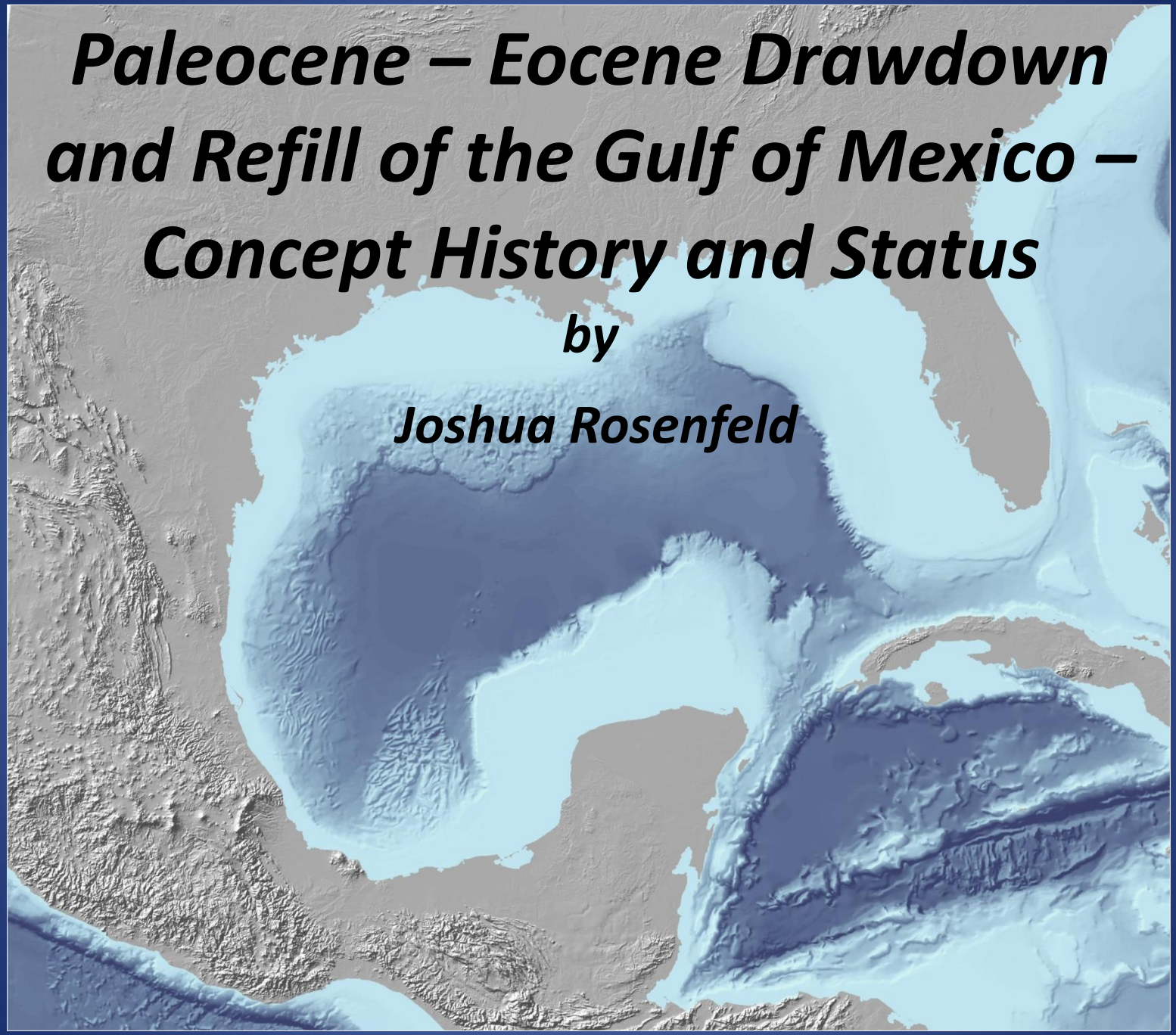
Paleocene – Eocene Drawdown and Refill of the Gulf of Mexico – Concept History and Status

by

Joshua Rosenfeld



The Concept:

- *The Gulf was isolated from the world ocean as the Cuban Arc docked against the Florida/Bahamas Block at about the Paleocene-Eocene boundary*

- *Subsequent evaporation lowered the level of the Gulf within several thousand years by some 2,000 meters.*

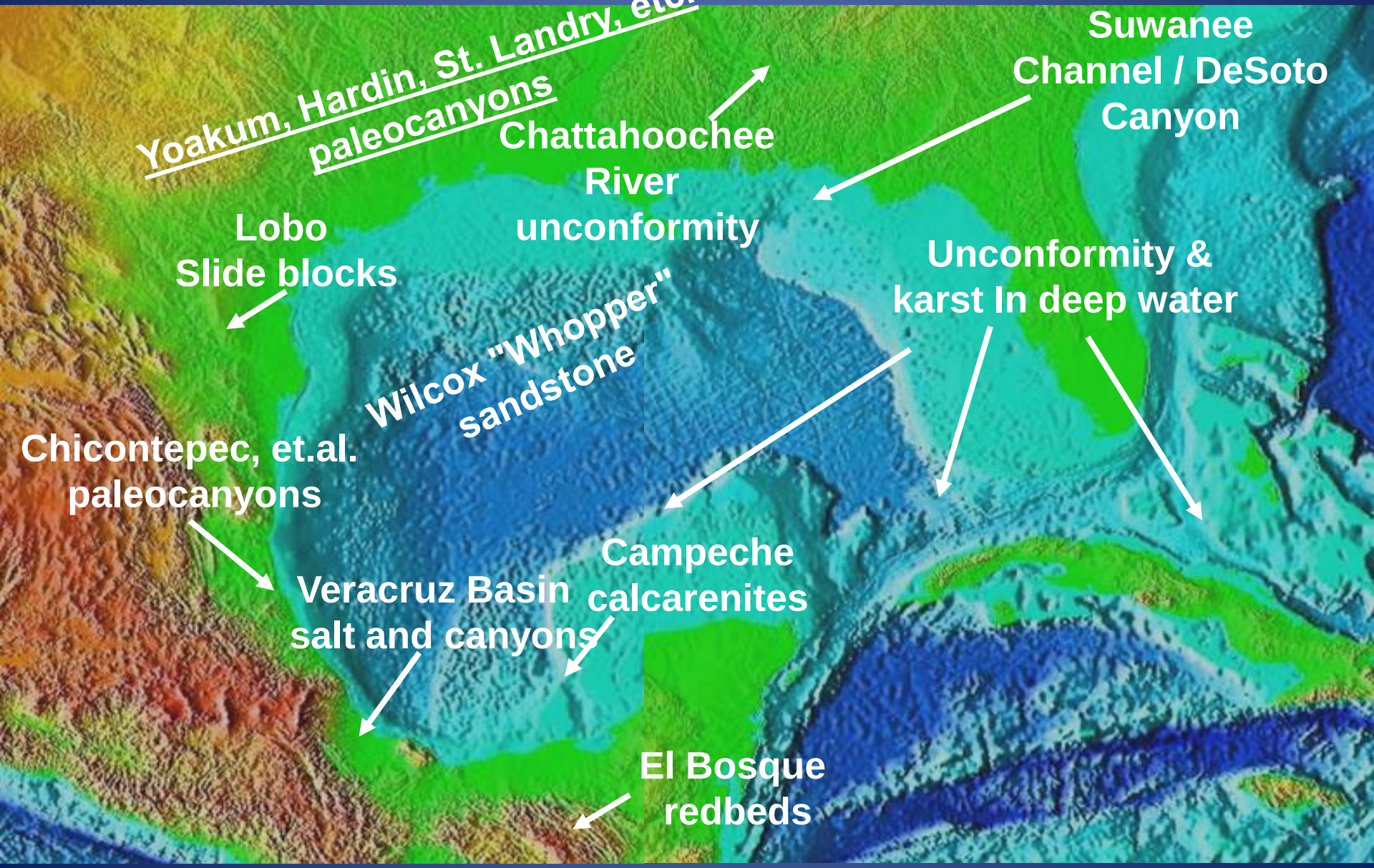
- *Isolation lasted about 1 million years.*

- *The Gulf refilled rapidly upon reconnection with the world ocean.*

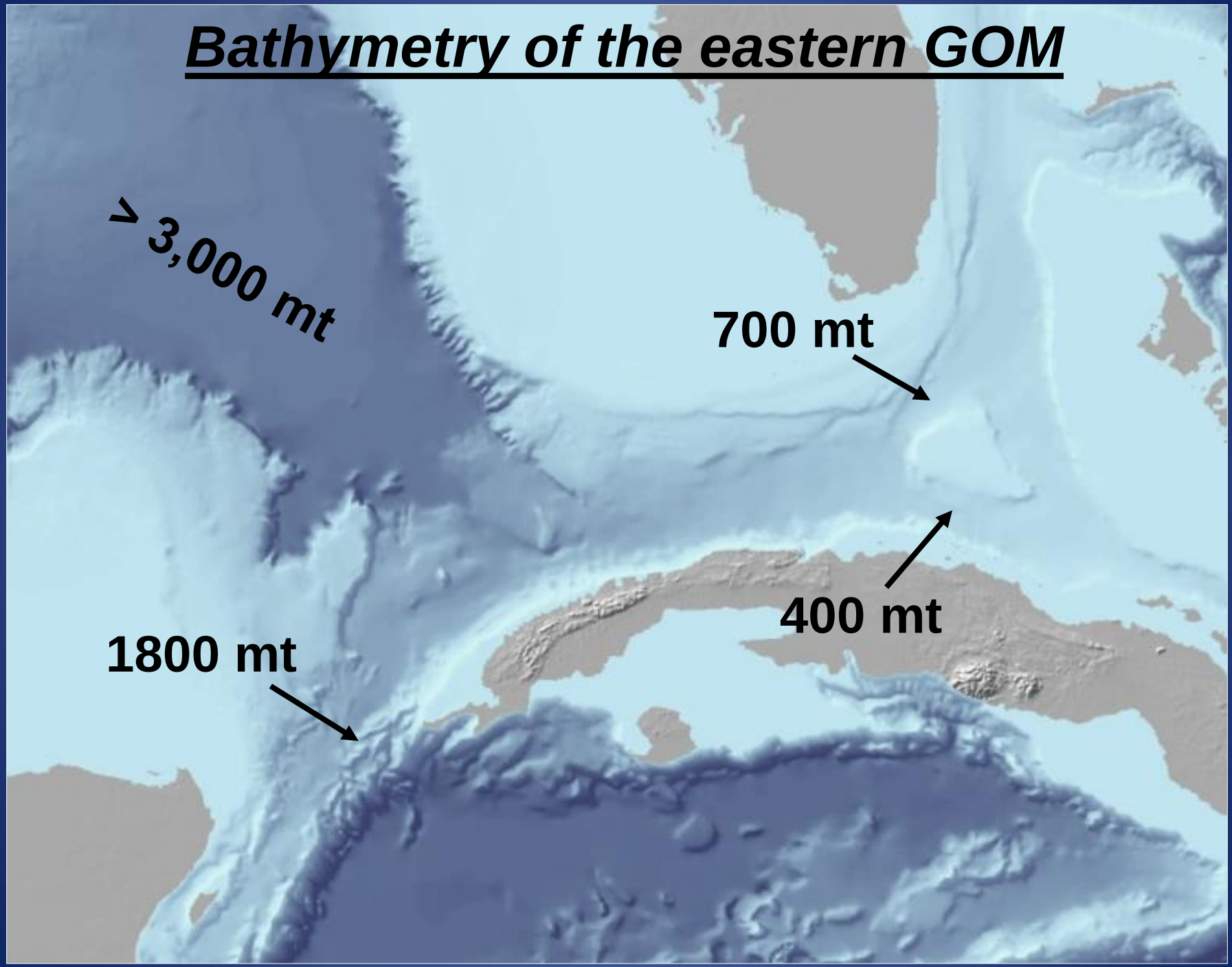
History – Print References

- ***Rosenfeld and Pindell: Offshore Magazine, January 2002***
- ***Rosenfeld and Pindell: AAPG Memoir 79, 2003***
- ***Berman and Rosenfeld: World Oil Magazine, July, 2007***
- ***Berman and Rosenfeld: GCSSEPM Perkins Conf. Proceedings, 2007***
- ***Rosenfeld: HGS Bulletin, October, 2008***
- ***Rosenfeld: GCSSEPM Perkins Conf. Proceedings, 2014***

