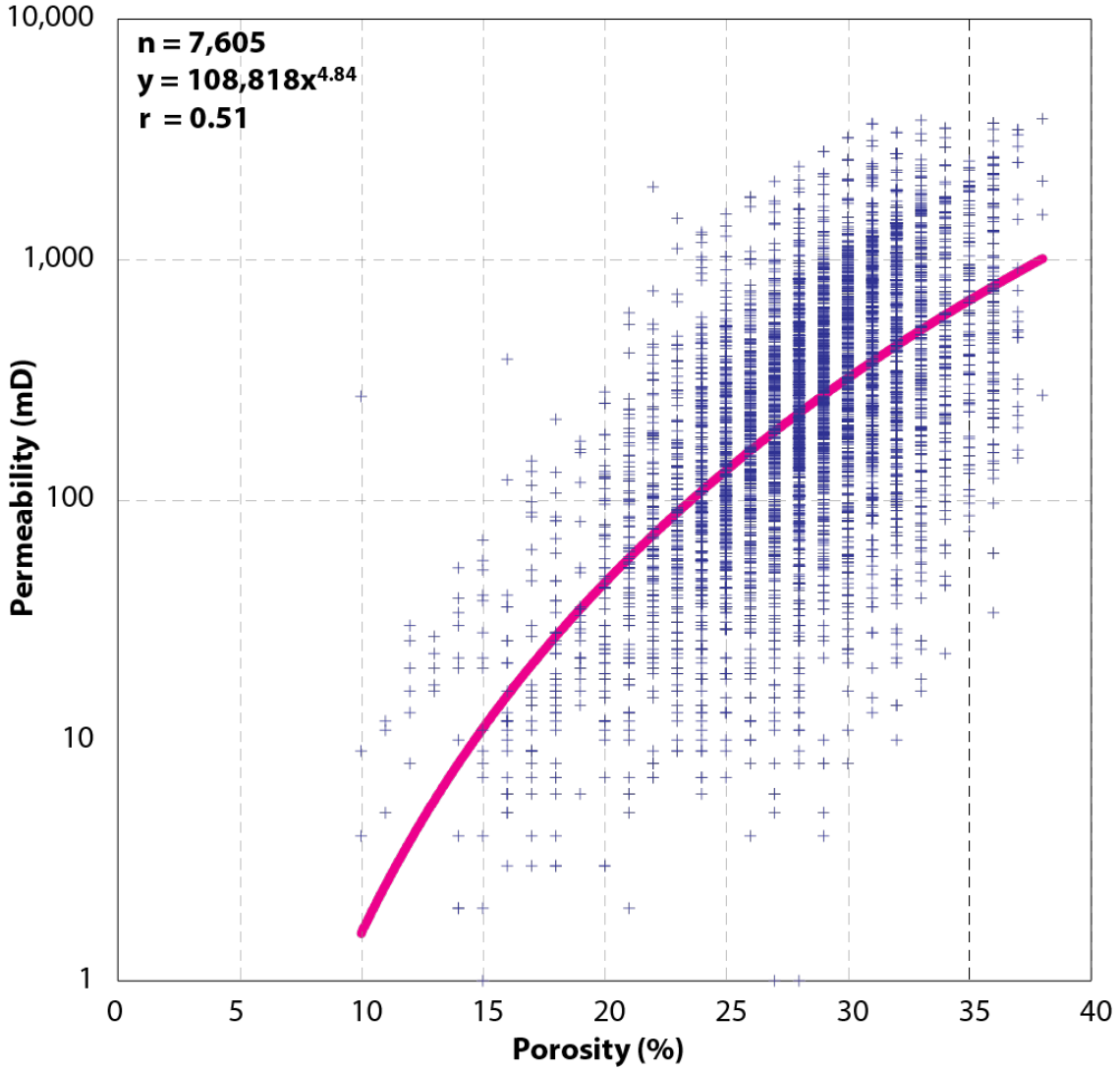


Net thickness (ft)

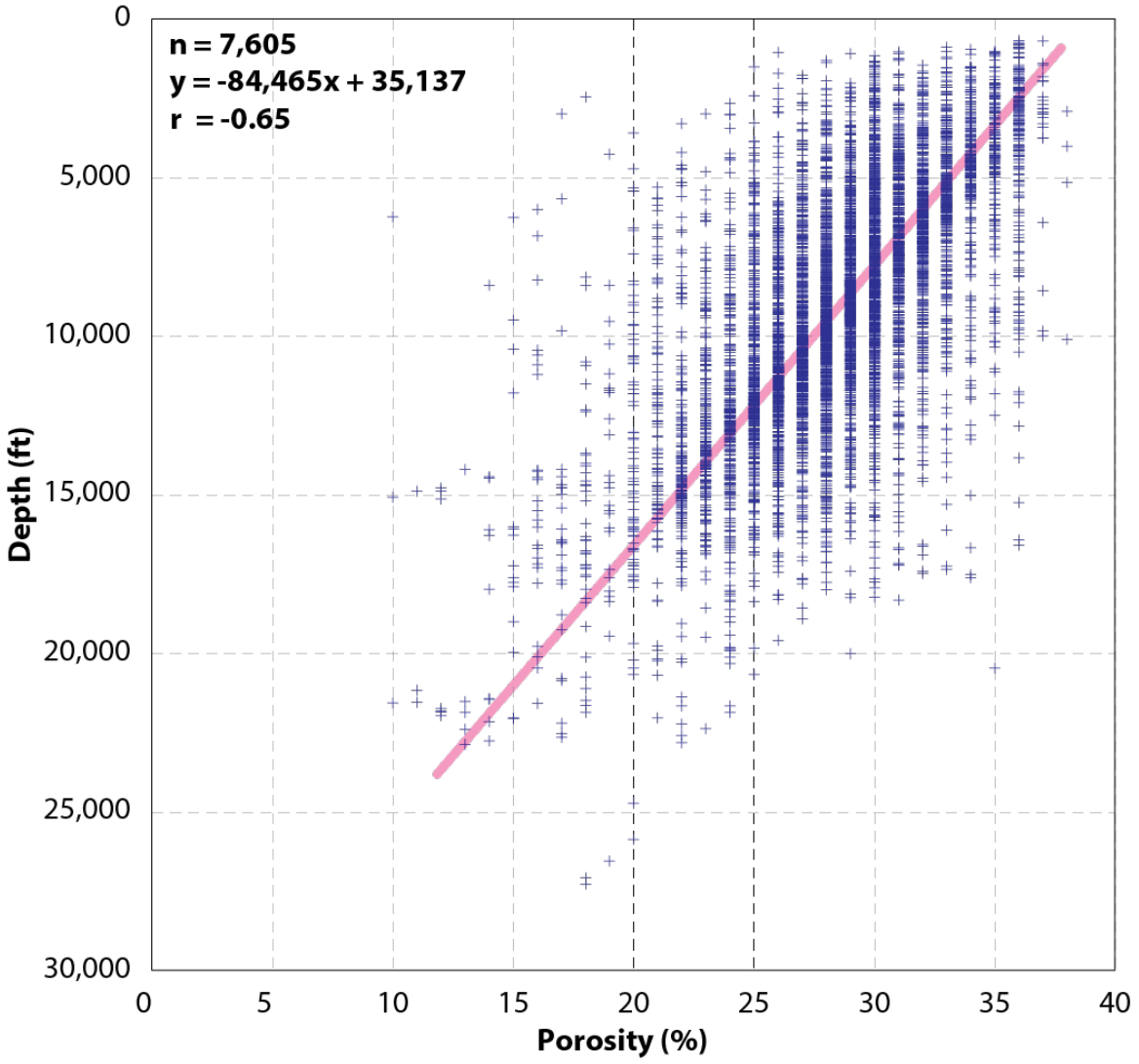
- < 20
- 20-40
- 40-80
- 80-160
- 160-320
- > 320