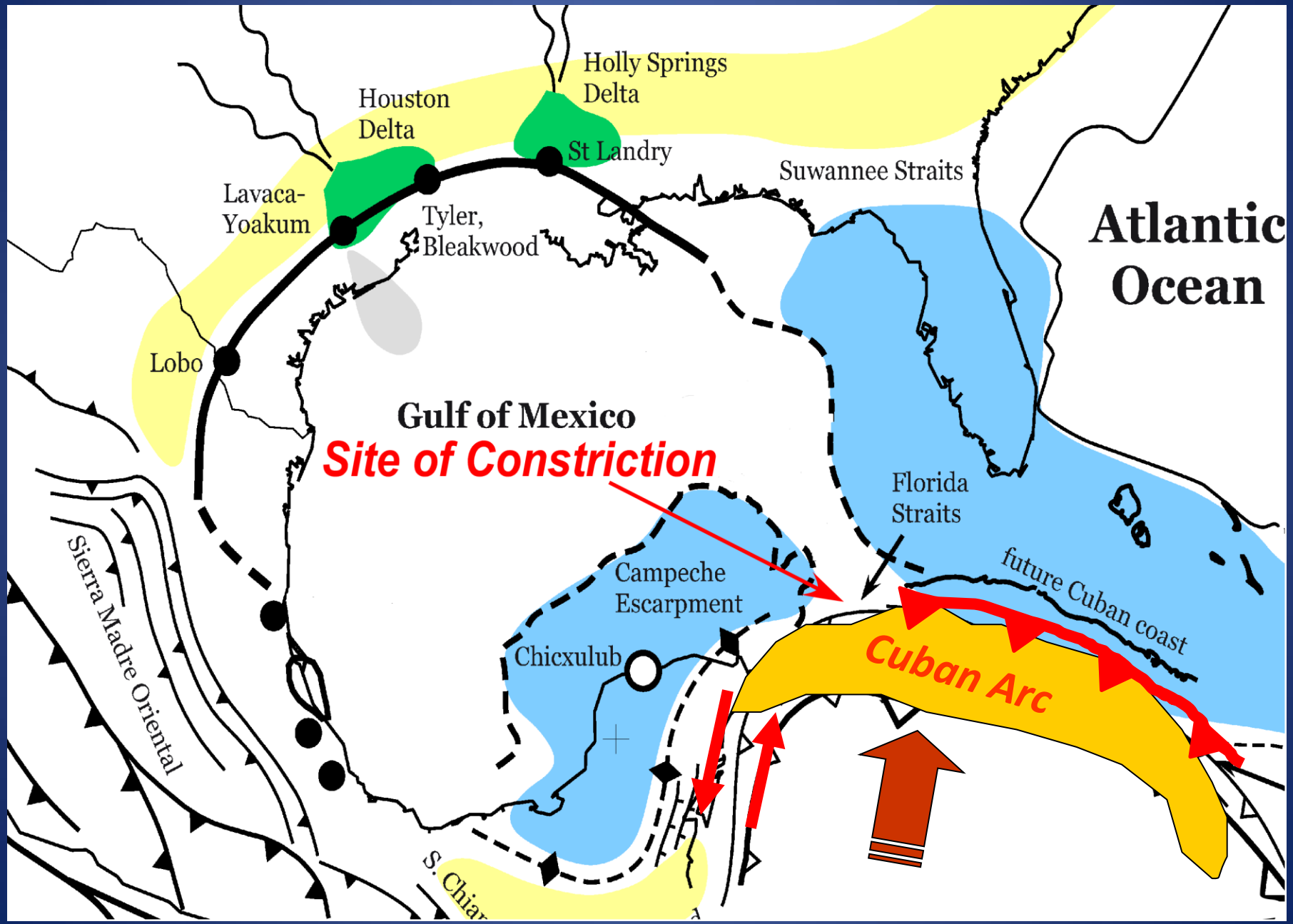
Paleocene - Eocene GOM Anomalies



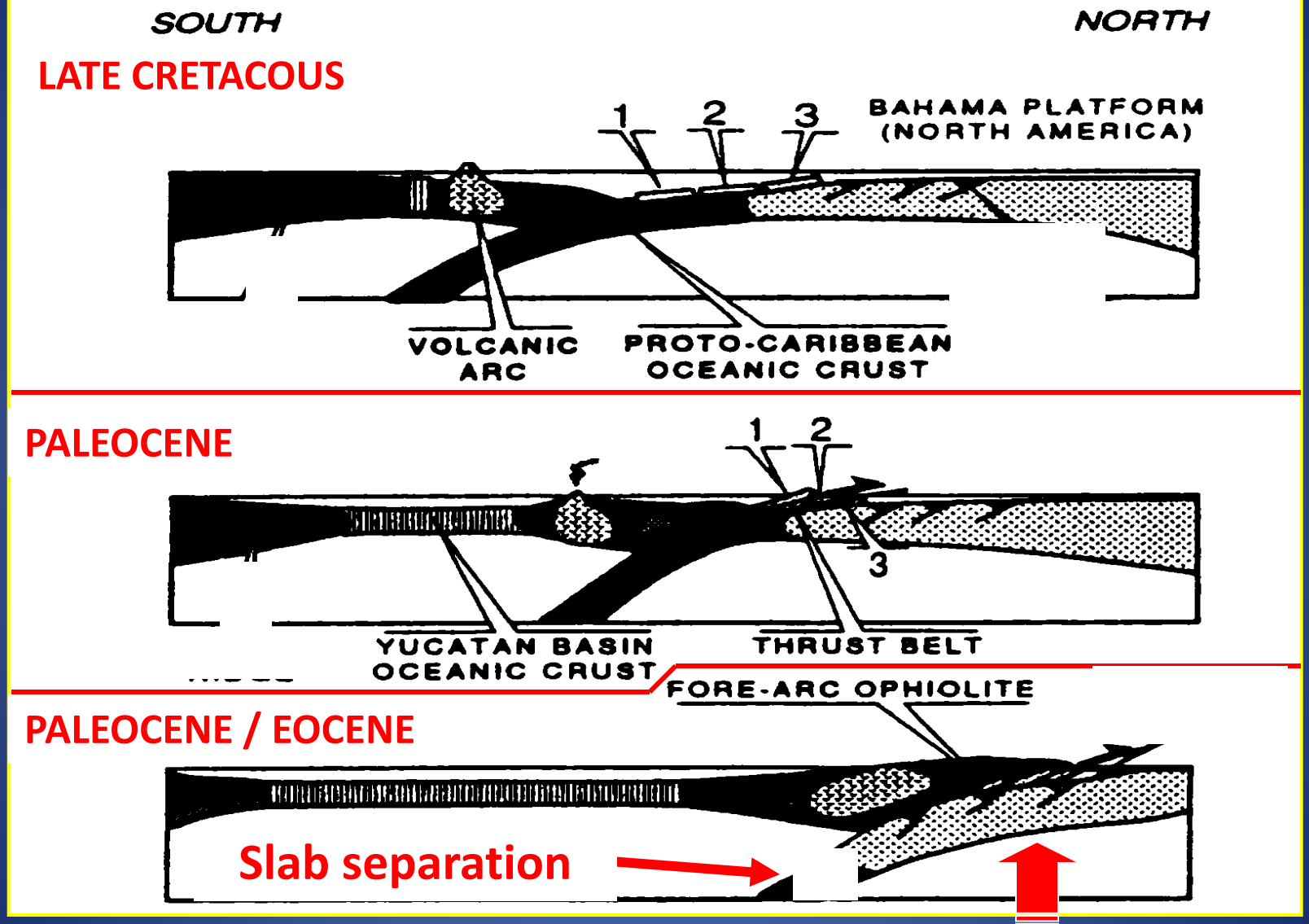
Bathymetry of the eastern GOM



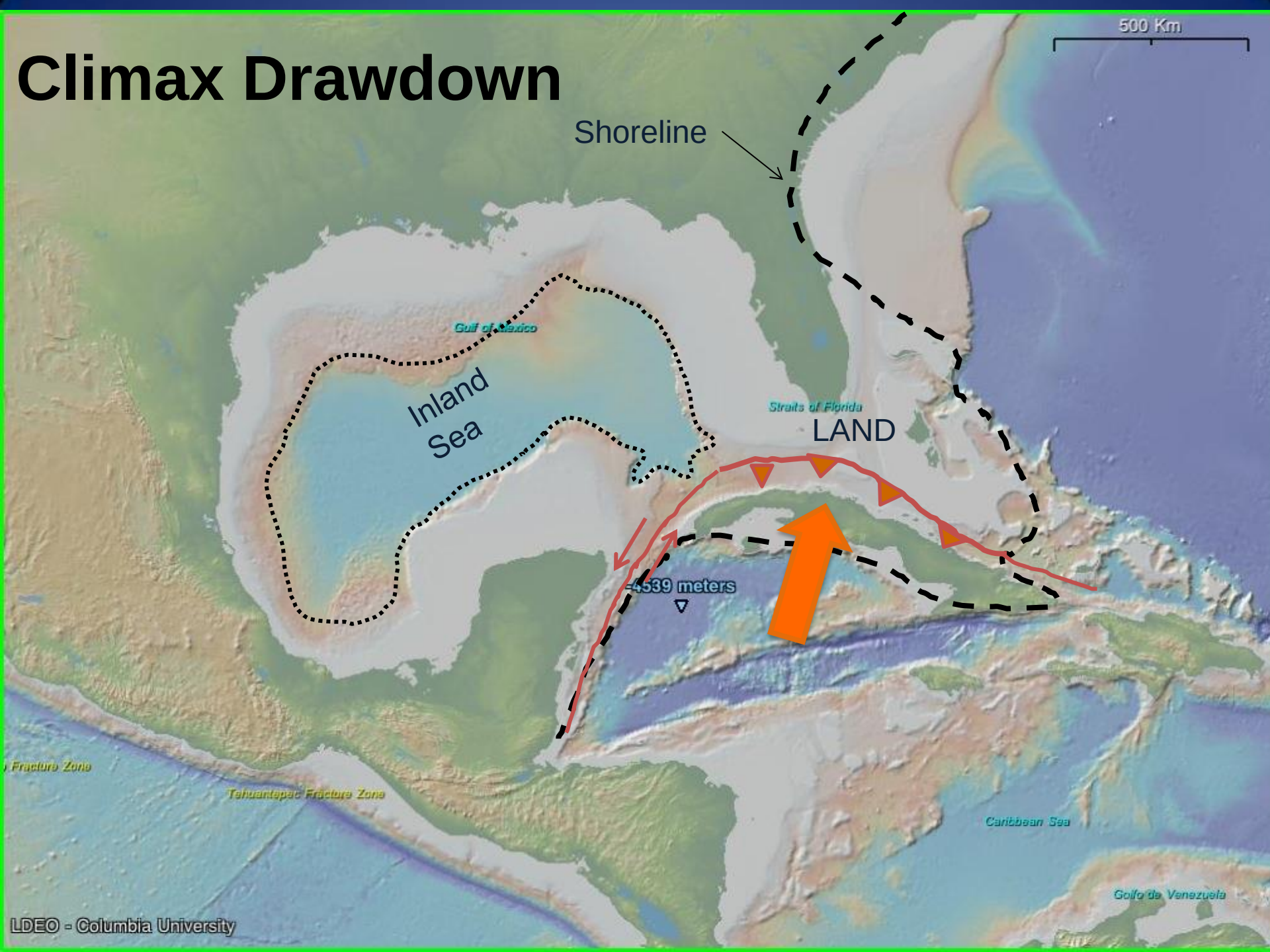
Isolation Mechanism



Cuba - Florida Collision



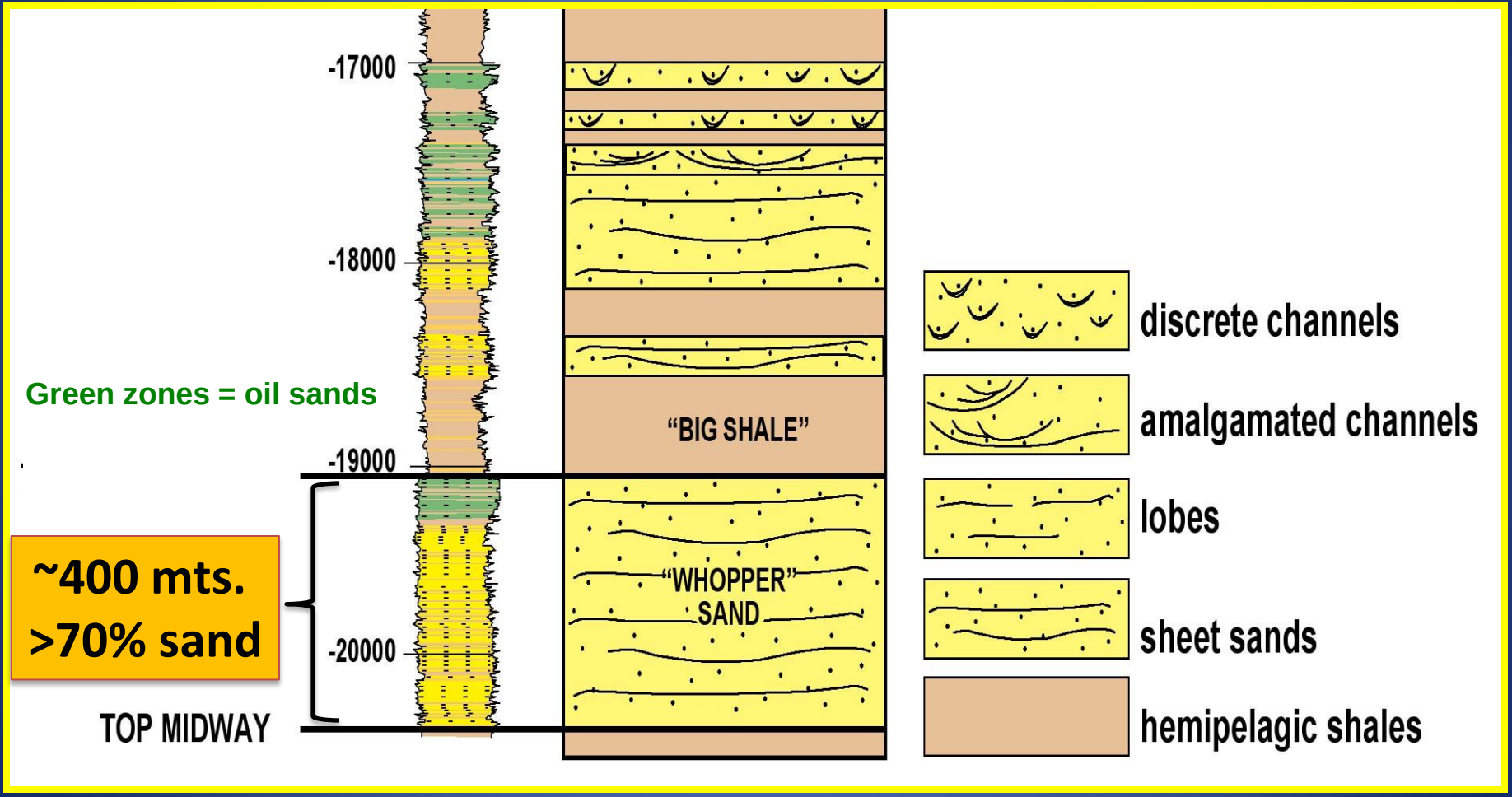
Adapted from Hutson, Mann and Renne, 1998


Climax Drawdown
Shoreline
500 Km
Gulf of Mexico
Inland Sea
Straits of Florida
LAND
-4539 meters
Fracture Zone
Tehuantepec Fracture Zone
Caribbean Sea
Golfo de Venezuela
LDEO - Columbia University

Isolation Effects

- *Rapid evaporative drawdown of Gulf*
- *Isostatic + tectonic uplift created a land bridge across Florida, Cuba, the Bahamas and Yucatan*
- *Extensive slumping of clastic shelf edges and slopes*
- *Canyon incision across shelves and slopes*
- *Bypass and recycling of sediments into the central Gulf*
- *Karsting of exposed shallow and deep basin carbonates*
- *Salt deposition in barred basins (i.e. Veracruz Basin)*
- *Massive hydocarbon release from hydrates and breached reservoirs triggered P/E Thermal Maximum(?)*

Wilcox section – Union Oil Trident well (2001)



Blickwede et al., 2004

"Whopper" Sand in the Great White well

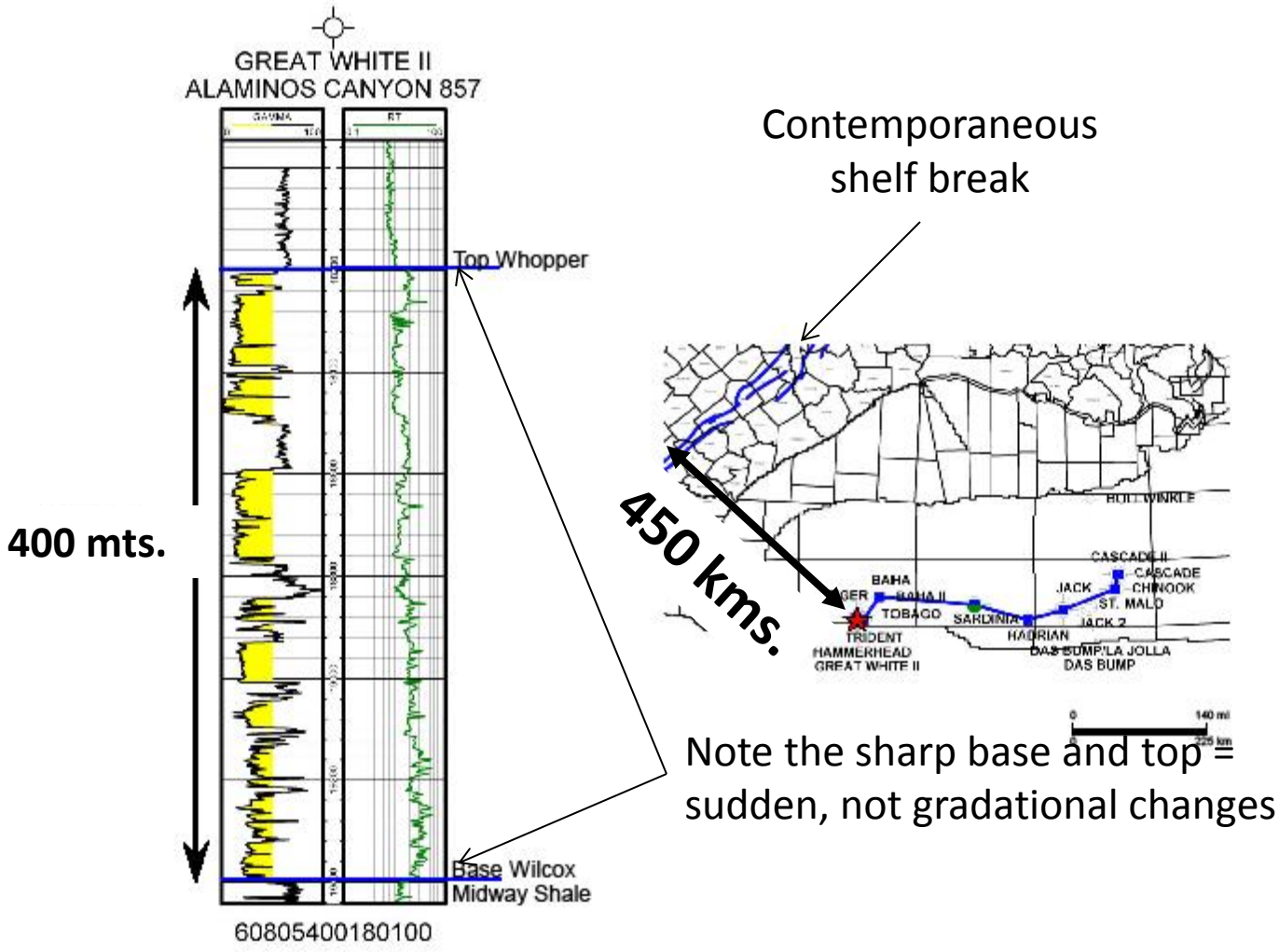


Figure 36. Wilcox section in Great Whilte well, Alaminos Canyon 857, API # 60805400180100. Gamma Ray curve is normalized with other deep Gulf Wilcox wells and re-scaled, shading less than 50 API Units. Data from IHS Energy.

Berman and Rosenfeld, 2008

Wilcox Regional Cross Section

AC 857 Great White #1 | AC 859 Tobago | AC 903 #1 Trident 1 | AC 818 Tiger | AC 951 Toledo 1 | AC 557 BAHA 2 | KC 681 Sardinia 1 | KC 919 Hadrian 1 | WR 759 Jack 1 | WR 678 St Malo 2 | WR 724 Das Bump | WR 469 Chinook | WR 206 Cascade | AT 574 Neptune #1 | AT 182 Sturgis | AT 63 Champlain #4 | AT 336 Showboat

7 mi. | 5 mi. | 13 mi. | 10 mi. | 27 mi. | 100 mi. | 57 mi. | 39 mi. | 22 mi. | 7 mi. | 33 mi. | 16 mi. | 58 mi. | 32 mi. | 38 mi. | 34 mi.

Top Wilcox
51.8 DLS
(Wilcox 1a)
55.5 SB
(Wilcox 1b)

57.5 Ma SB
(Wilcox 2)

58.5 Ma SB
(Wilcox 3)

59.2 Ma SB
(Wilcox 4)

Midway
60.0 SB

Cretaceous
65.5 SB

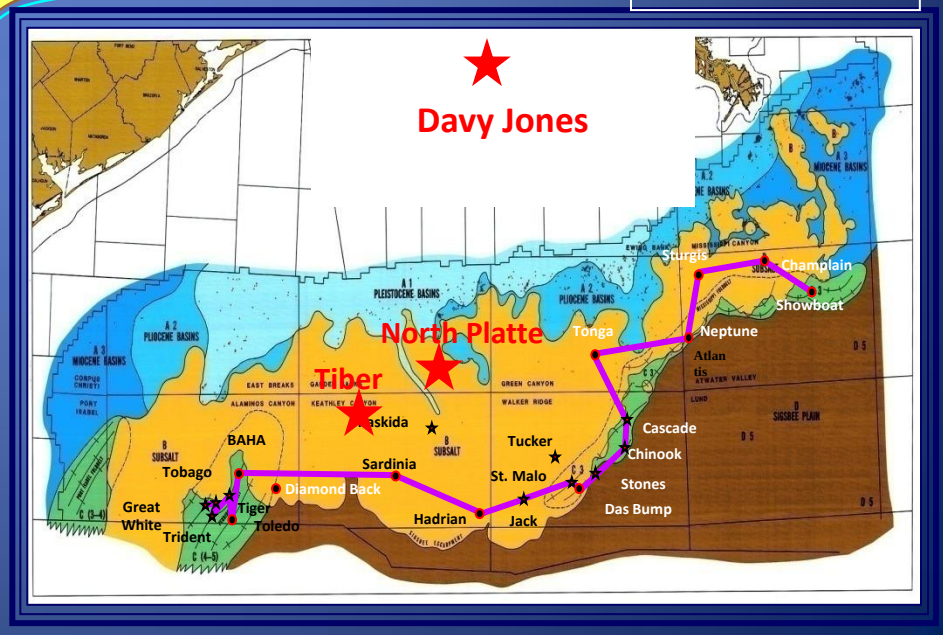
1
2
3
4

"Whopper Sandstone"

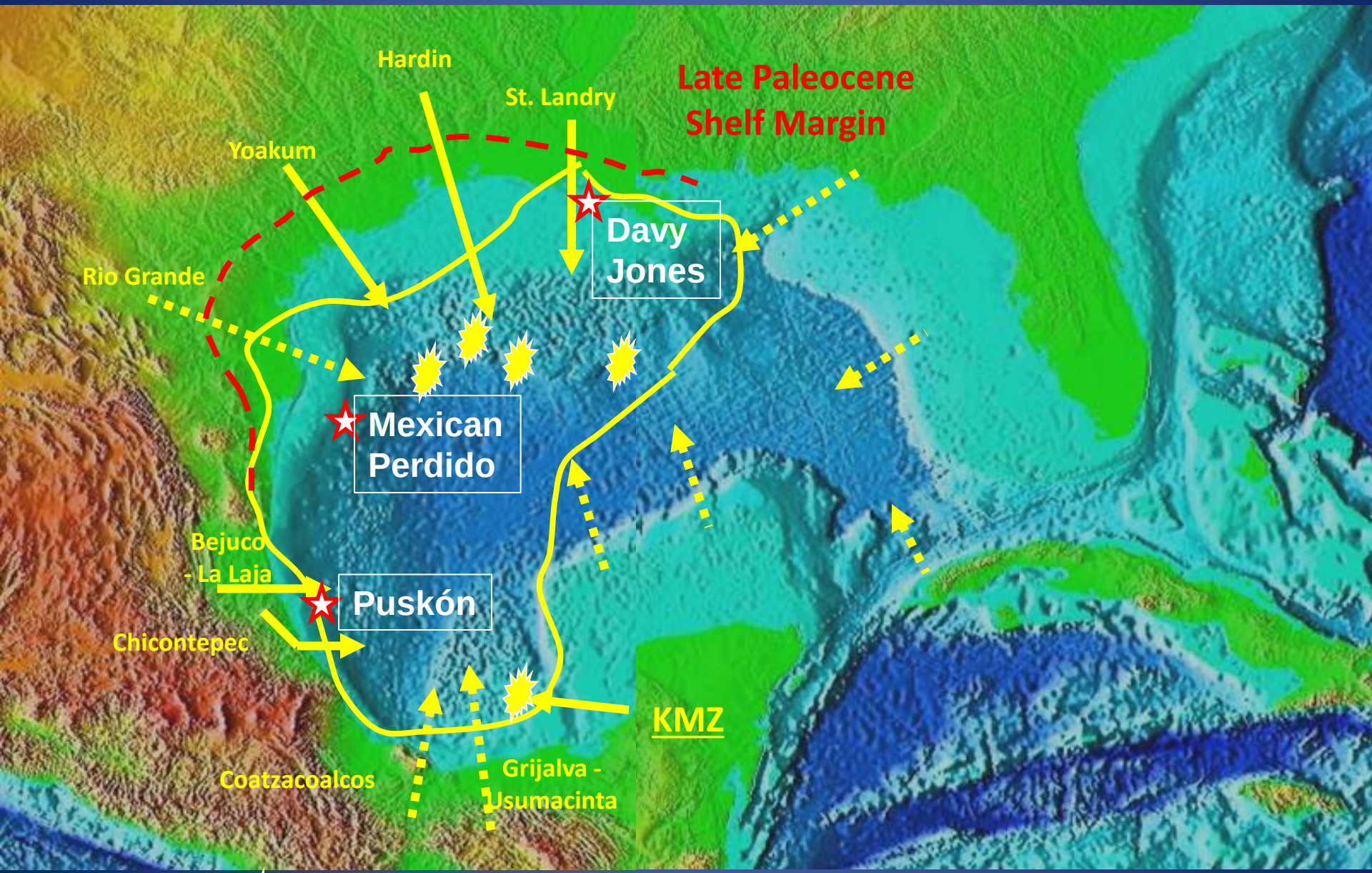
0.8 my
>1500 m/my

600 kms. end-to-end

Rains, Zarra & Meyer, 2008

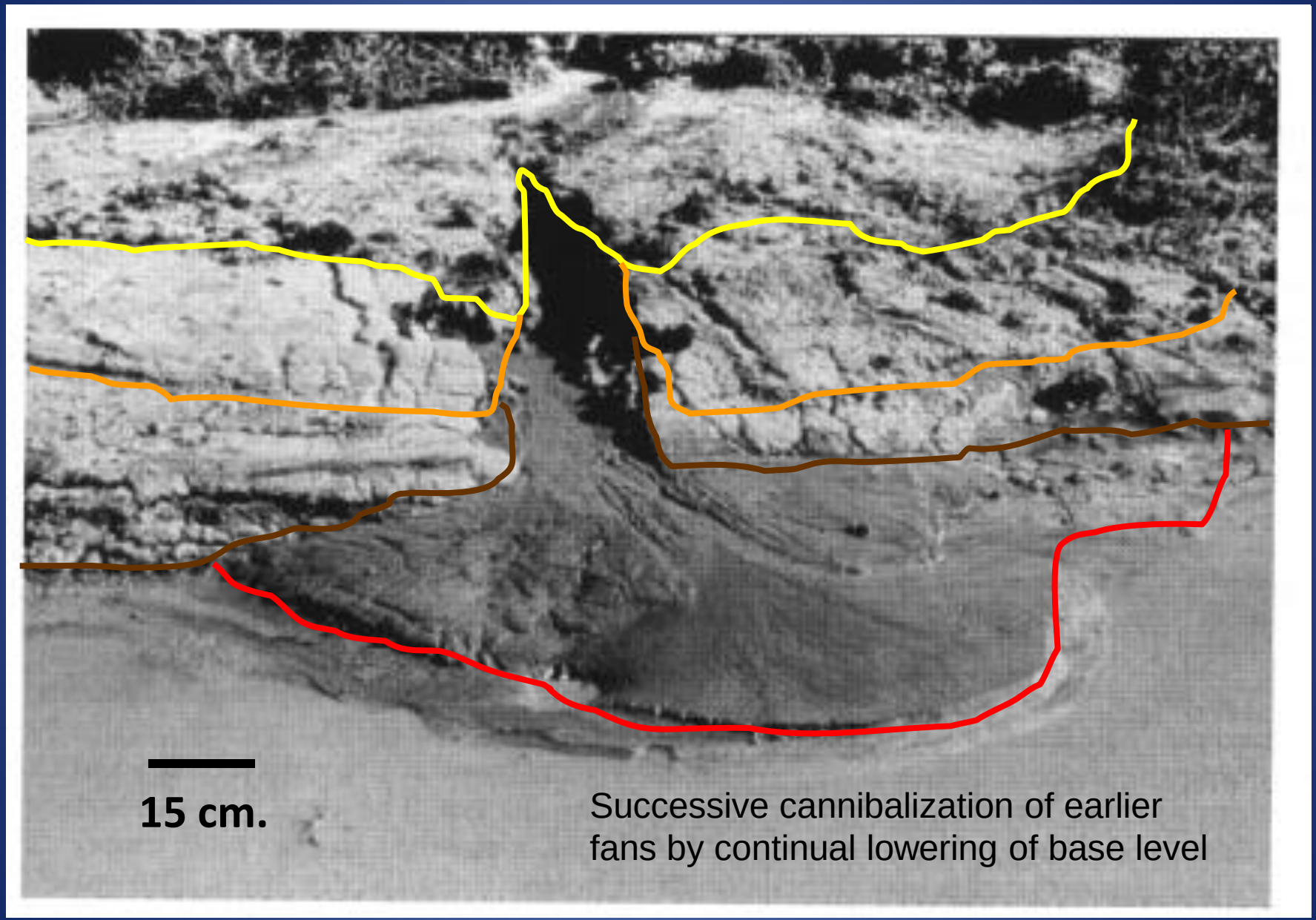


Deep Water Wilcox Sandstone Trend



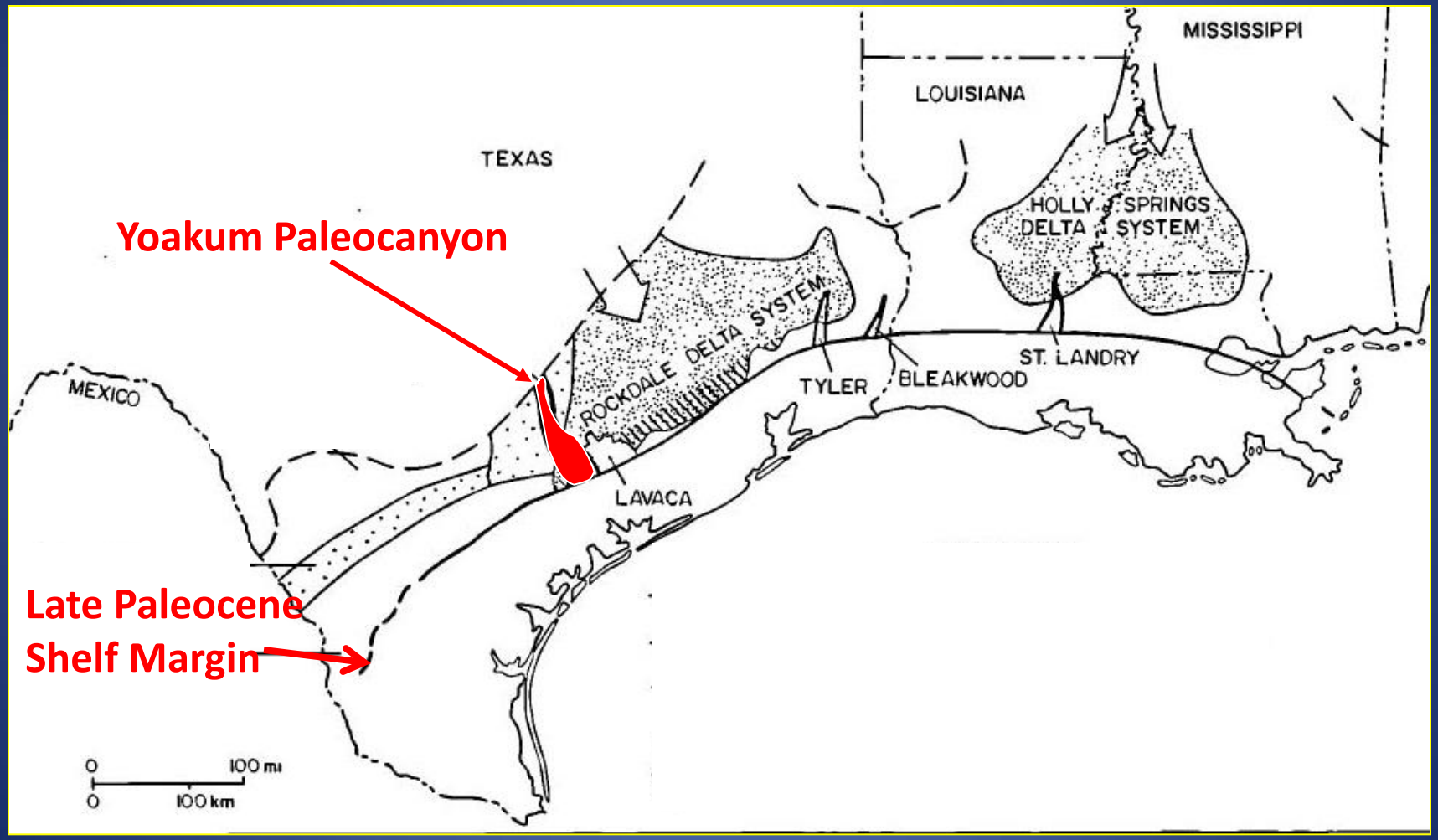
= Proven sandstone area

"Forced Regression" Sequence



Posamentier et al, 1992

Paleocanyons



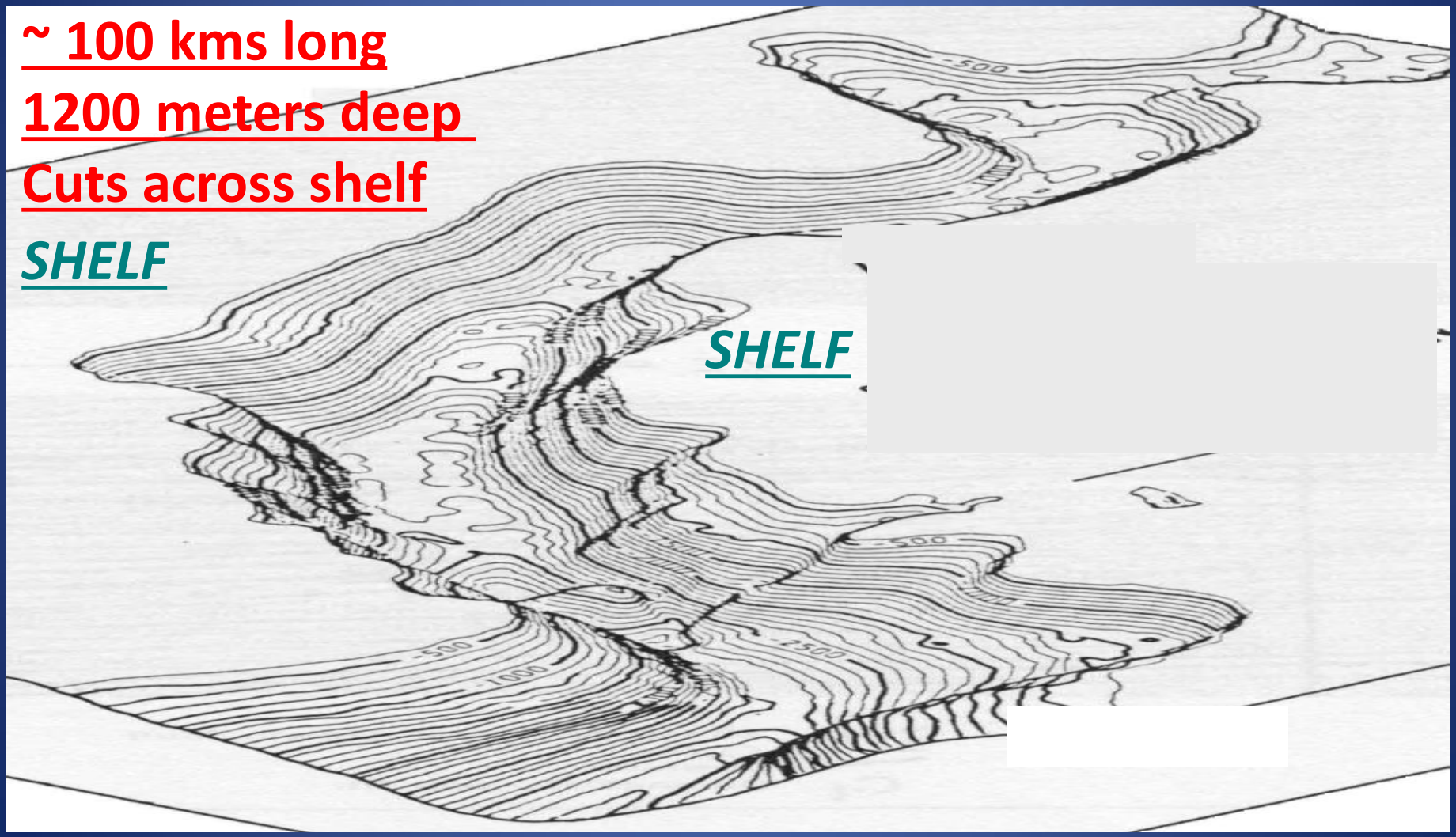
From Galloway, Dingus and Paige, 1991

Yoakum Paleocanyon

~ 100 kms long

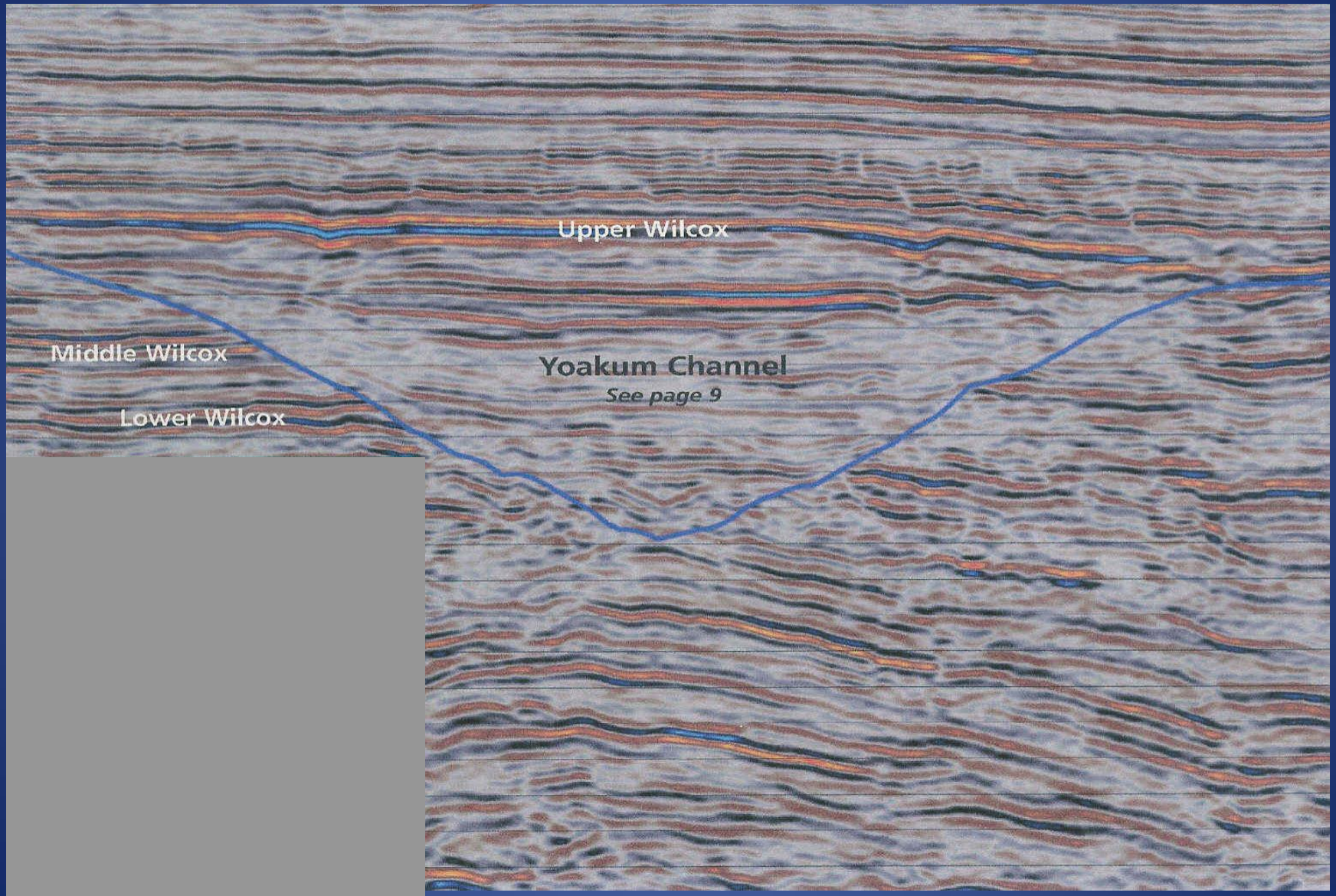
1200 meters deep

Cuts across shelf



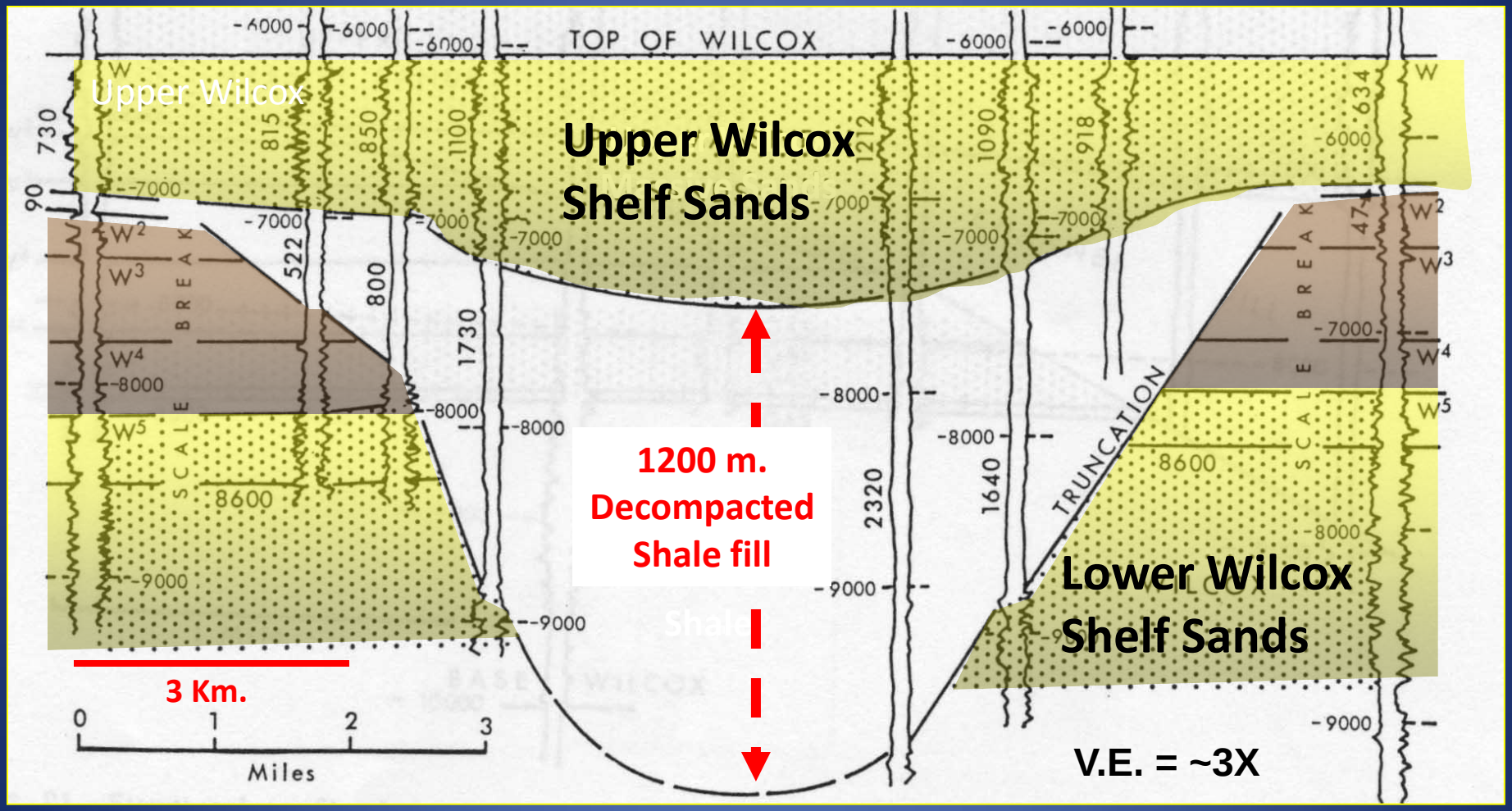
From Galloway, Dingus and Paige, 1991

Seismic Section – Yoakum Paleocanyon



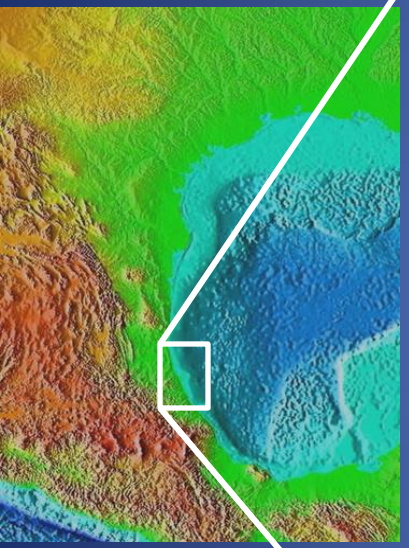