Effective Porosity and Permeability

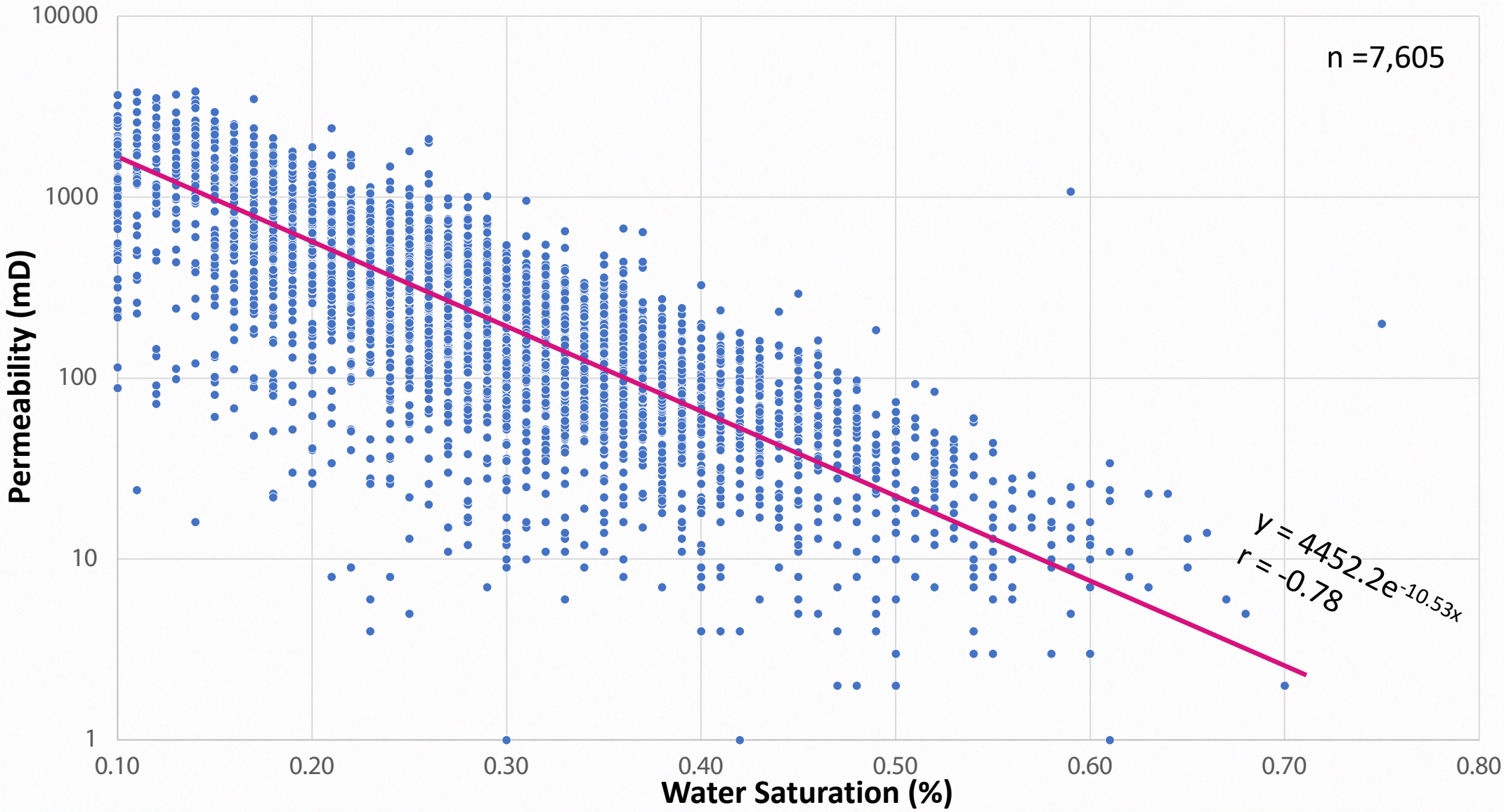
Porosity-Permeability plot



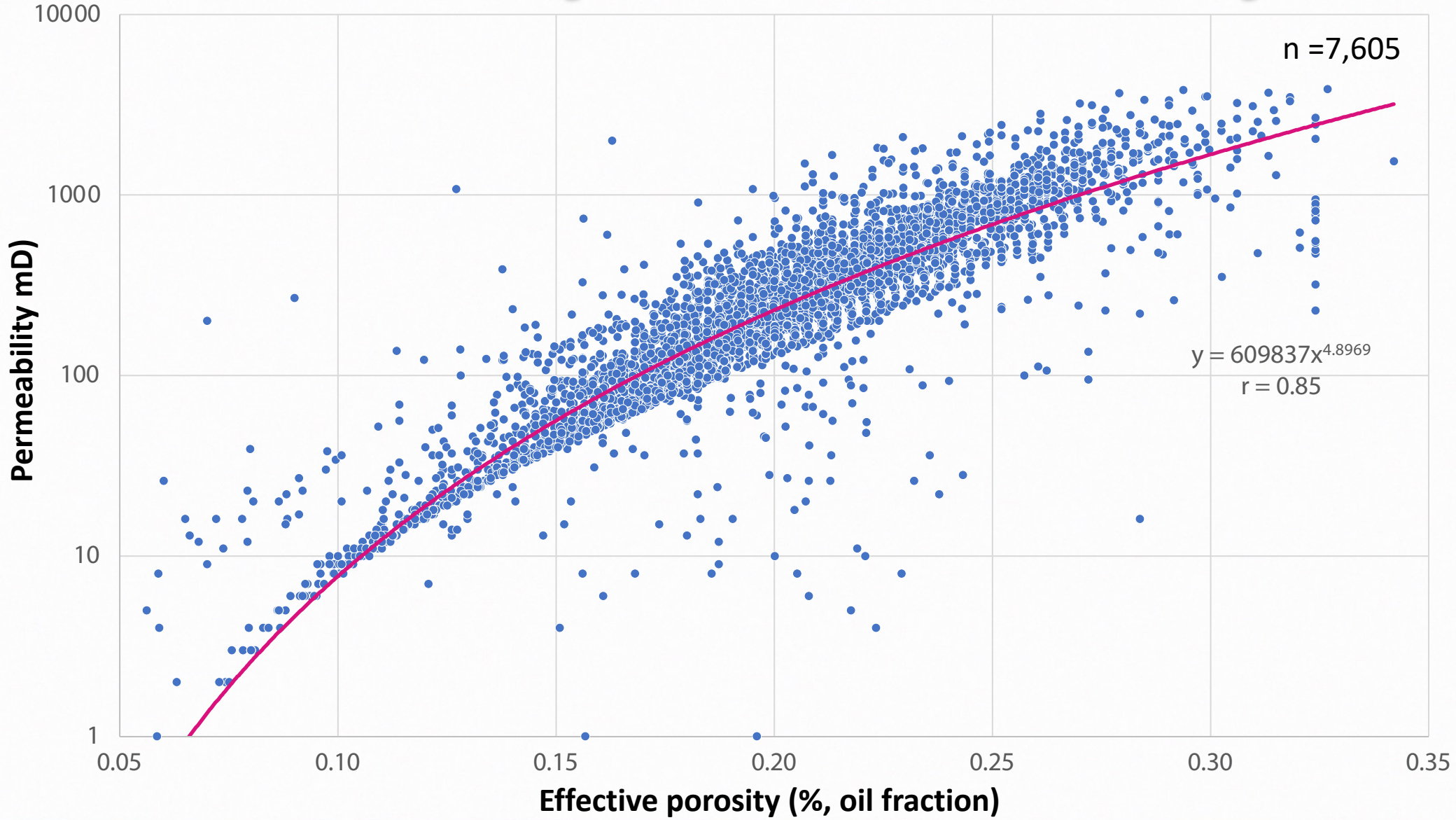
Porosity-Depth plot



Water Saturation vs. Permeability



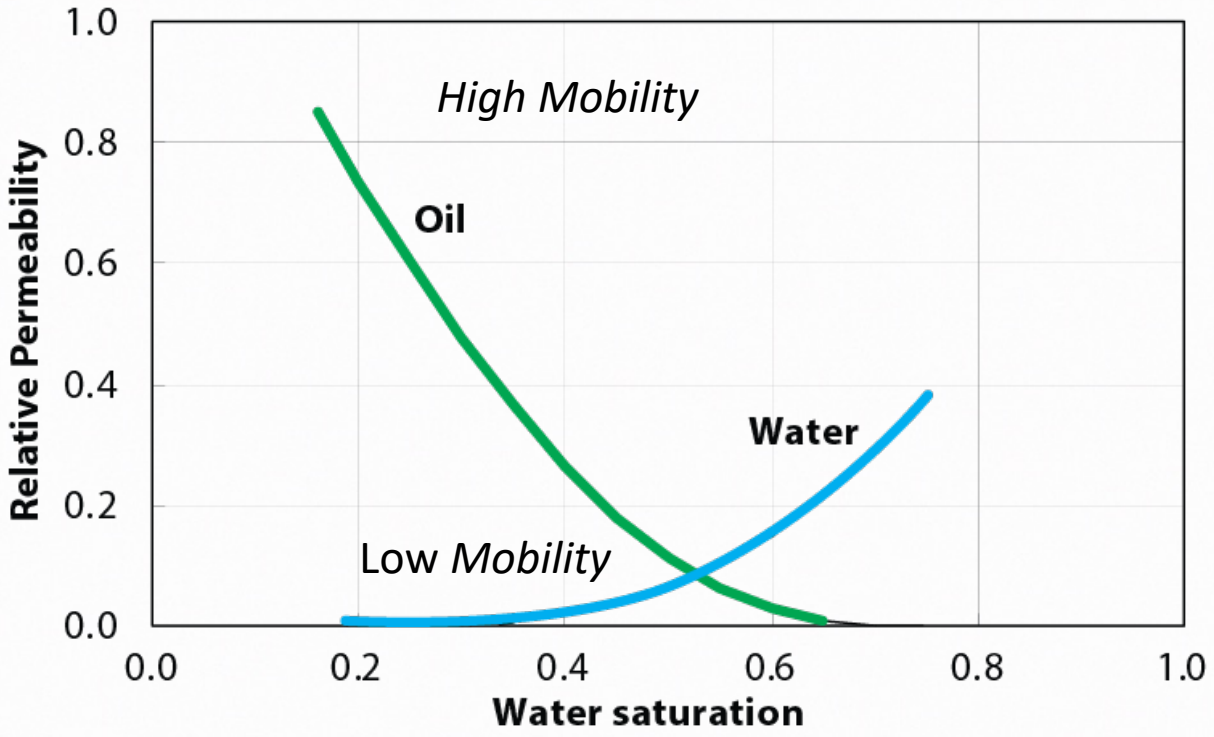
Effective Porosity vs. Permeability



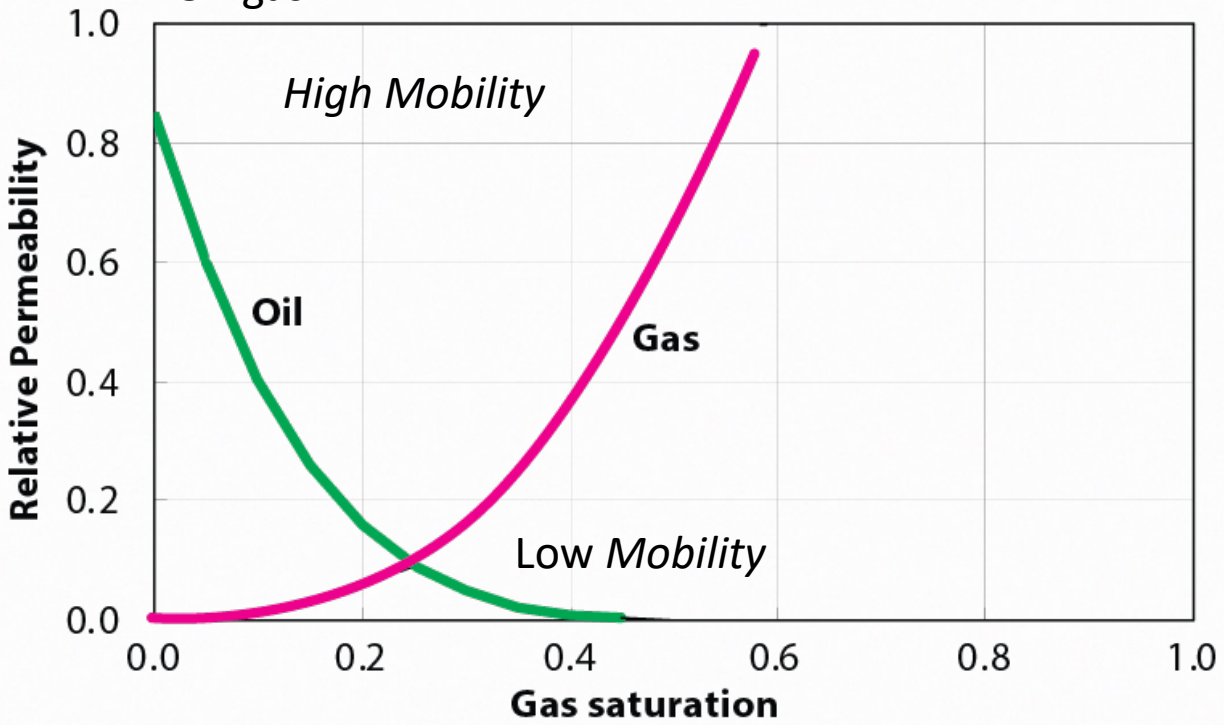
Relative Permeability Curves

Pliocene J1 and J2 reservoirs, Bullwinkle