P. Britt, HGS Bulletin April, 2006

Yoakum Paleocanyon



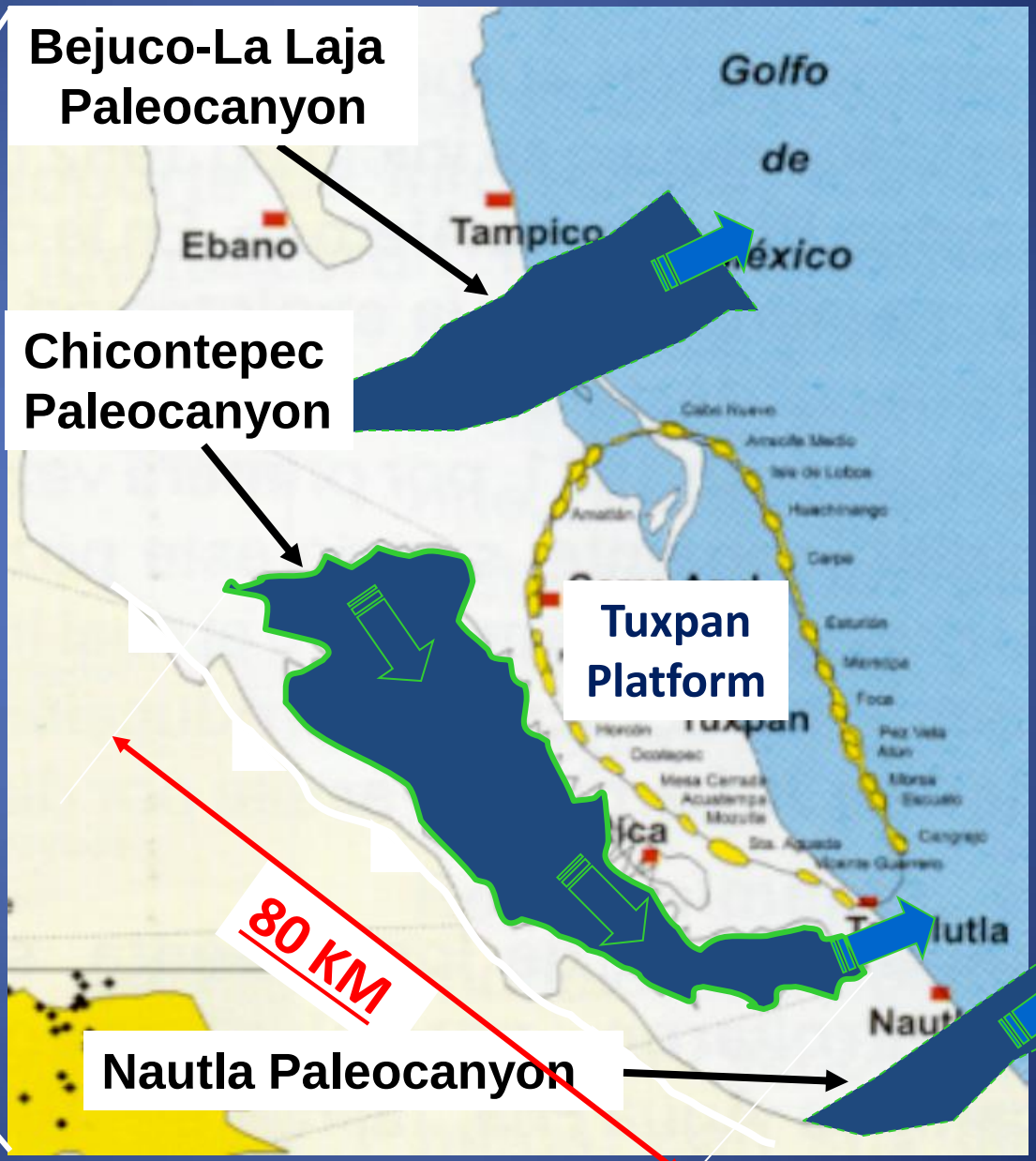
From Hoyt, 1959

Central Mexico Paleocanyons



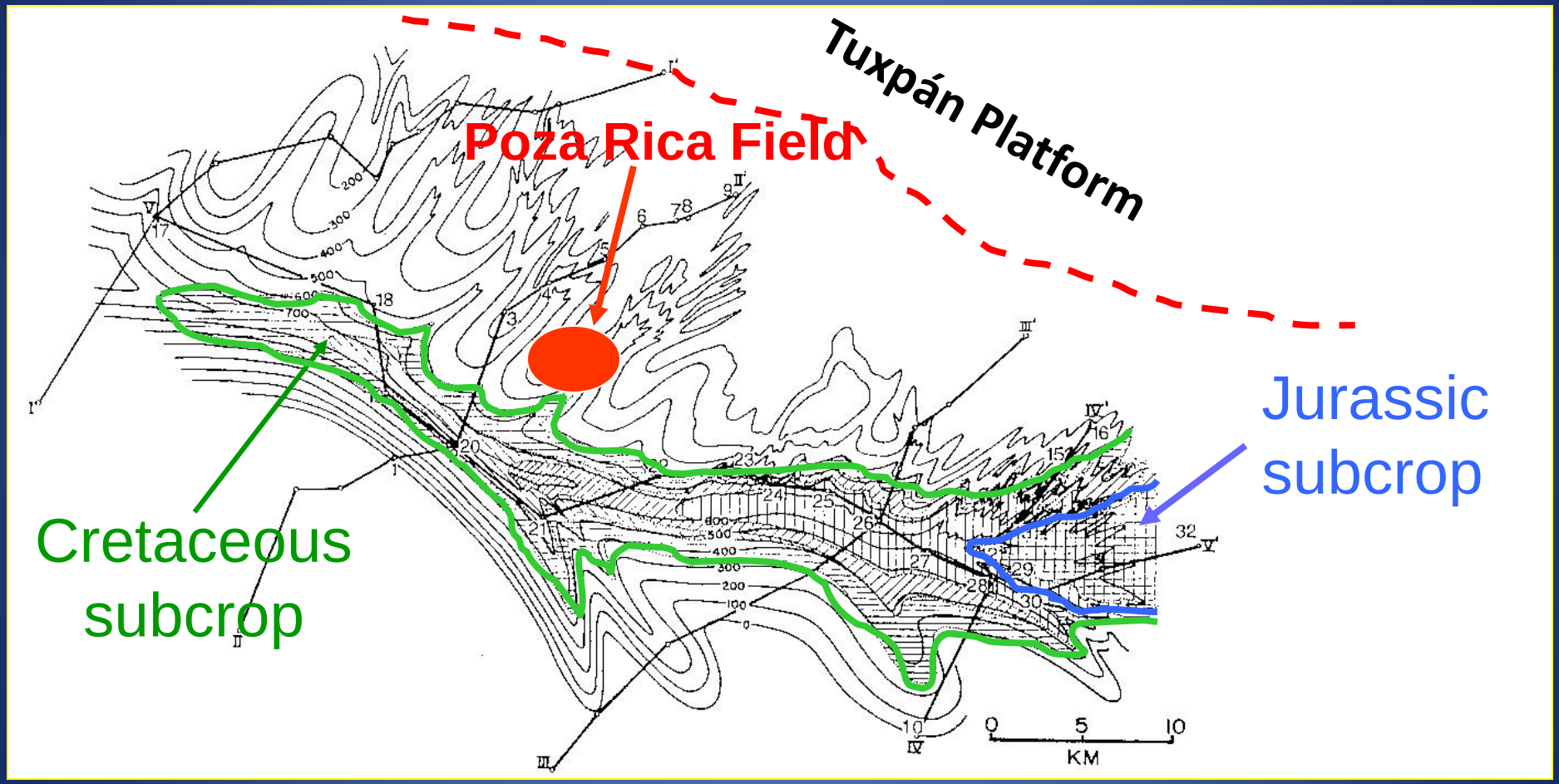
Youngest subcrop
= Paleocene

Oldest Fill = Eocene



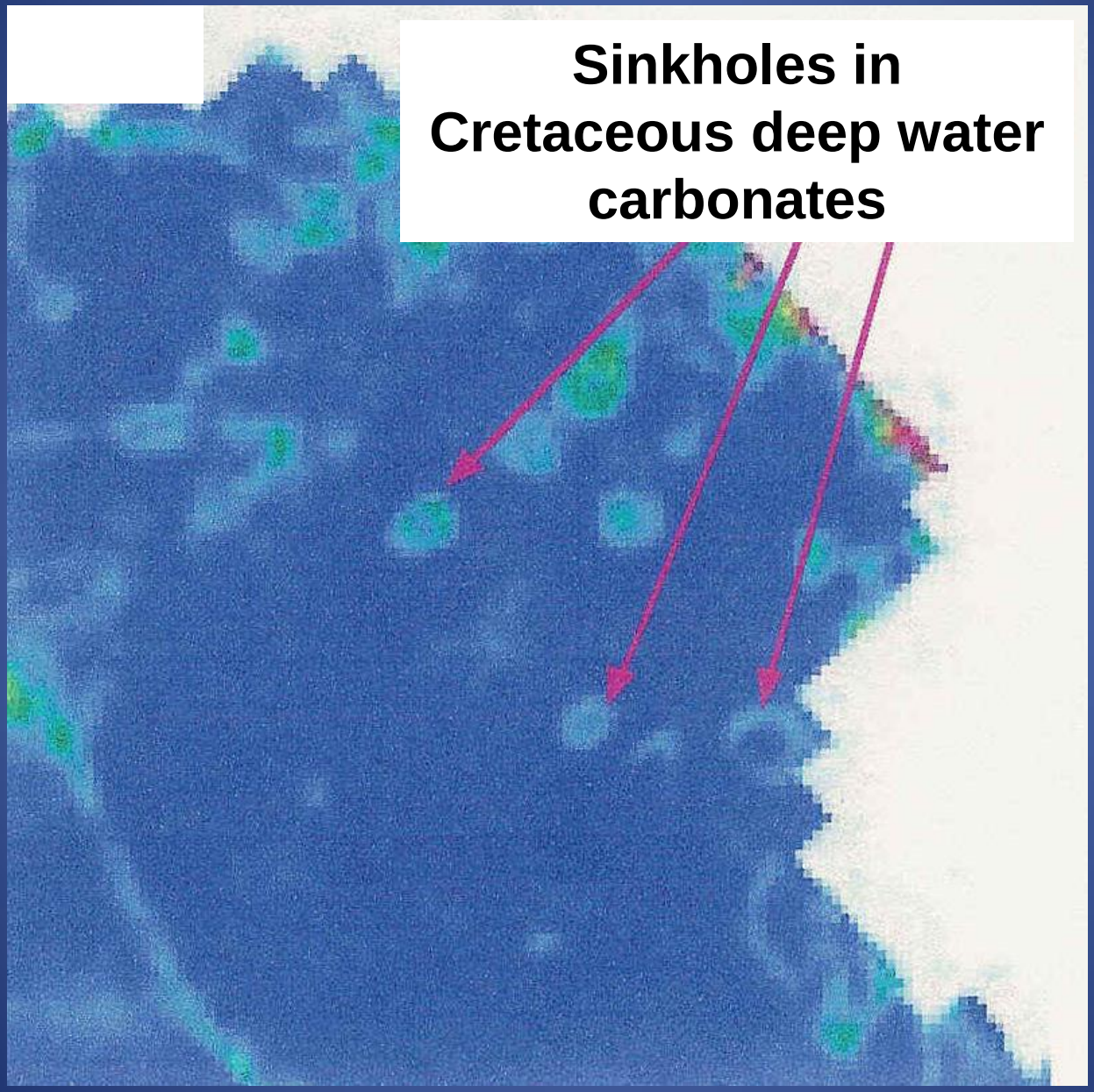
Adapted from Pemex, 1999

Chicontepec Paleocanyon eroded into lithified carbonates



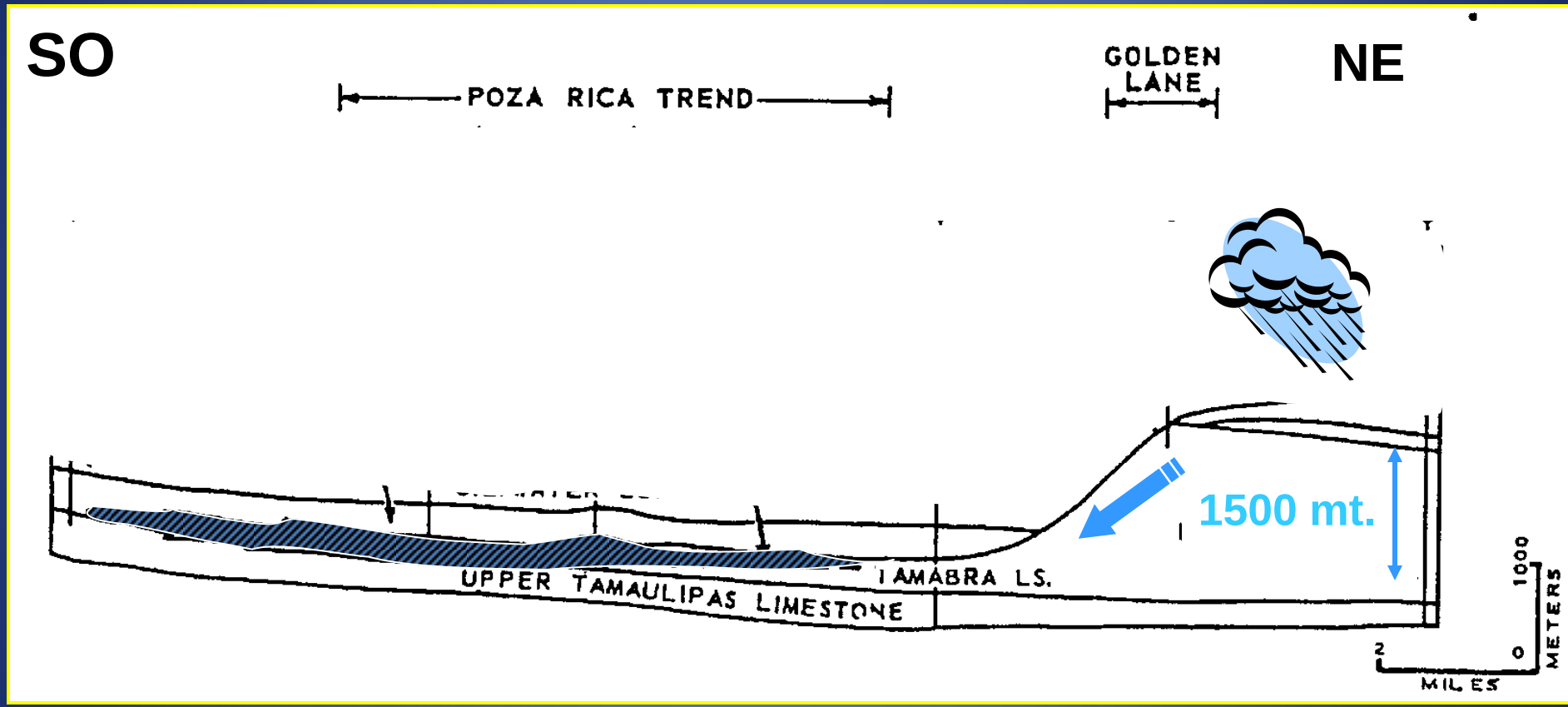
Adapted from Busch and Govela, 1978

Poza Rica 3D Seismic (Time slice)



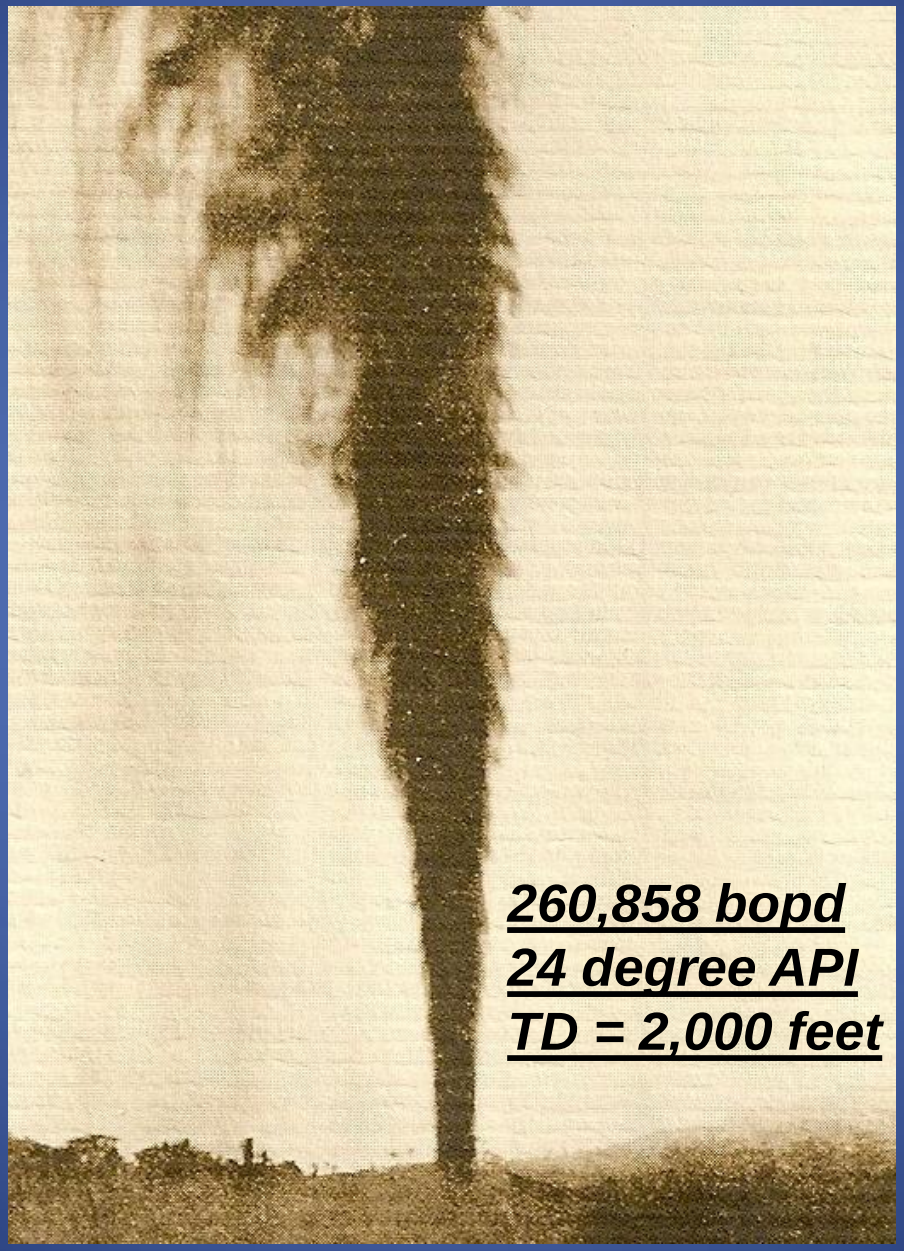
Horbury, 2004

Campo Poza Rica – Faja de Oro

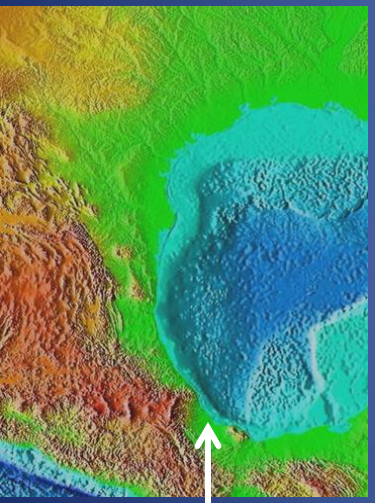


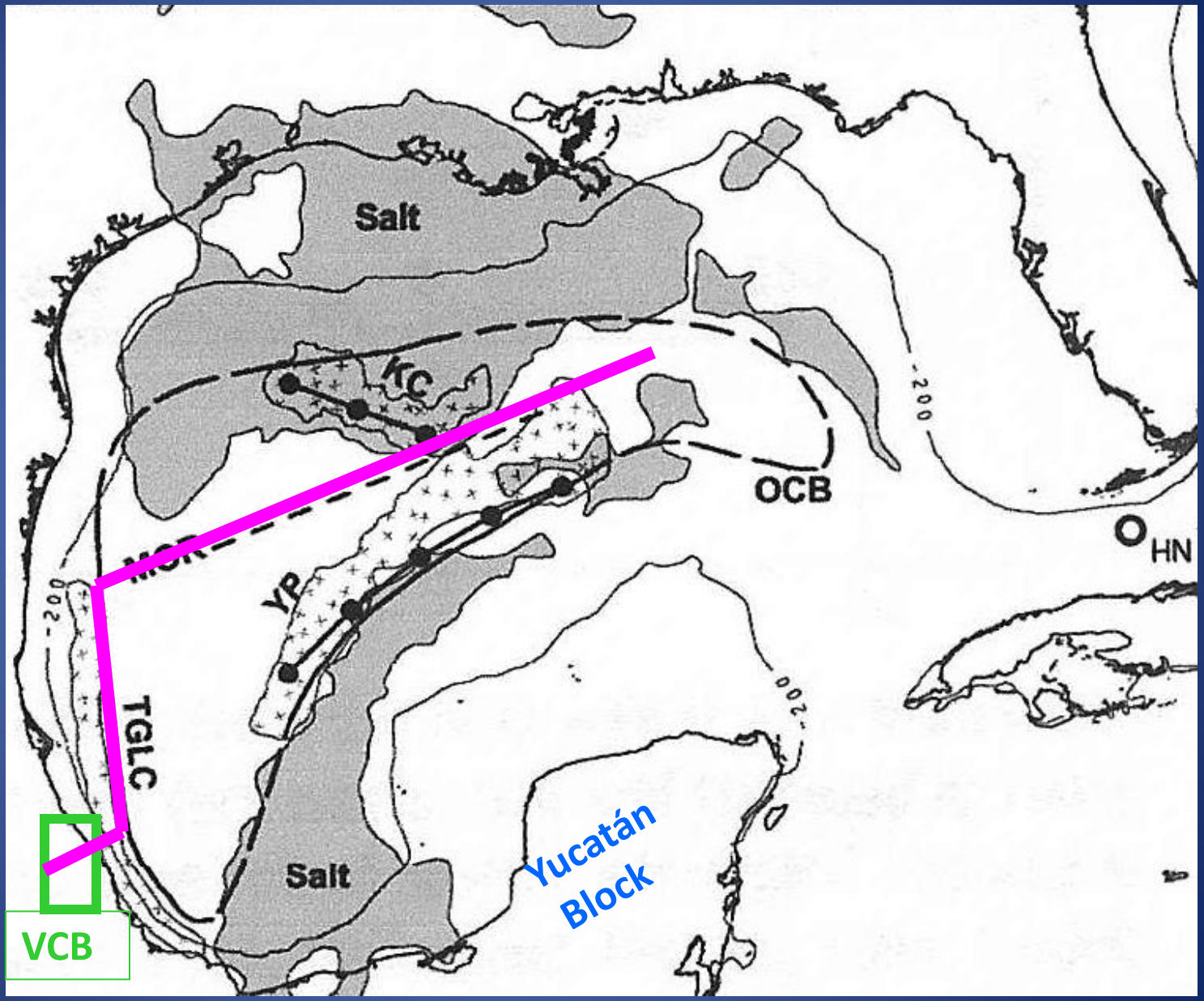
Adapted from Coogan, Bebout and Maggio, 1972