Platform, Green Canyon Block 65

Oil-water



Oil-gas

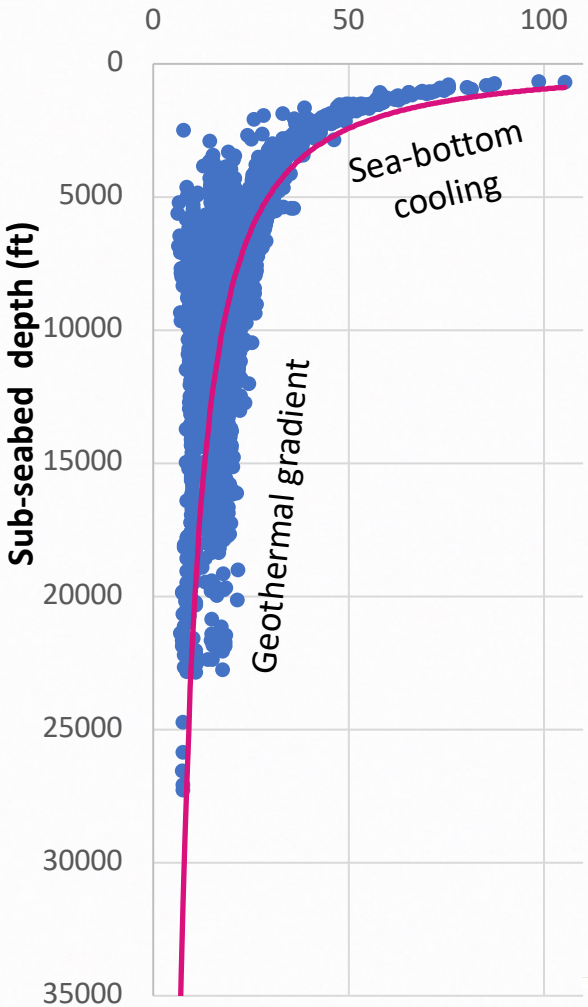


Best (2002)

What do relative permeability curves look like in a CO_2 storage system?

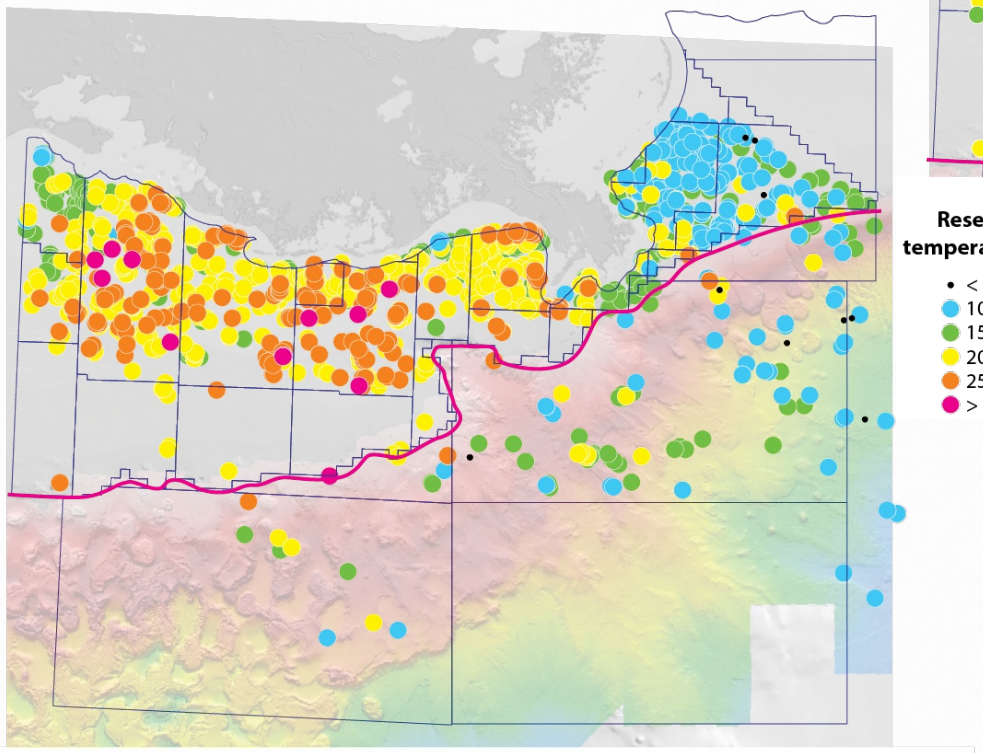
Original Temperature

Geothermal gradient (°F/1000 ft)



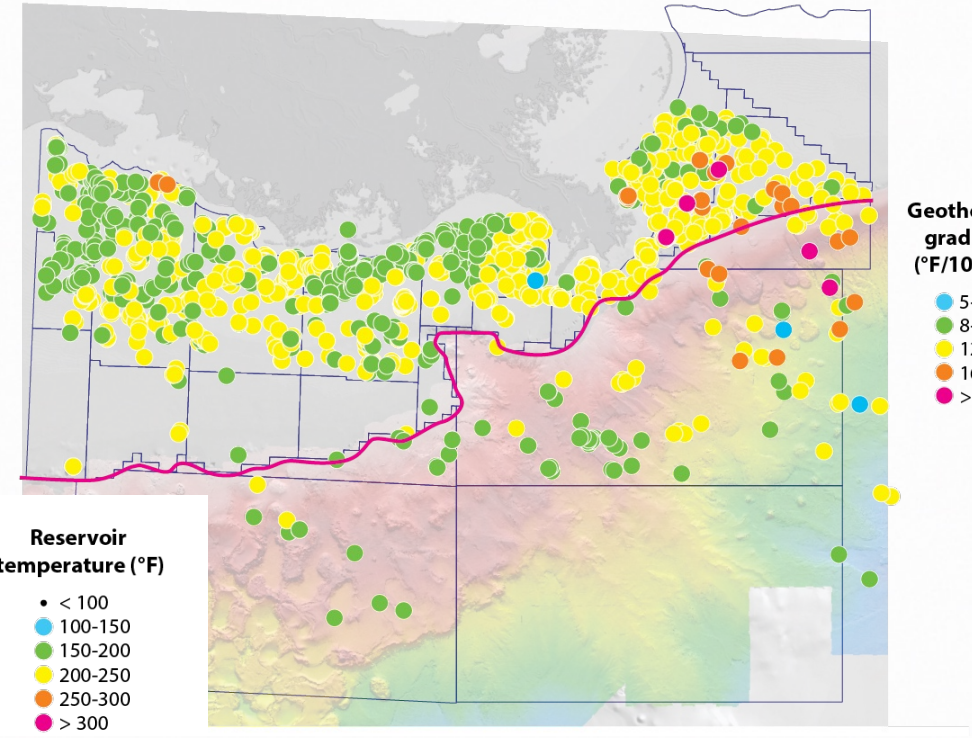
Reservoir temperature

Miocene: Tortonian-Messinian (11.63–5.33 Ma)