Cerro Azul # 4: February, 1921

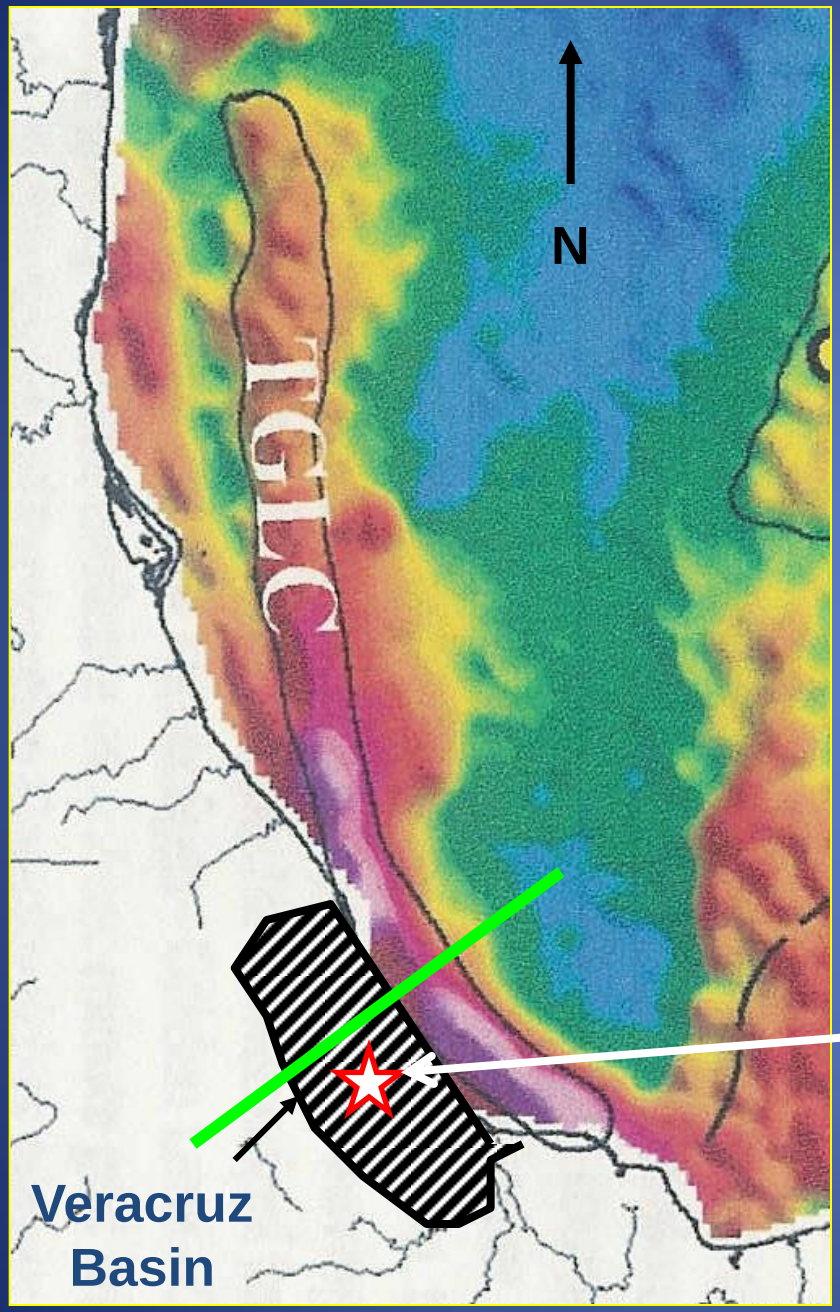


Veracruz Basin-Oceanic Crust





From Bird et. al, 2005

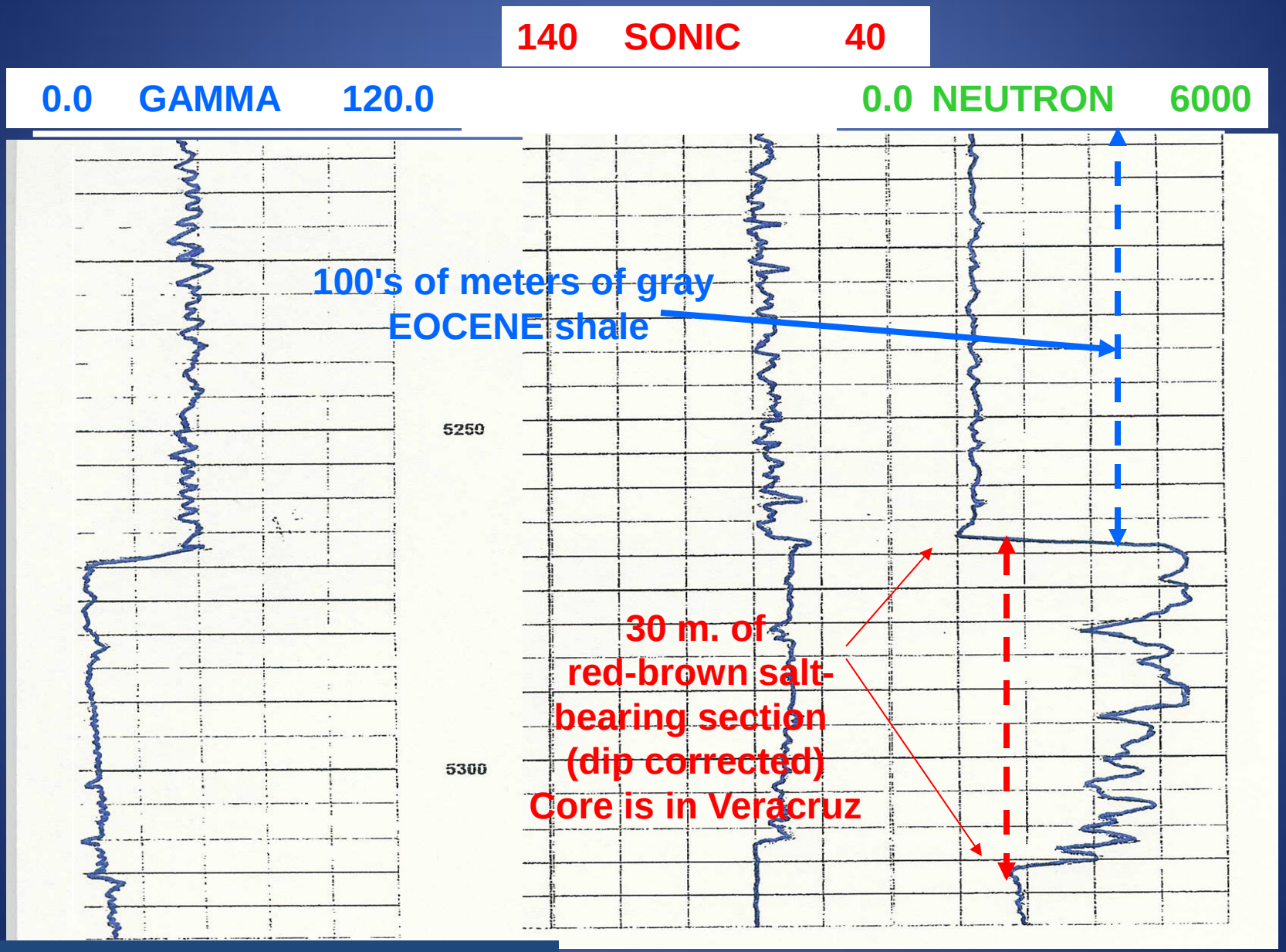


Veracruz Basin separated from main GOM by a basaltic transform ridge (Anegada High)

Mataespino 101-B well

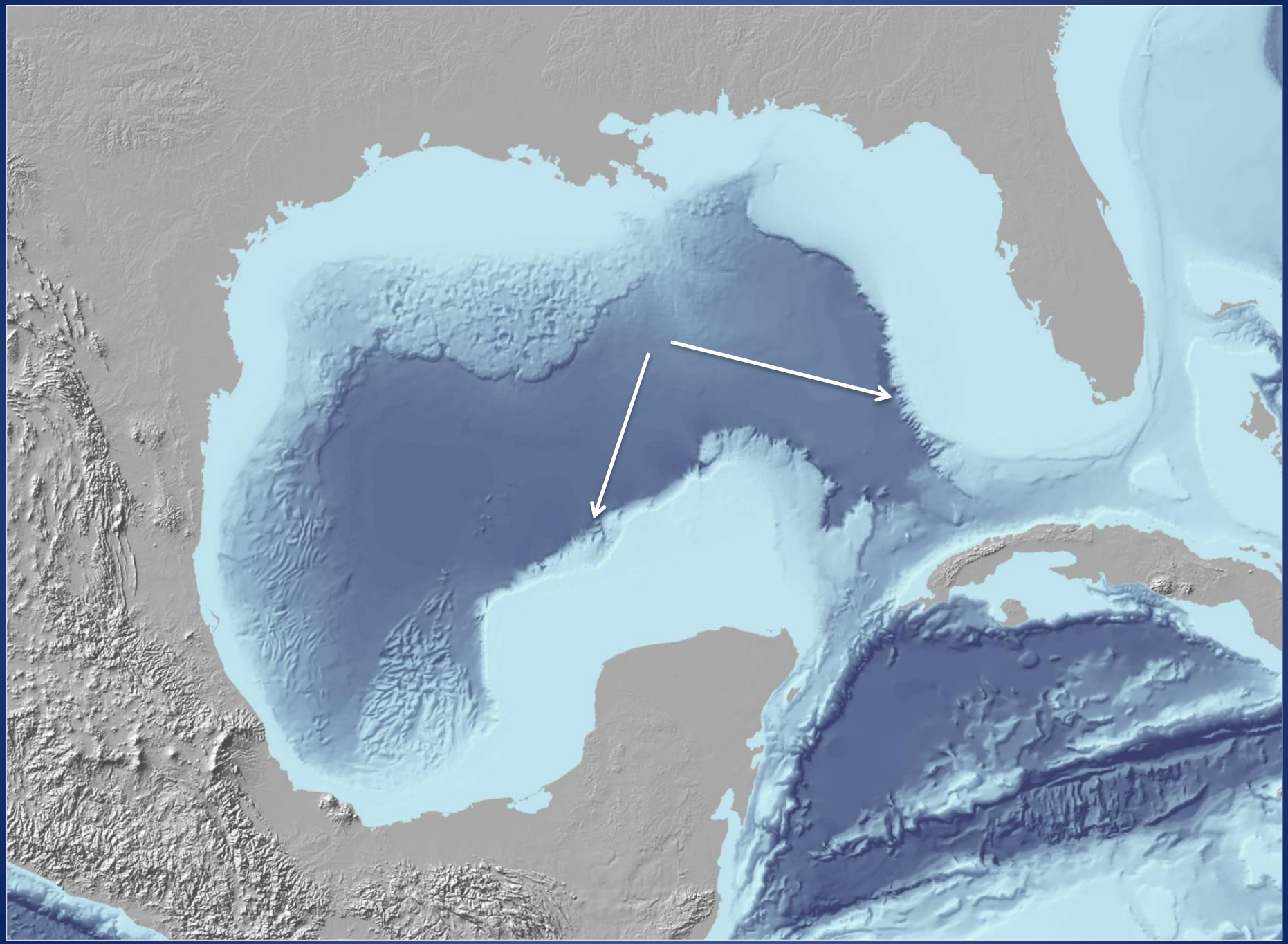
Bird et. al, 2005

Pemex Mataespino-101B

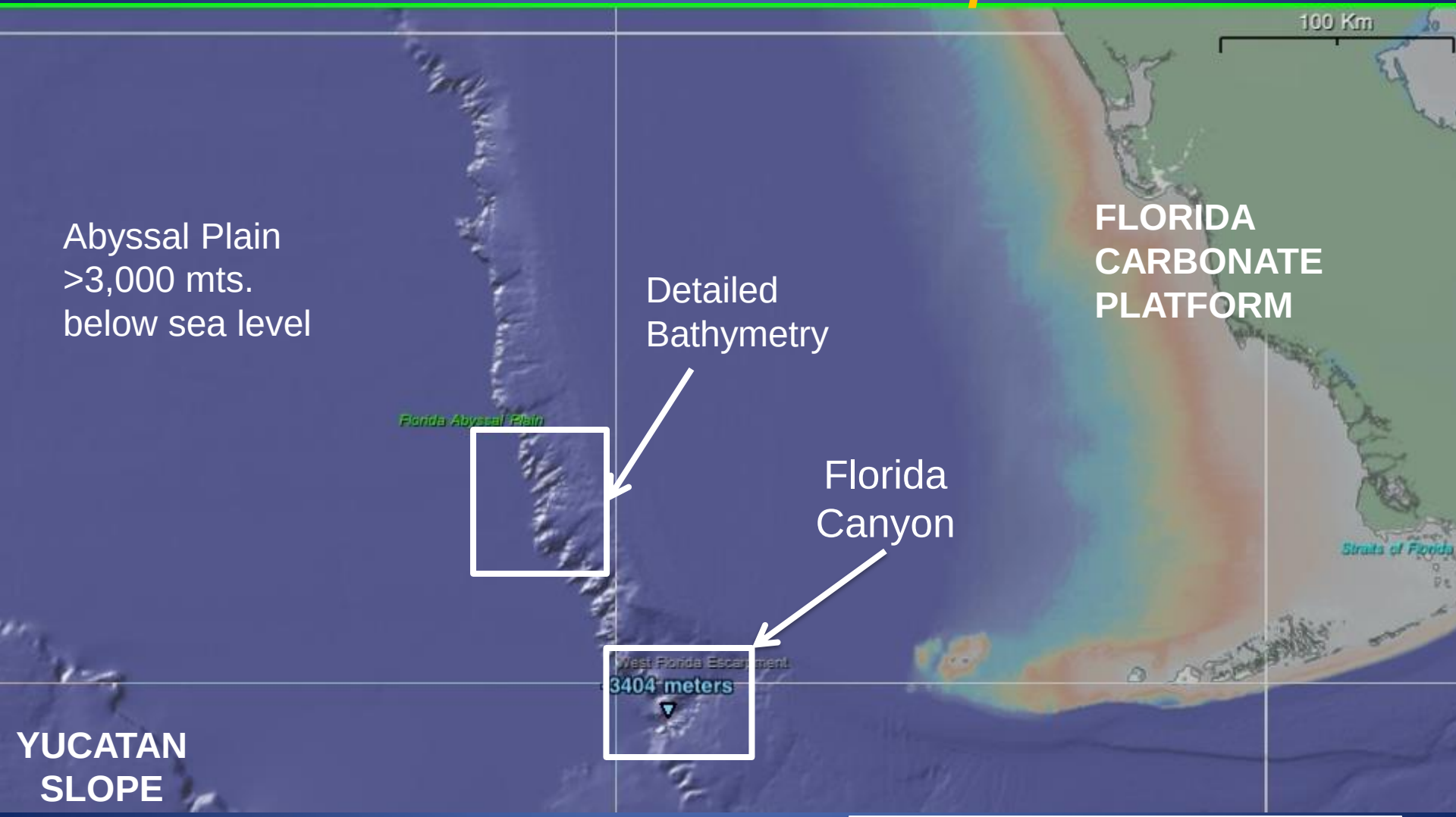


The Southeastern Gulf

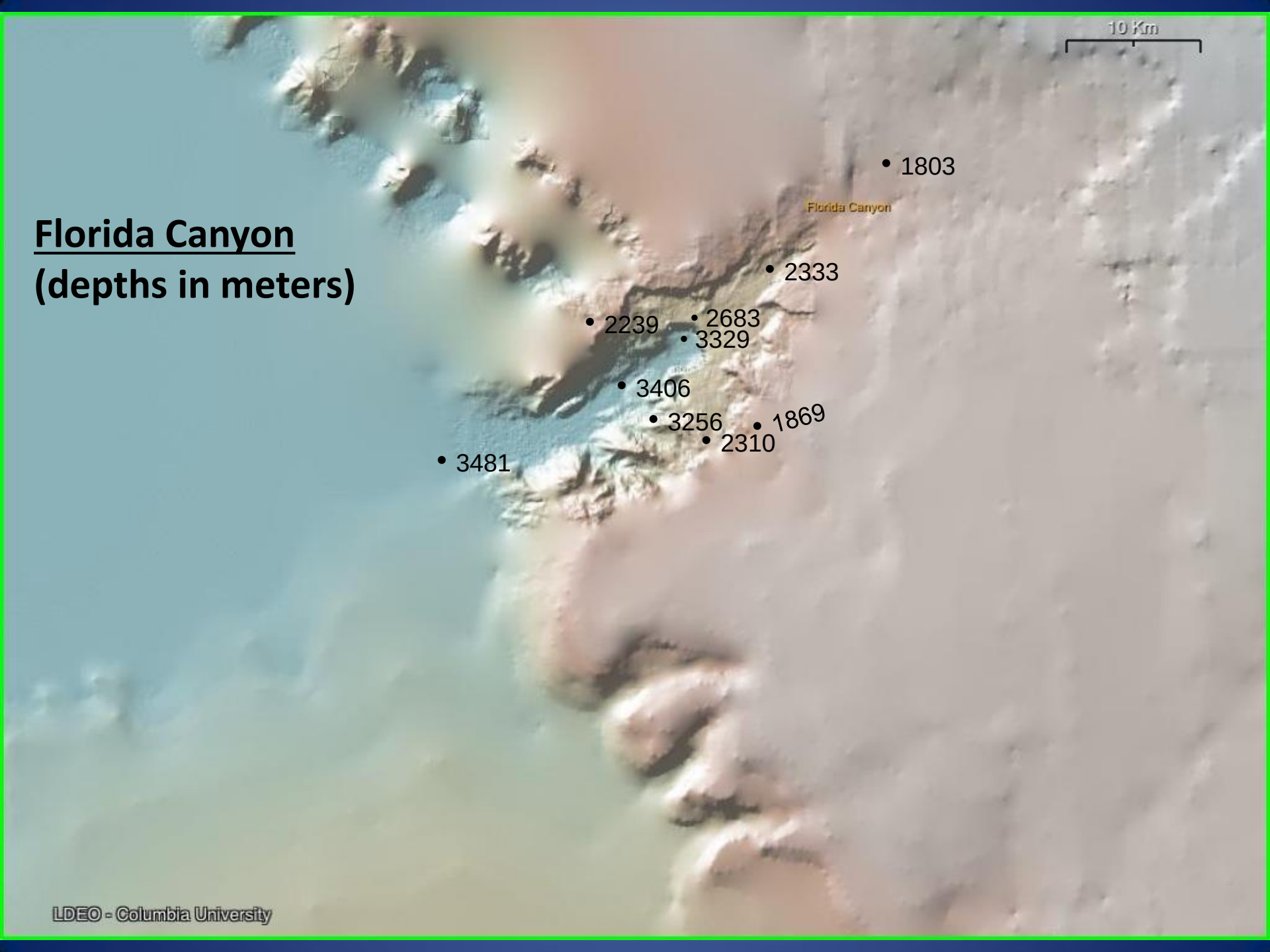
(Florida and Yucatan margins)



Erosional Aspect of the Florida and Yucatán Carbonate Escarpments

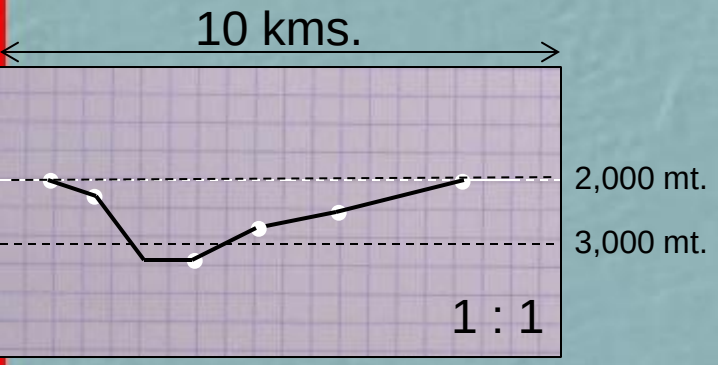


NOTE: No Paleocene/Eocene tectonic activity, topographic relief, nor major rivers.