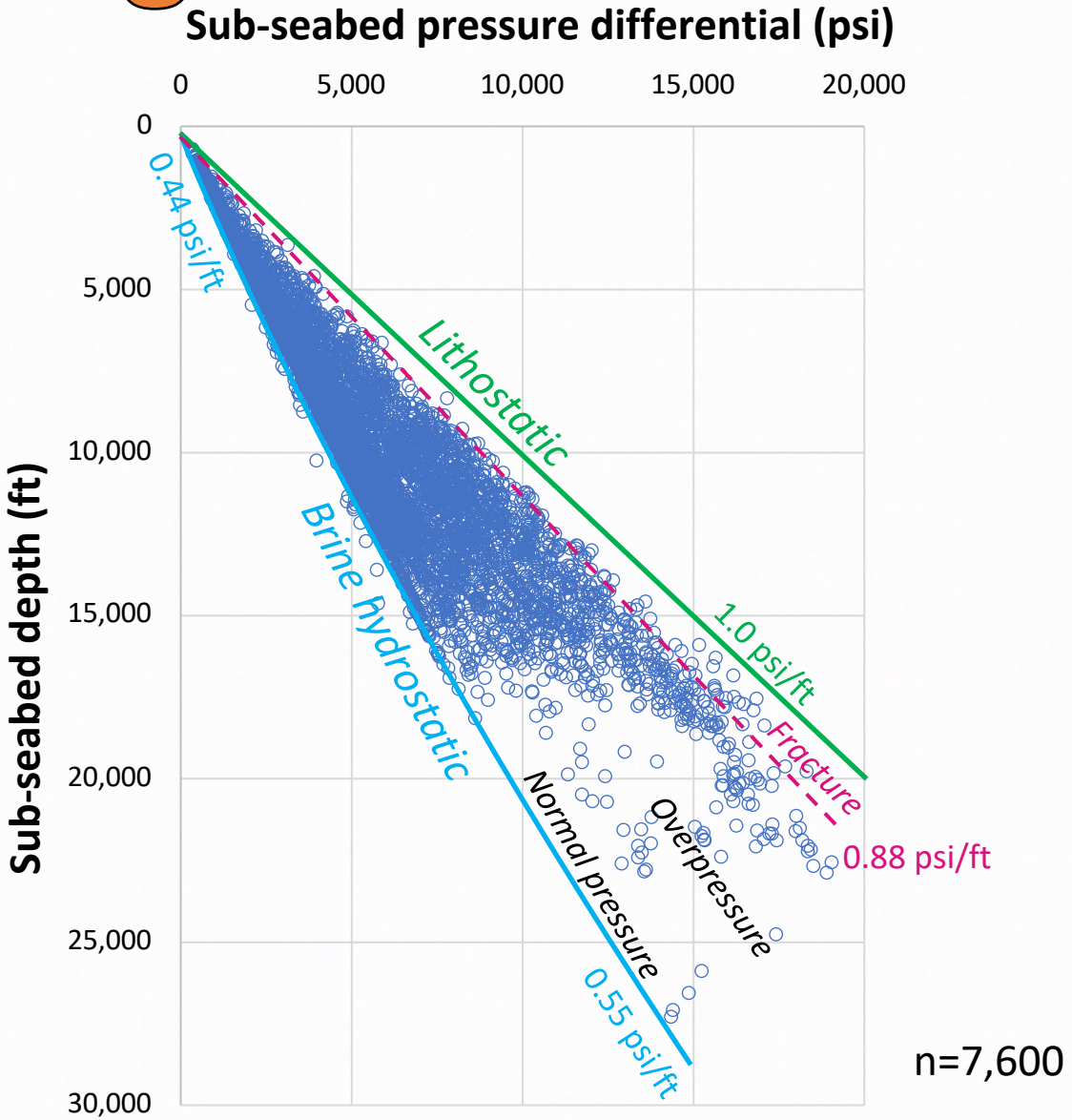


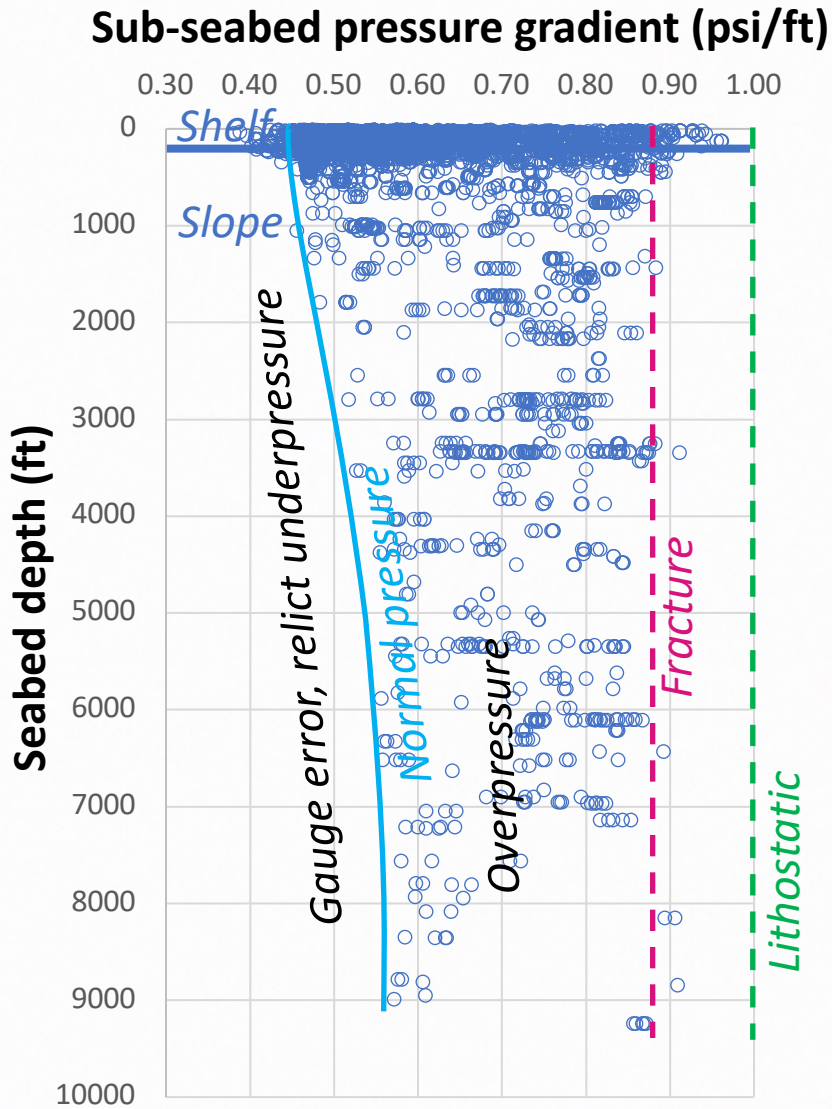
Geothermal gradient

Miocene: Tortonian-Messinian (11.63–5.33 Ma)



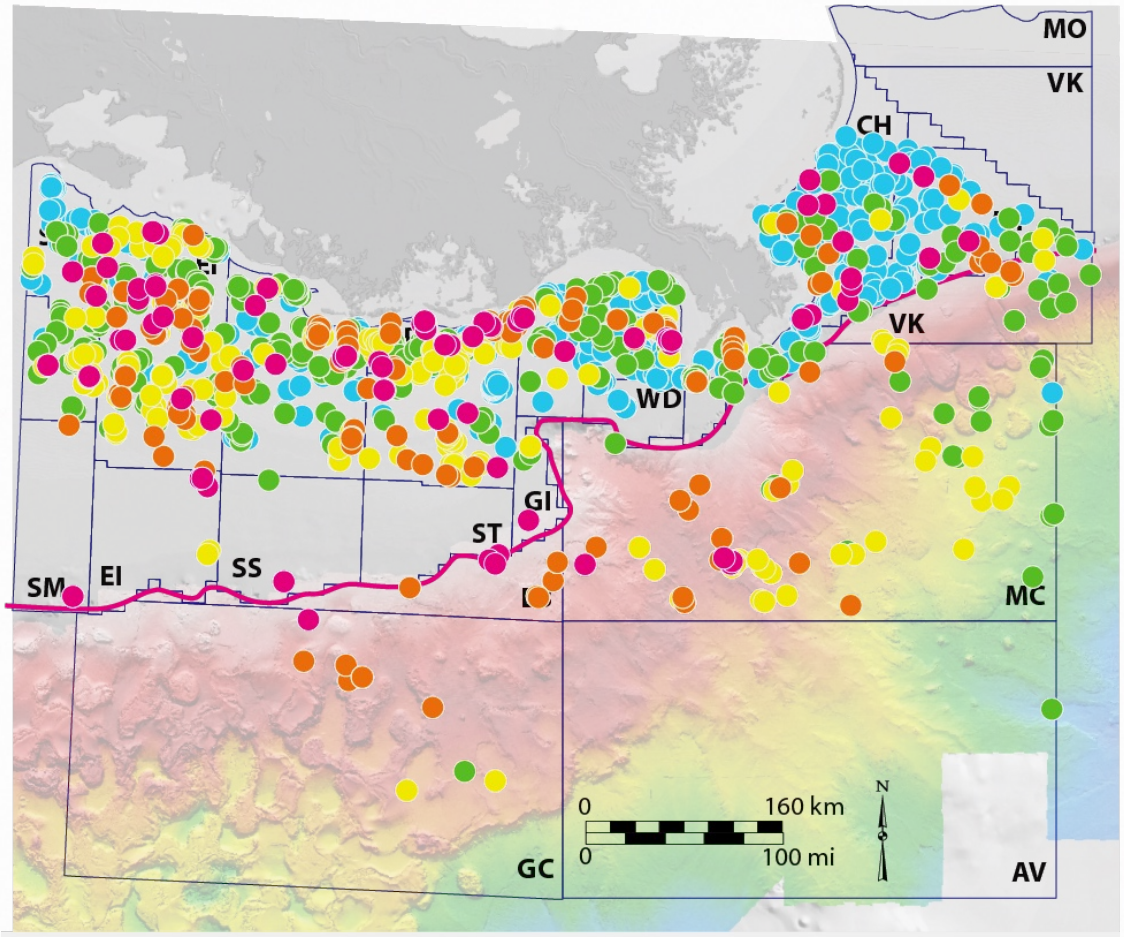
Original Pressure Profiles



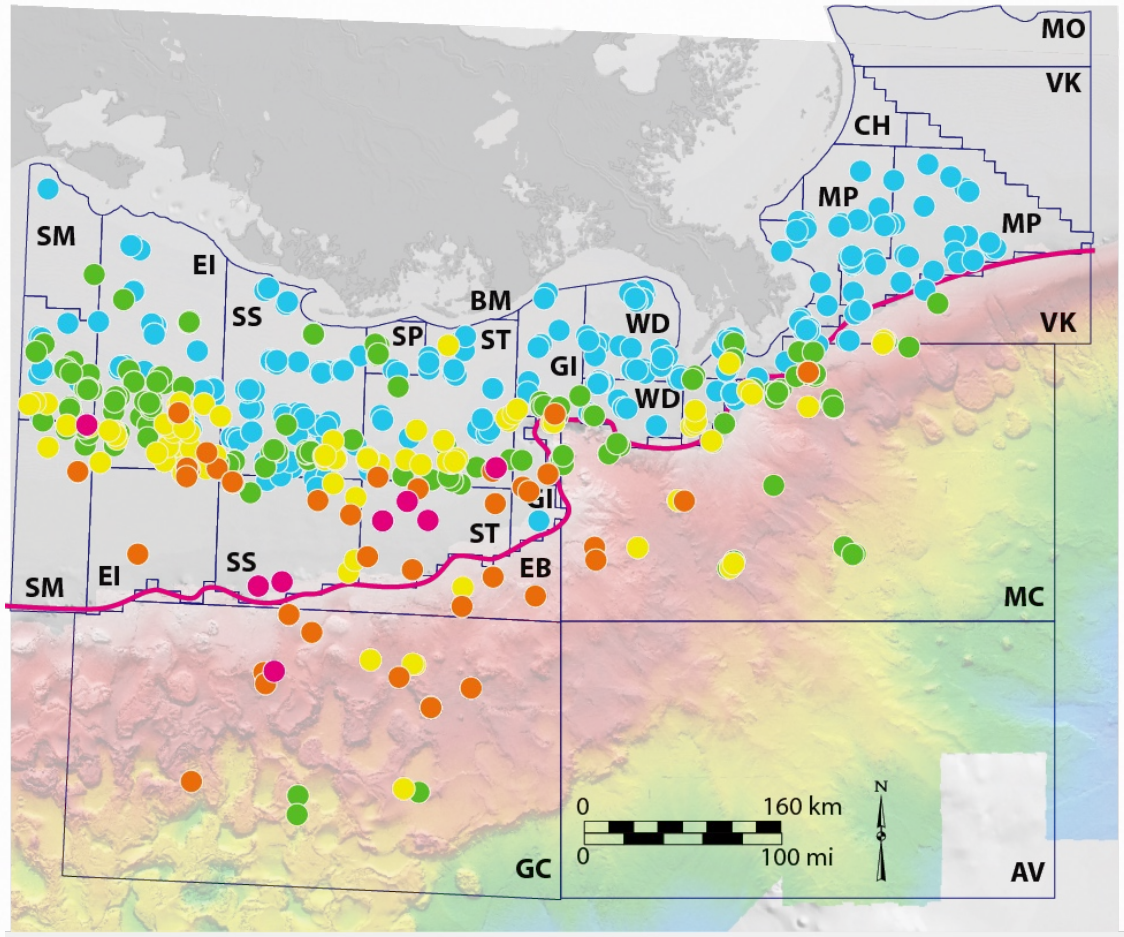


Original Pressure Gradient

Miocene: Tortonian–Messinian (11.63–5.33 Ma)



Pliocene: Zanclean (5.53–3.60 Ma)



Pressure gradient (psi/ft)

- < 0.50
- 0.50–0.60
- 0.60–0.70
- 0.70–0.80
- 0.80–0.90
- > 0.90

Storage Resource by Reservoir Age

Age	Age top (Ma)	Area (km^2)	Avg. subsea depth (ft)	Average Temperature (°C)	Avg. pressure (Mpa)	Avg.CO_2 density (g/cc)	P_{50} Storage resource (Gt)
Pleistocene undiff.	0.001	36,807	5,268	56	20	0.75	36
Pliocene (Piacenzian)	2.58	46,357	7,669	72	30	0.79	37
Pliocene (Zanclean)	3.60	44,373	9,428	83	37	0.81	36
Miocene (Tortonian-Messinian)	5.33	61,473	10,703	93	43	0.82	30
Miocene (Serravallian)	11.63	36,650	10,372	84	47	0.85	37
Miocene (Langhian)	13.82	2,714	16,575	118	82	0.89	45
Miocene (Burdigalian)	15.97	108	21,792	148	113	1.10	81
Cenozoic undiff.	0.001	10,772	23,563	93	108	1.00	157
Cretaceous	66	2,351	13,985	126	46	0.72	14
TOTAL							**473**

176 Gt

Observations

- Shelf and slope have numerous storage/enhanced recovery options.
- Abundant high-quality reservoirs and sealing strata.
- Analytical criteria include many aspects of depositional style, structural style, hydrodynamics, geothermics, and routine reservoir properties.
- Fluid saturation and relative permeability important considerations-gas mobility higher in oil than water.
- Pressure-temperature field highly variable in shelf and slope.
- P_{50} storage resource in each stratigraphic interval ranges from 14-81 Gt.
- Preliminary P_{50} storage resource estimated at 473 Gt; 176 Gt in Serravallian-Pleistocene section.