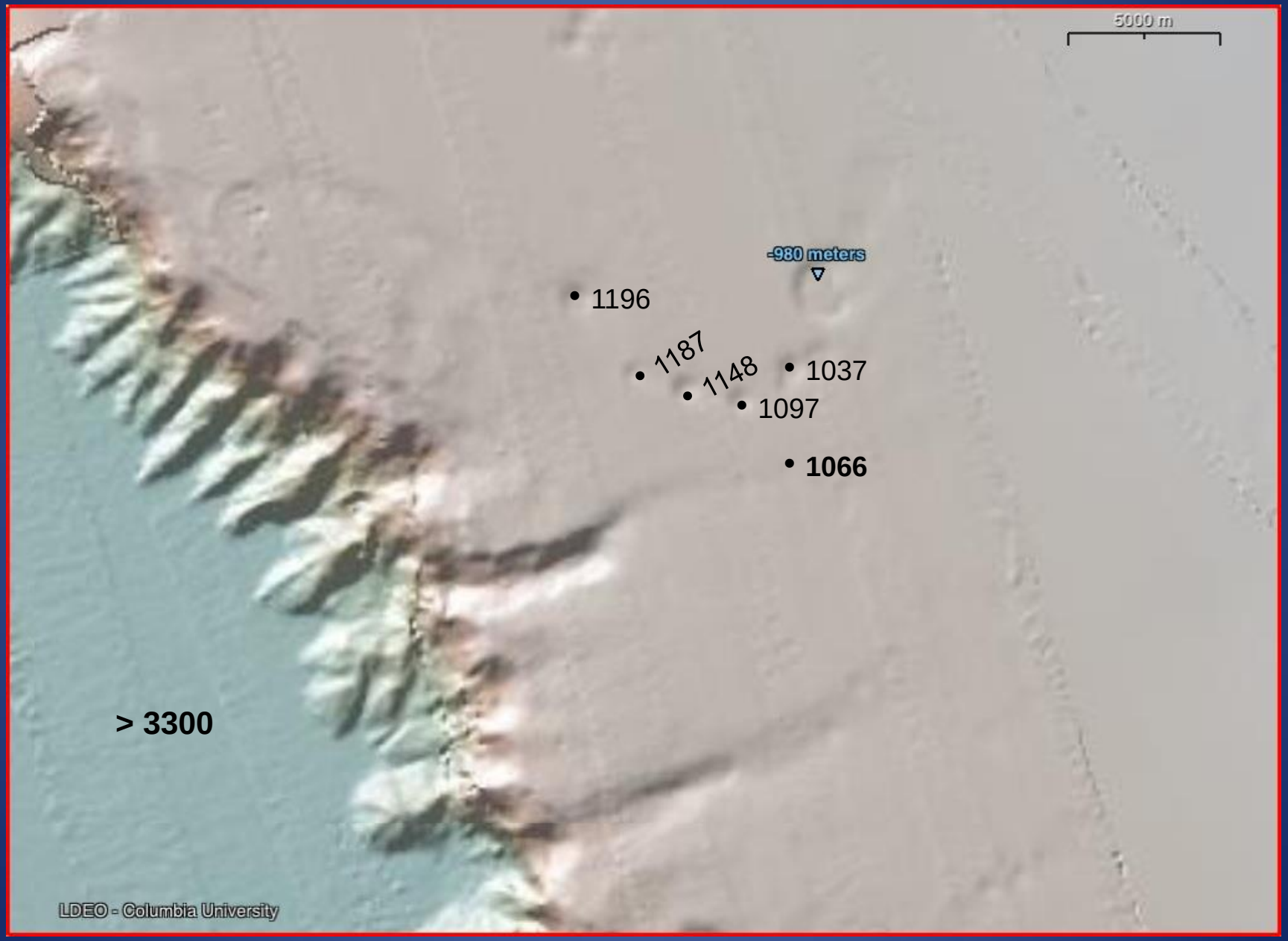


Florida Canyon
(depths in meters)

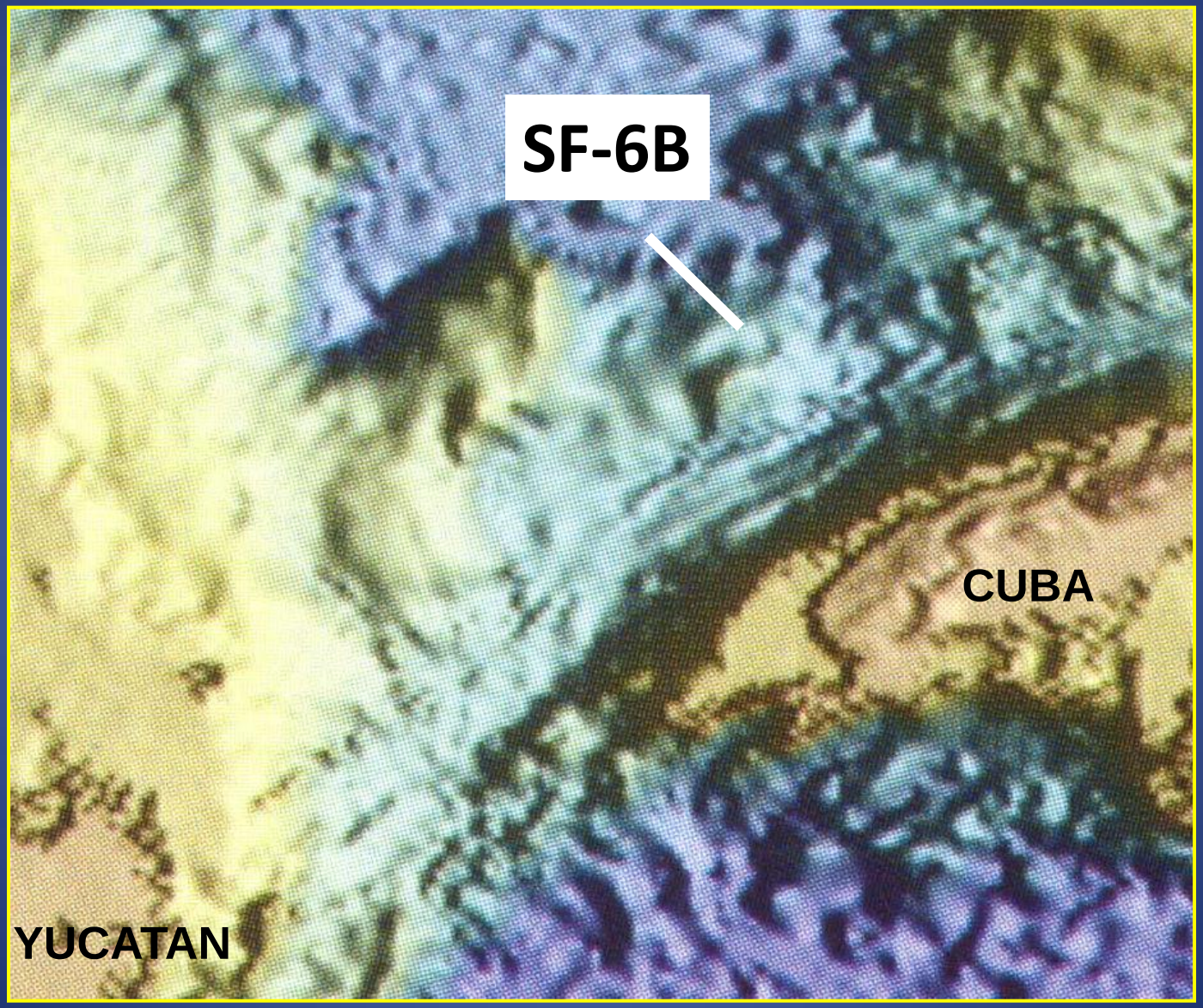
Typical “minor canyon”



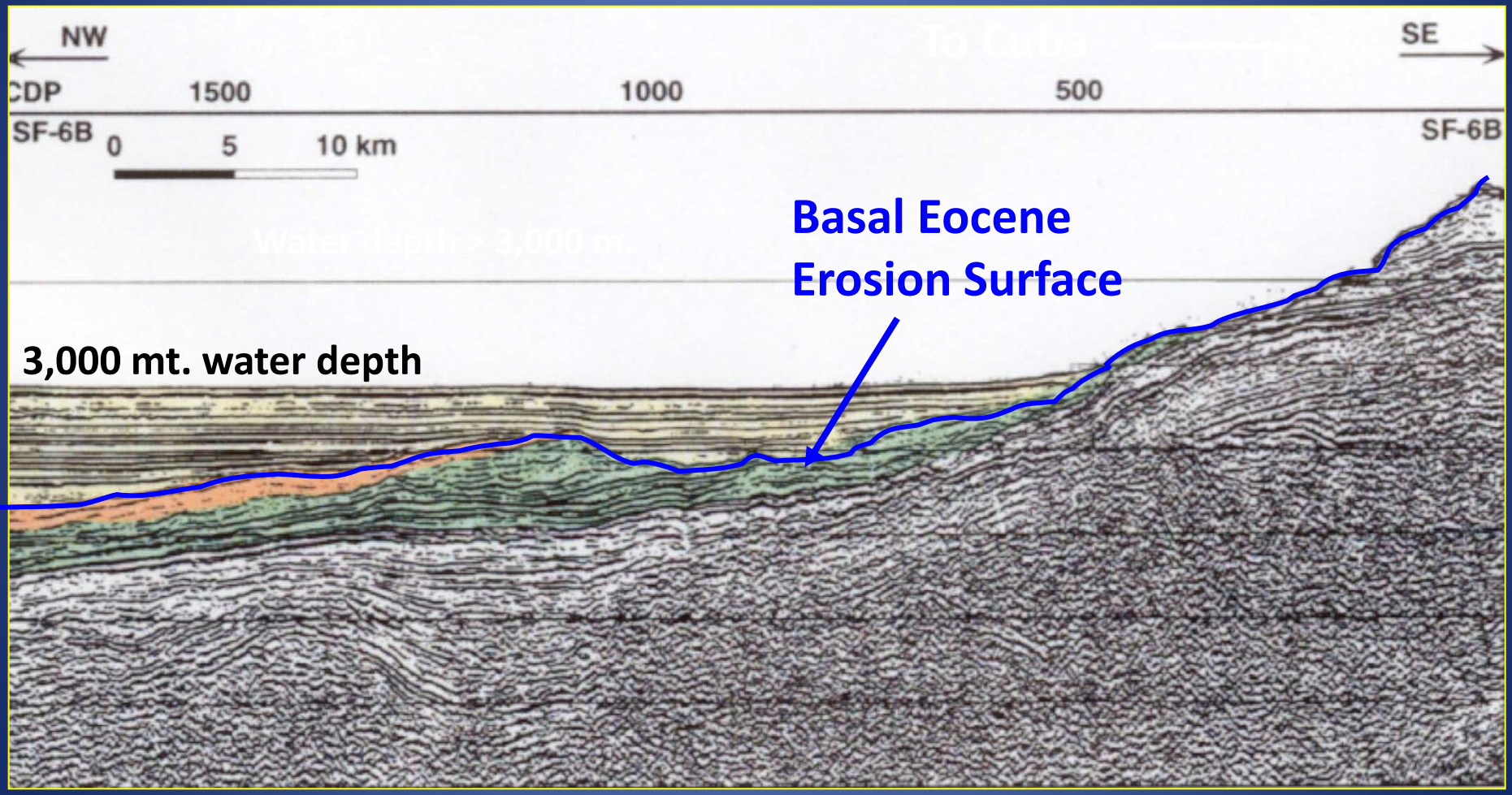
A: Sinkholes on Florida Slope



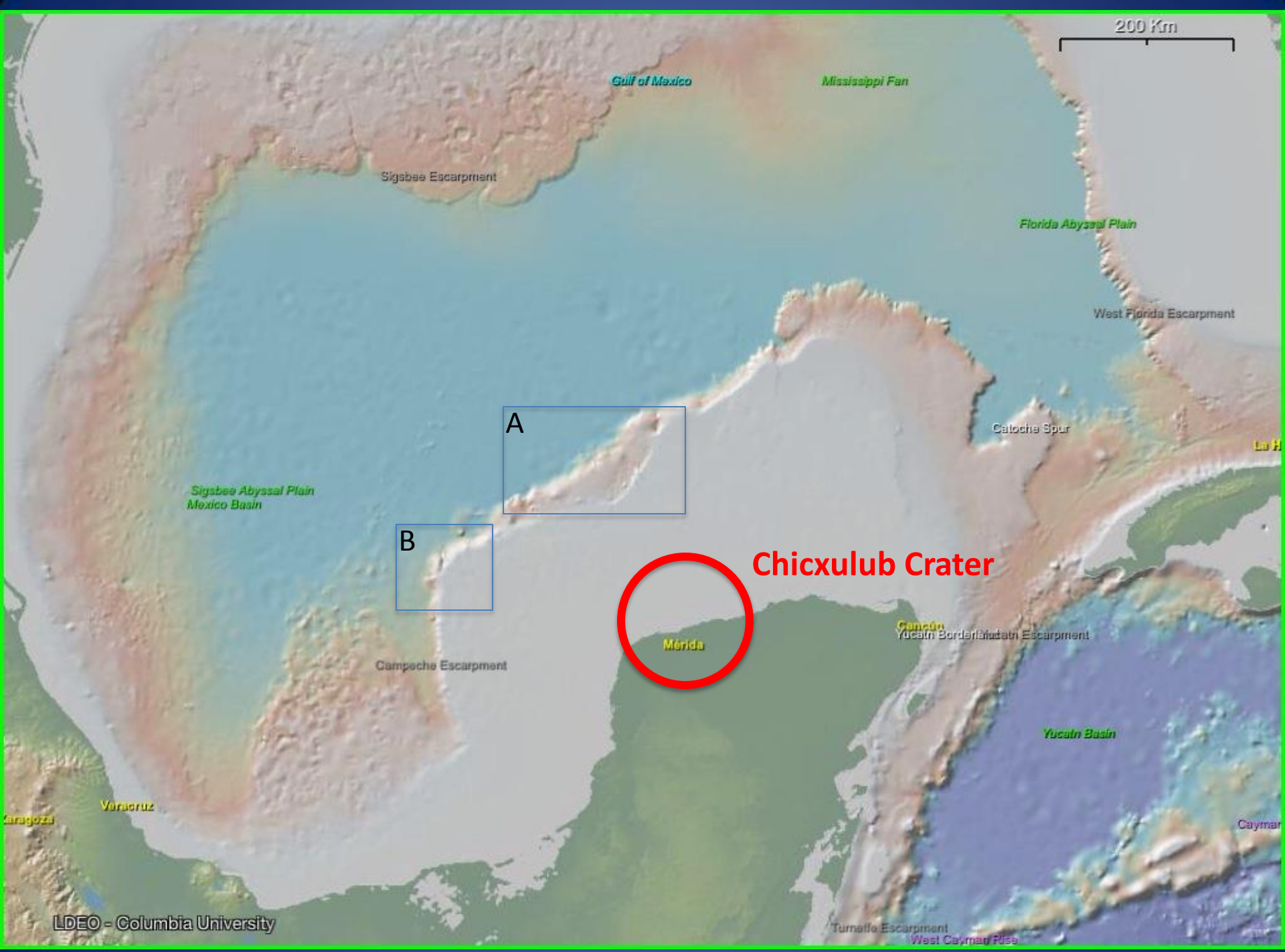
Seismic Line Location



Seismic Line SF-6B

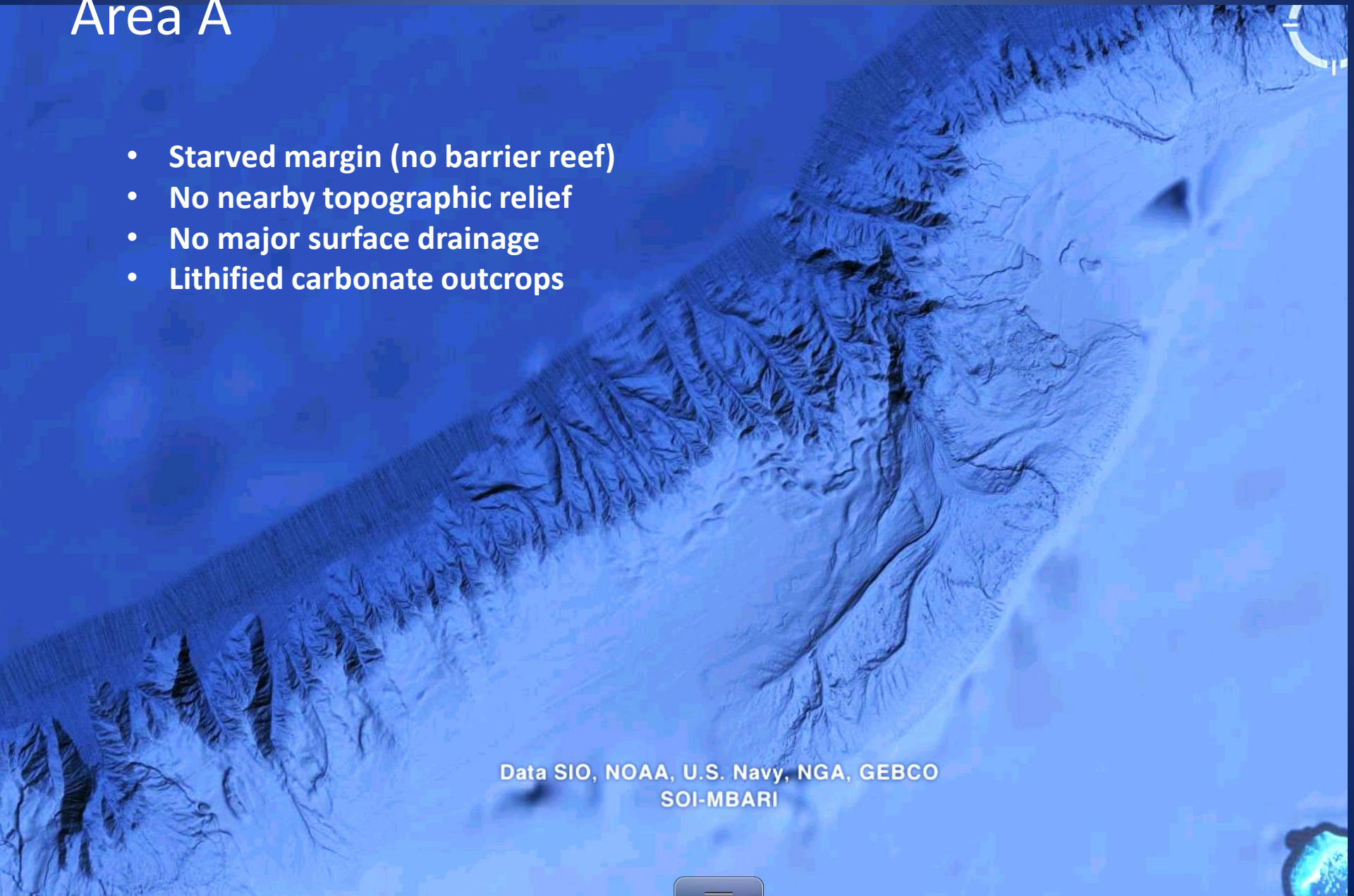


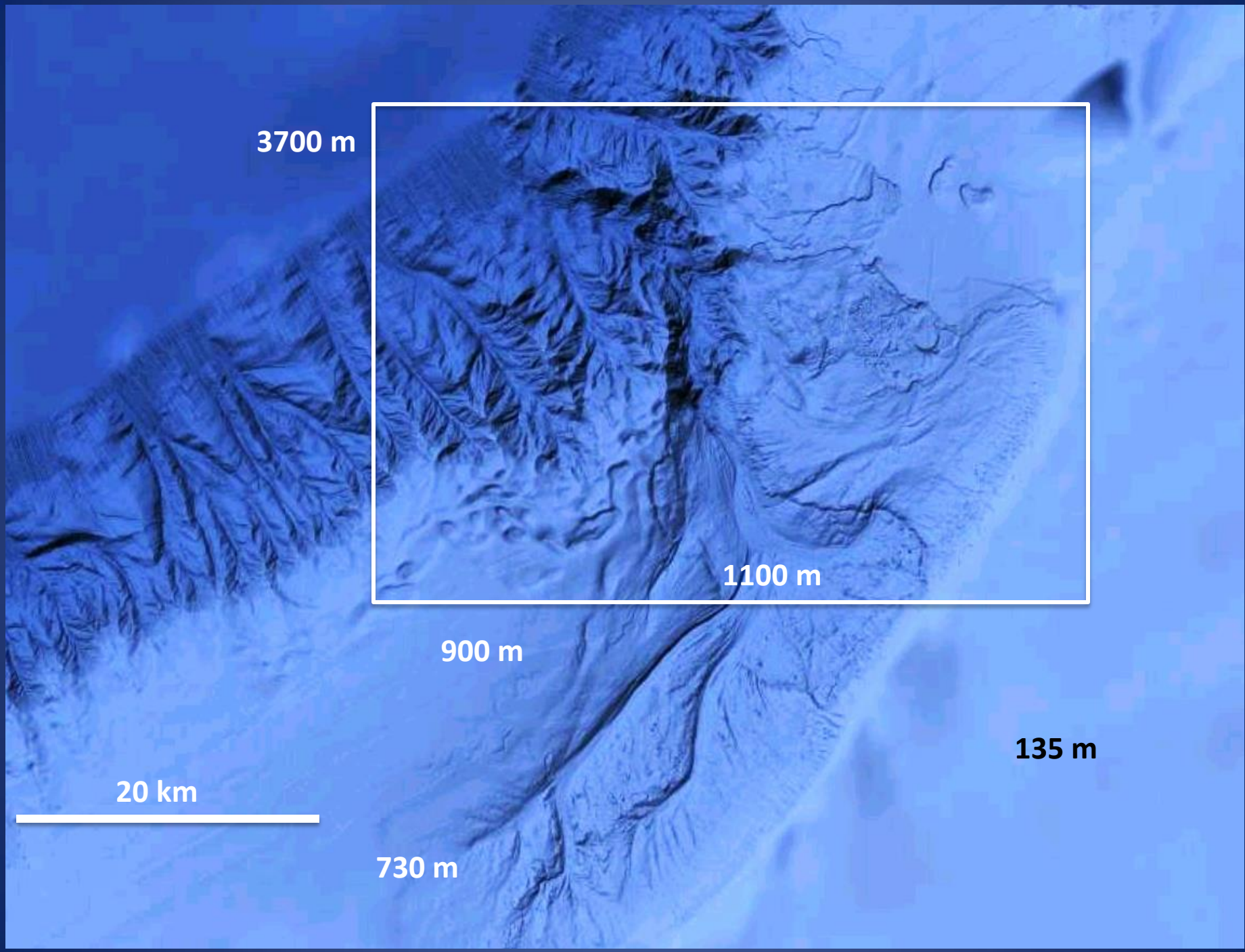
From Marton and Buffler, 1999

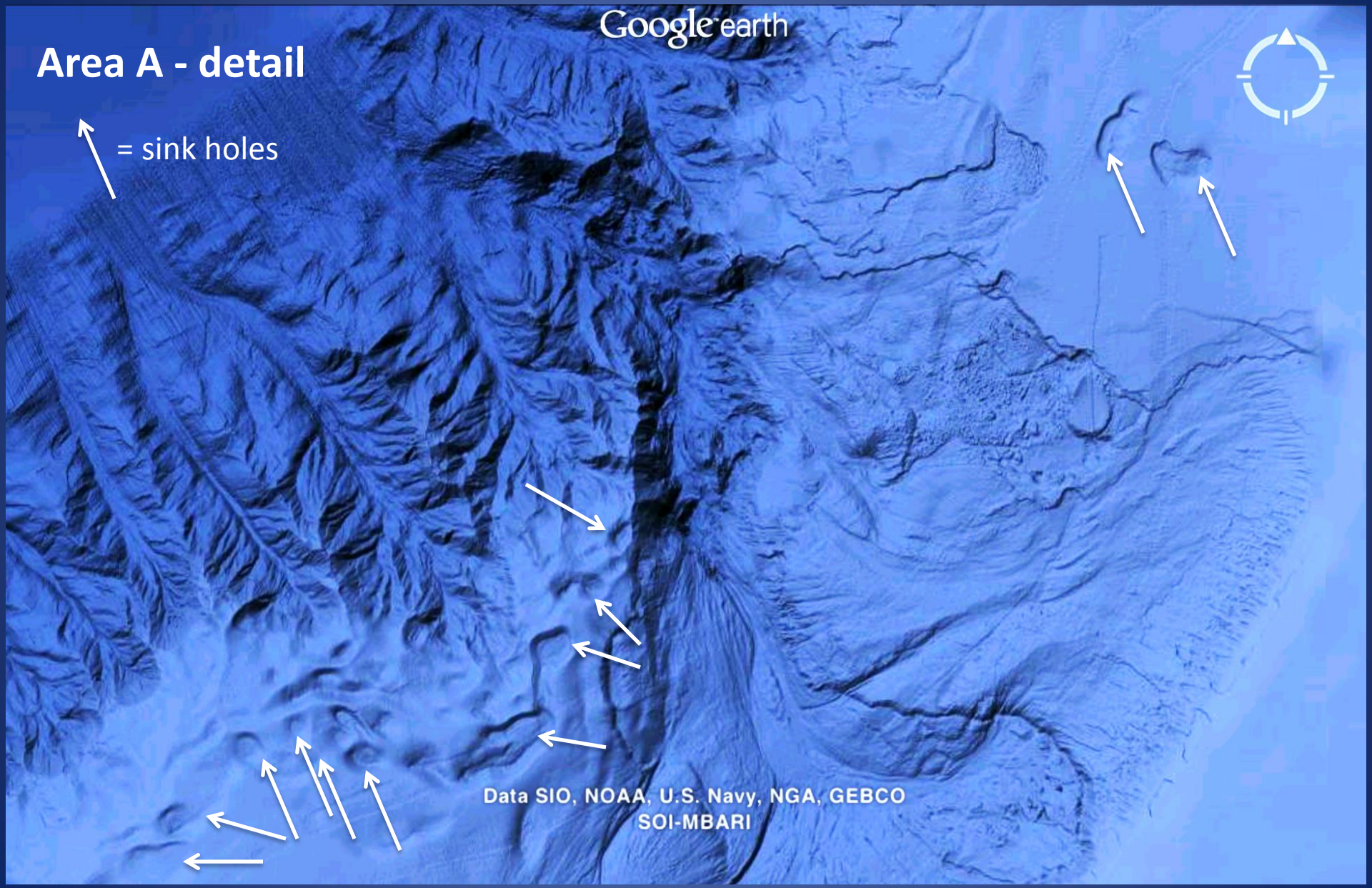

200 Km
Gulf of Mexico
Mississippi Fan
Sigsbee Escarpment
Florida Abyssal Plain
West Florida Escarpment
A
Catoche Spur
Sigsbee Abyssal Plain
Mexico Basin
B
Chicxulub Crater
Mérida
Cancún
Yucatn Escarpment
Campeche Escarpment
Yucatn Basin
Veracruz
Turneffe Escarpment
West Cayman Rise
LDEO - Columbia University

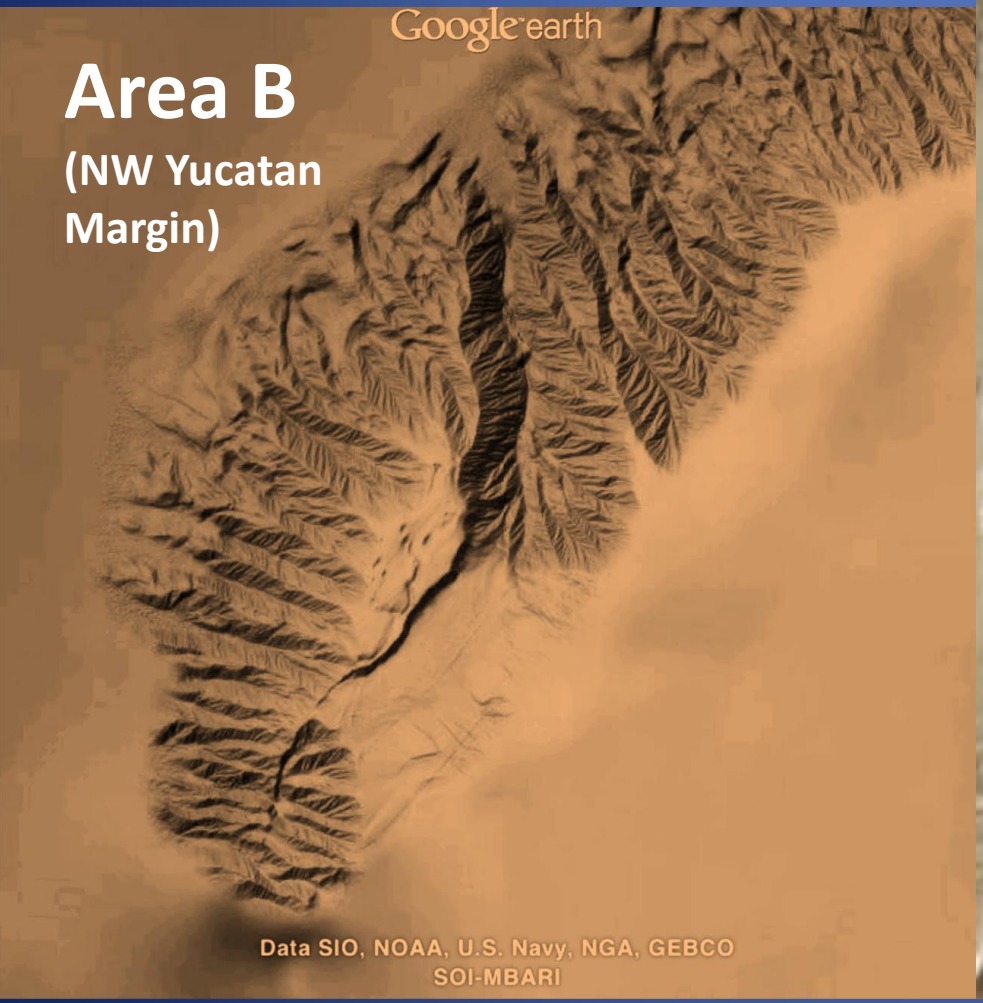
Area A

- Starved margin (no barrier reef)
- No nearby topographic relief
- No major surface drainage
- Lithified carbonate outcrops




3700 m
1100 m
900 m
135 m
20 km
730 m


Area A - detail
= sink holes
Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
SOI-MBARI

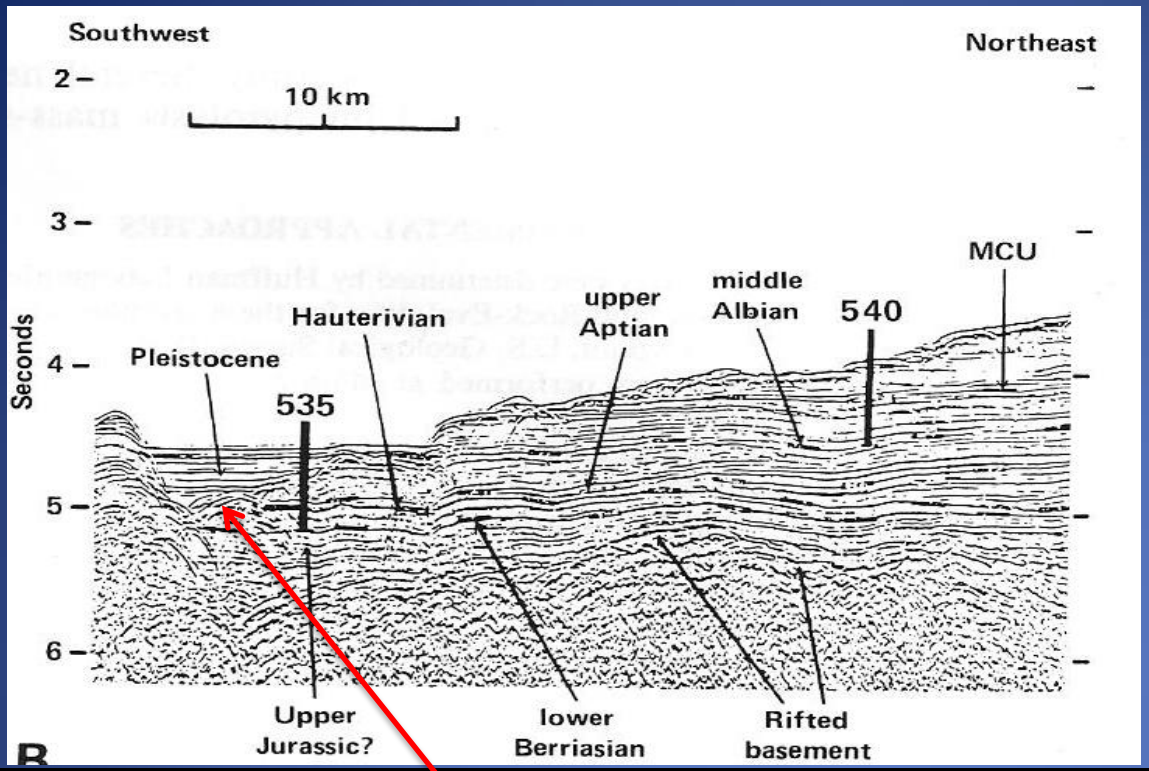

Google earth
Area B
(NW Yucatan Margin)
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
SOI-MBARI

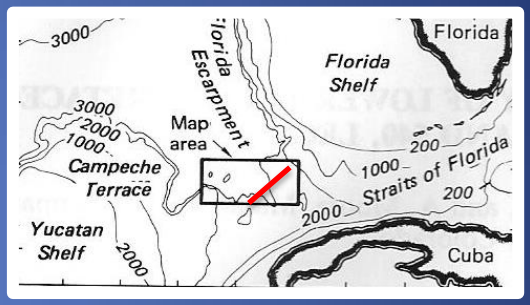

Death Valley

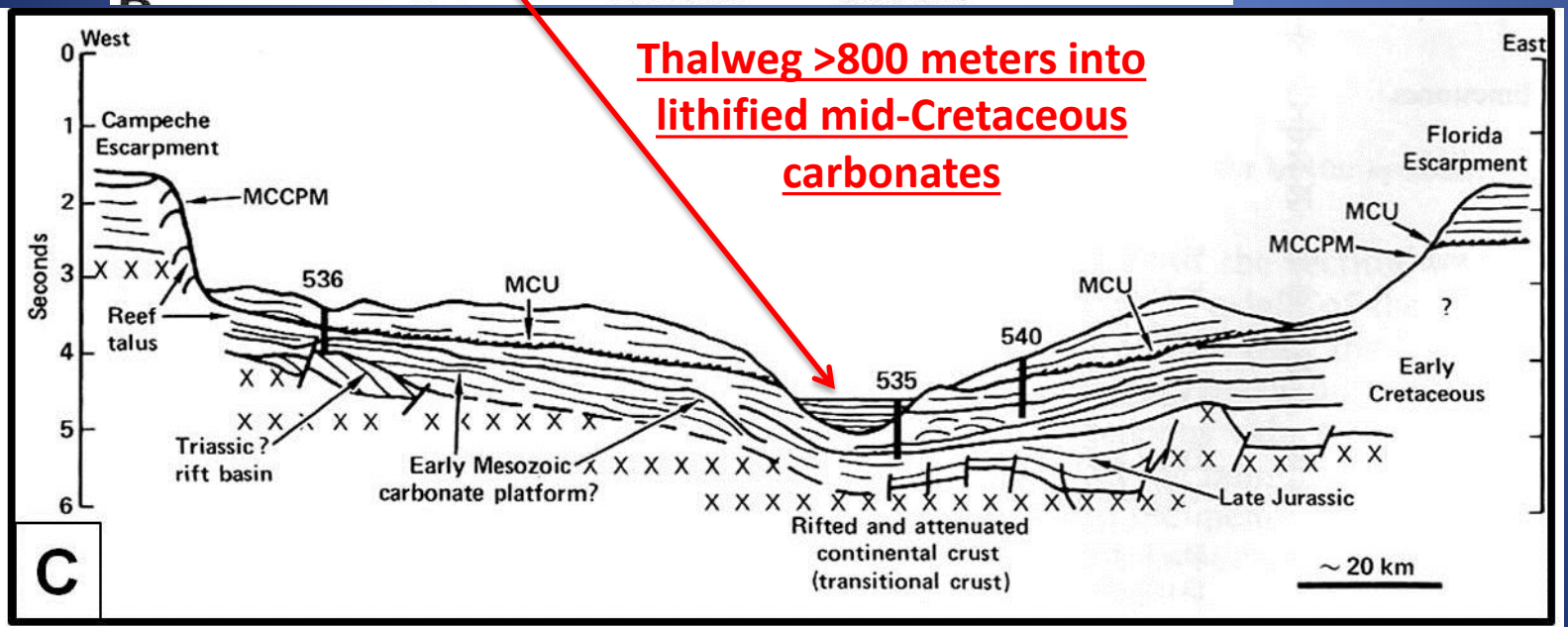
Reconnection and Refill

Breakthrough and Refill

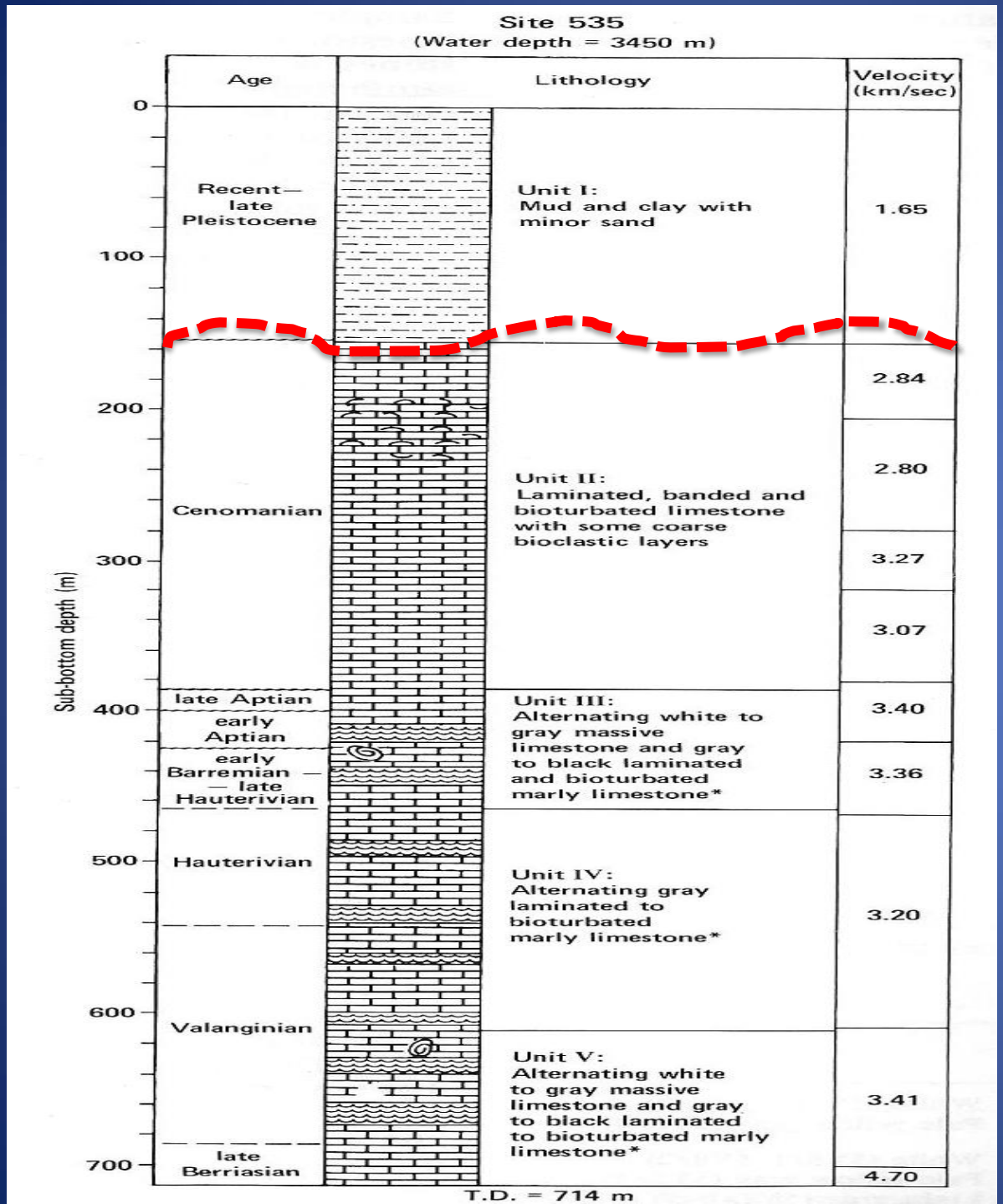
DSDP Leg 77, 1981
Straits of Florida
Site 535





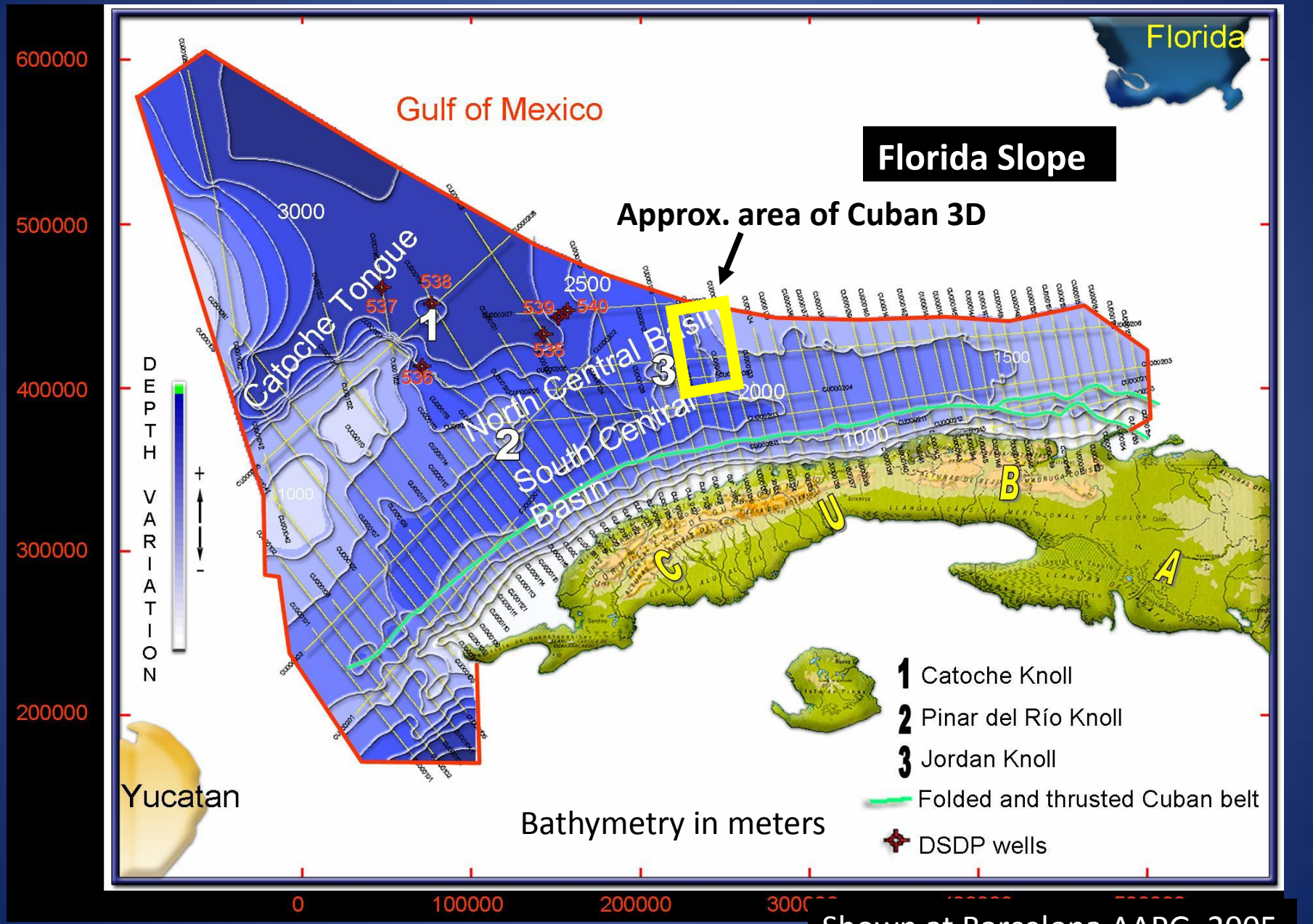


Thalweg >800 meters into lithified mid-Cretaceous carbonates



DSDP Leg 77, Site 535 (site is on the flank of the thalweg)

Sinkholes and Erosion in Deep Florida Strait

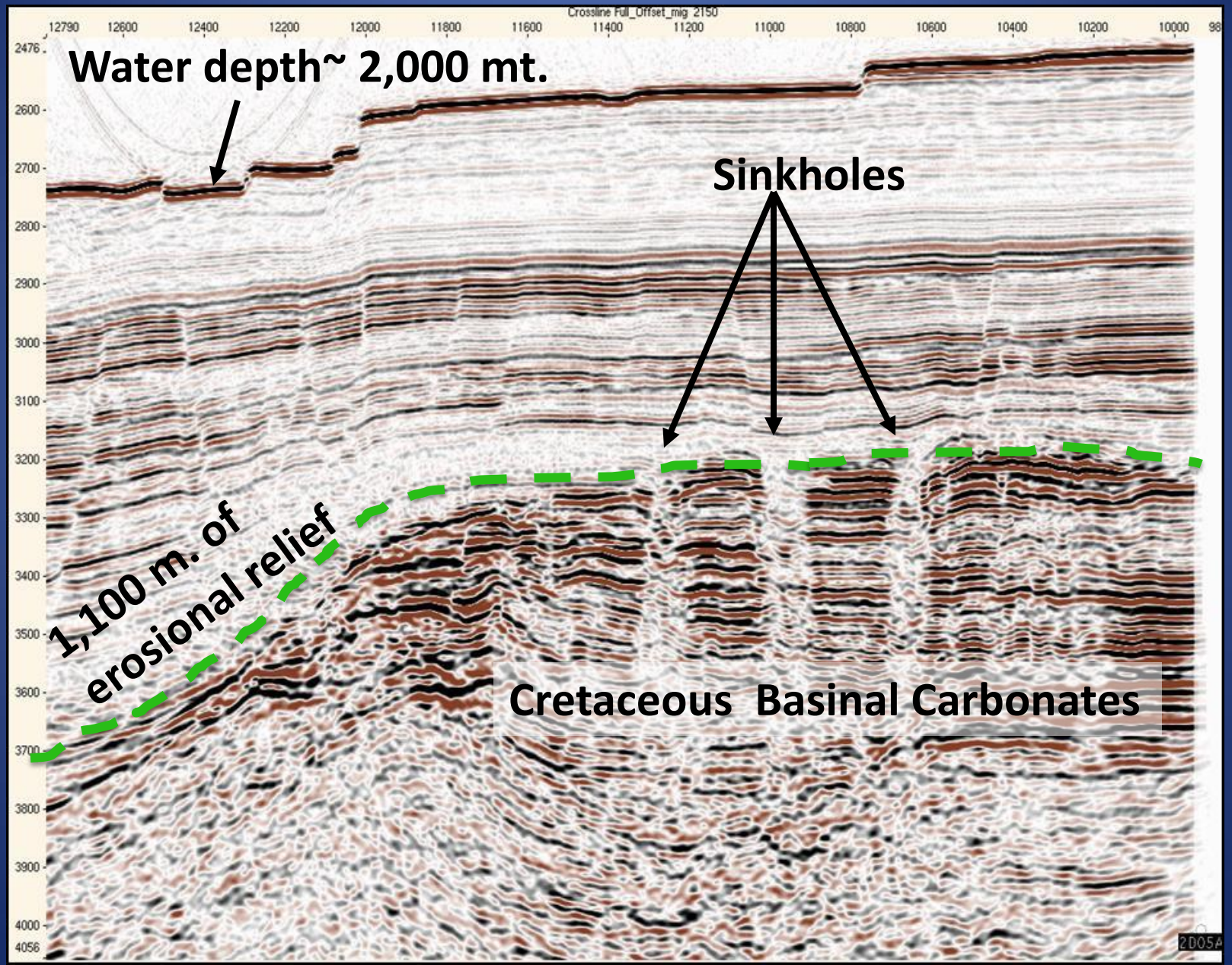


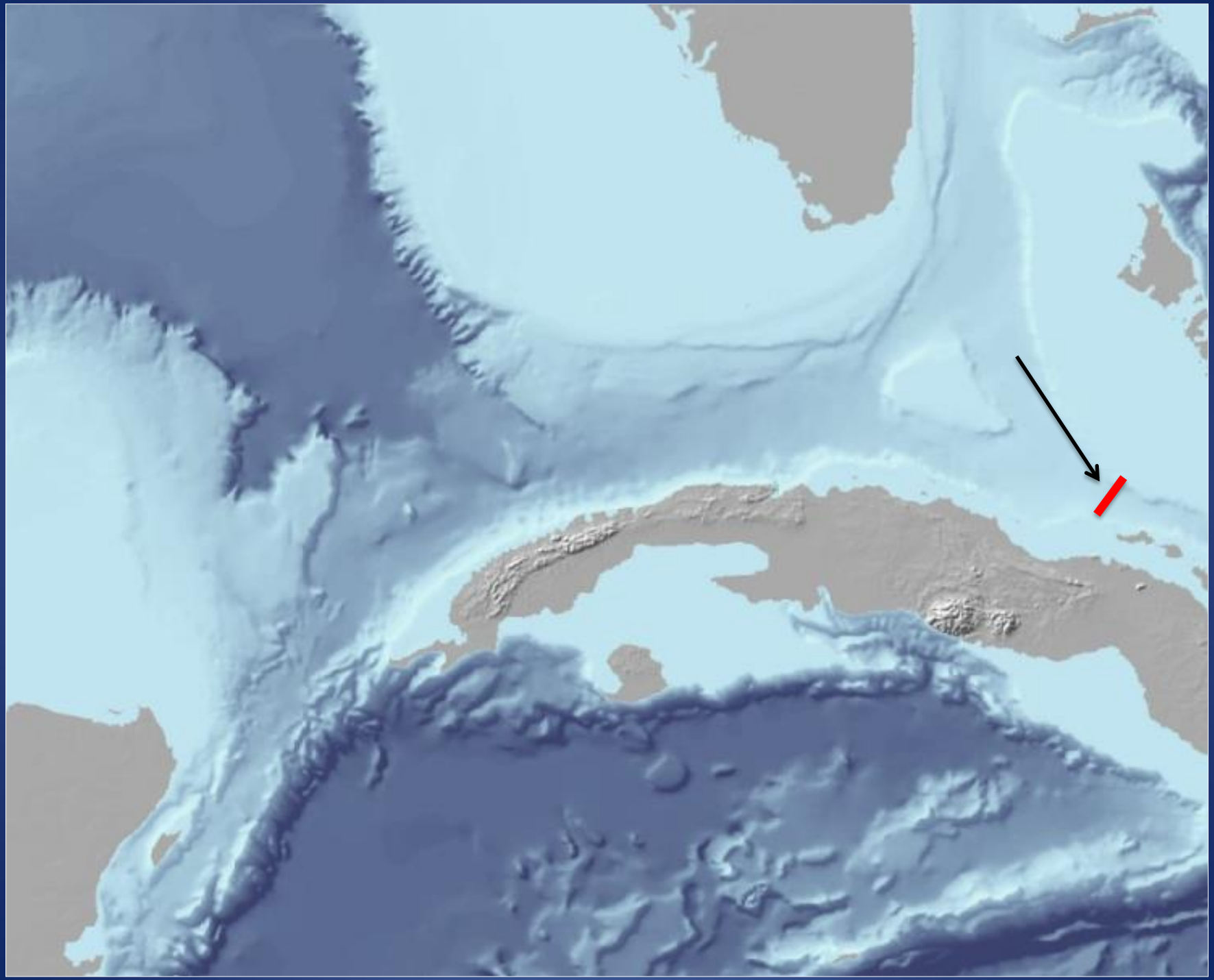
Shown at Barcelona AAPG, 2005

Sinkholes and Erosion in Florida Strait on 3D Seismic

S

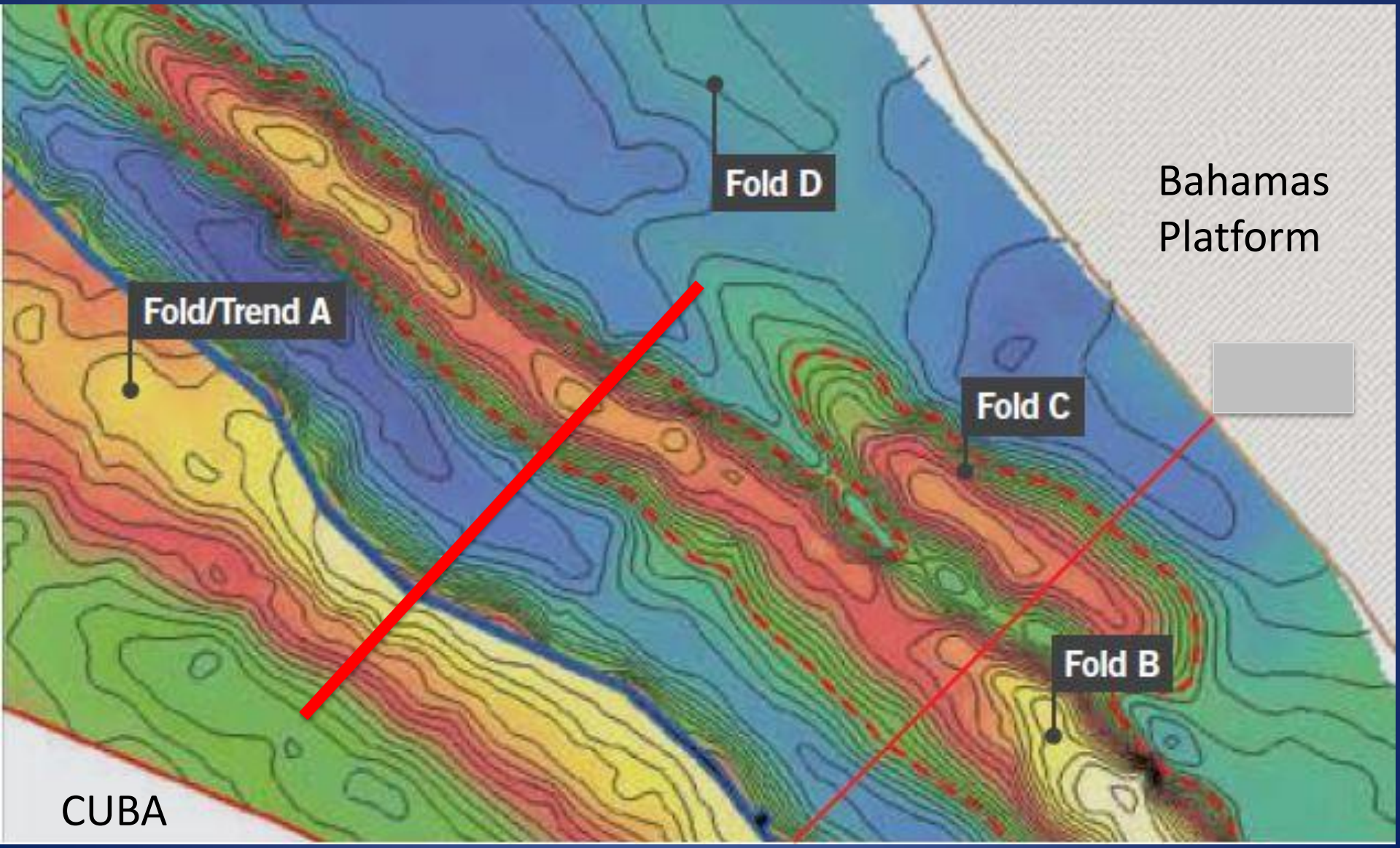
N





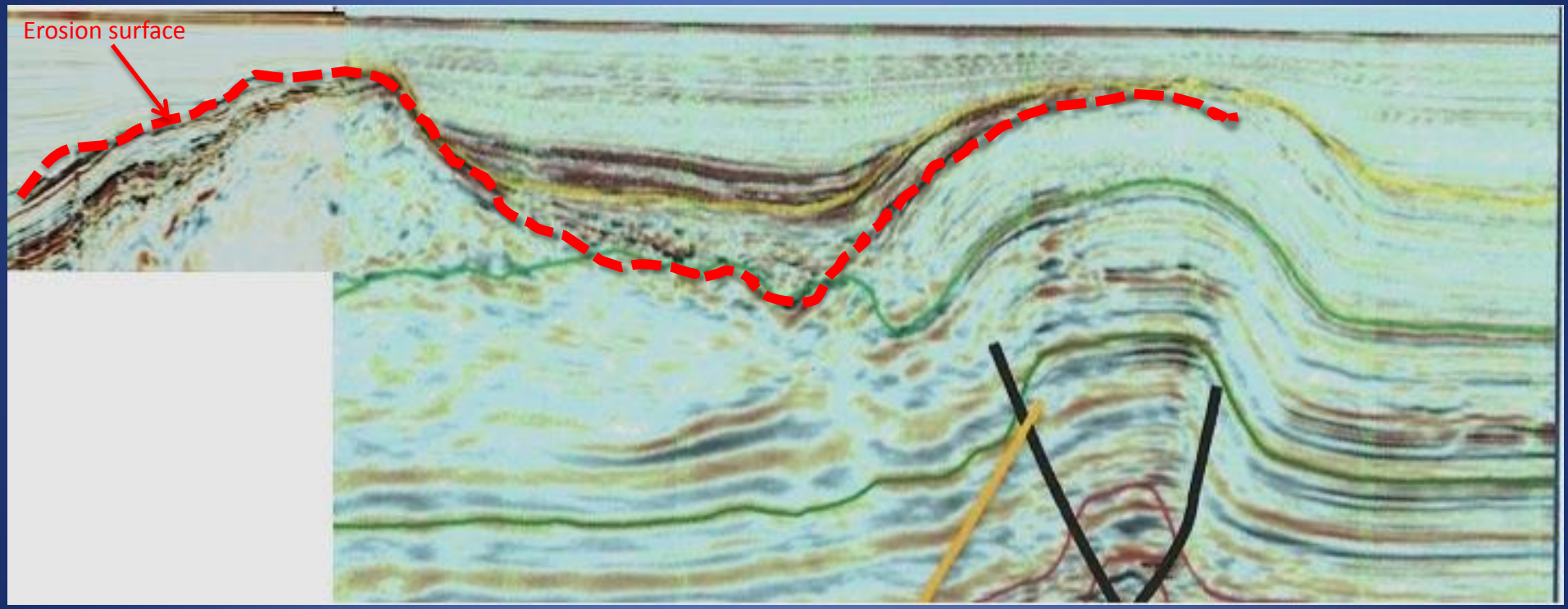
Bahamas Channel – Top Cretaceous

(Bahamas Petroleum Company website)



Bahamas Channel Seismic

SW NE

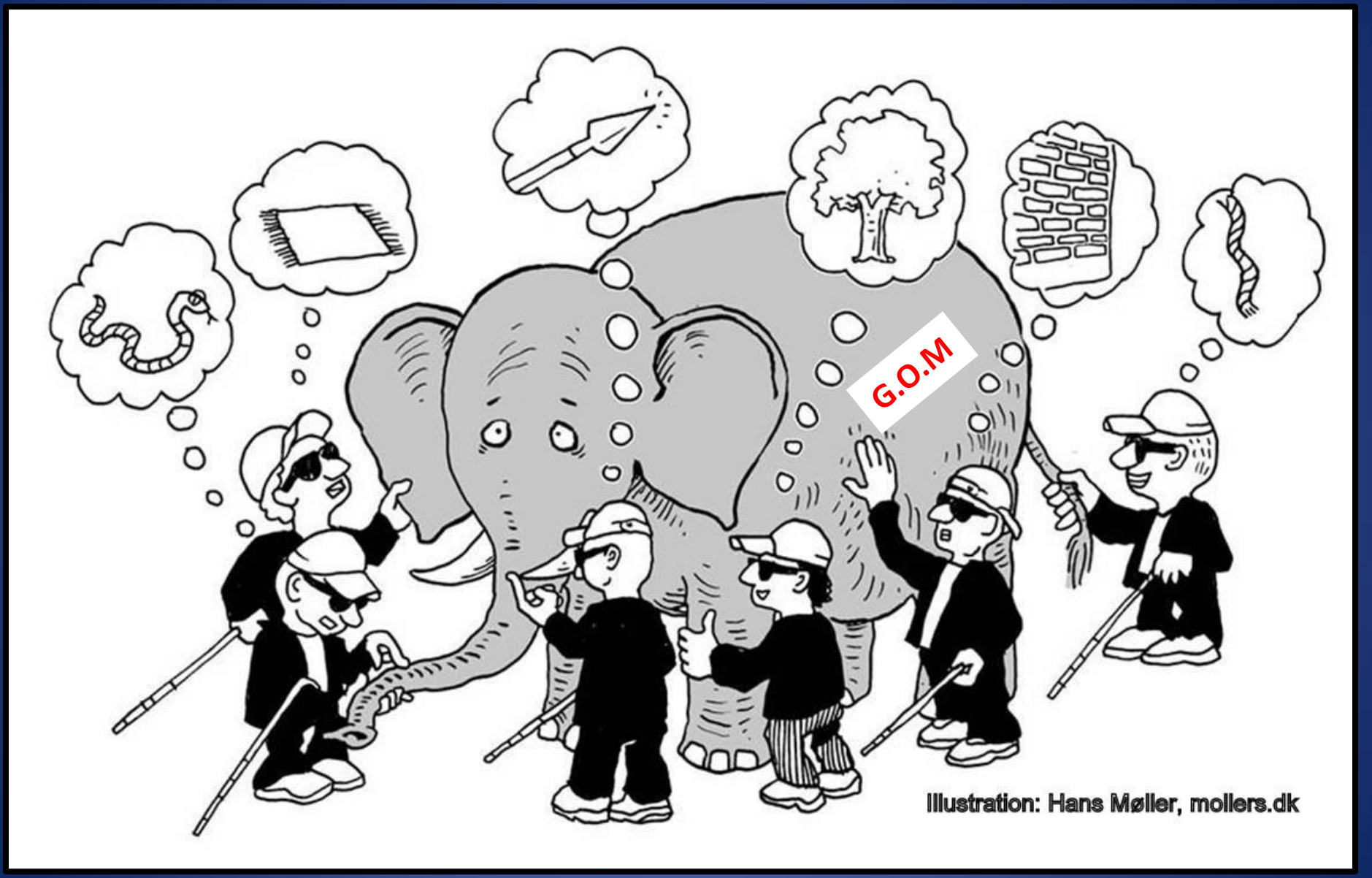


From Bahamas Petroleum Company website

Conclusion: Anomalies that the drawdown explains and other hypotheses don't:

- *Sudden inception and cessation of massive sheet sand deposition at least 450 kms outboard of the shelfbreak.*
- *Rapid excavation of deep canyons across tens of kms of shelf without tectonic uplift or global drop in sea level.*
- *Erosion of hard rock in the deep basin (karst and canyons).*
- *Deep thalweg in the Cuba - Florida/Bahamas suture zone.*

Everyone's an Expert on the Gulf



"*Everything should be made as simple as possible, but not simpler*." A. Einstein