

Hydrocarbon Exploration Plays in the Great Caribbean Region and Neighboring Provinces*

By

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Abstract

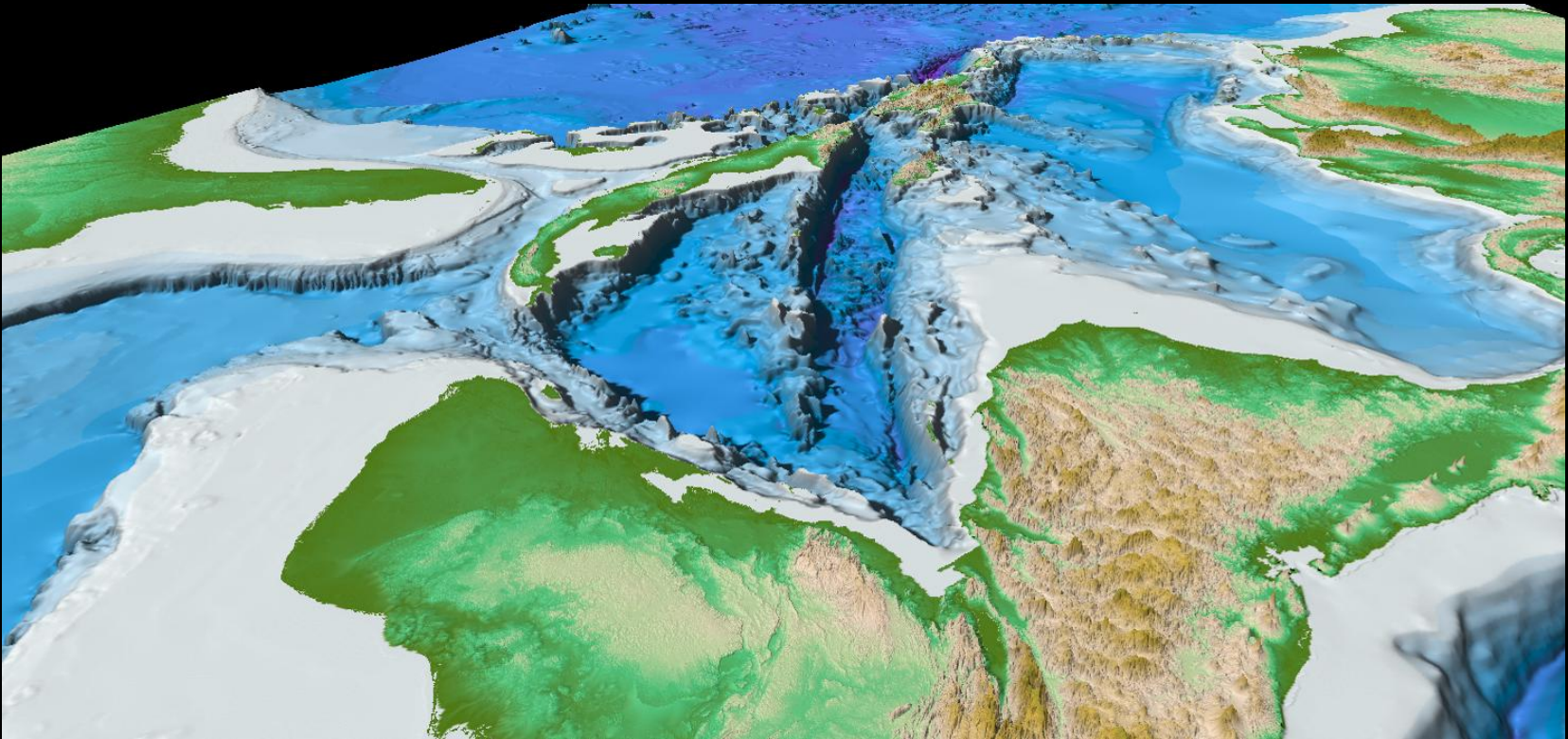
The Caribbean region is located between two of the largest hydrocarbons provinces in the western hemisphere (the Gulf of Mexico and the northern South American foreland basins), and until now, it has been considered a hydrocarbon poor region. Because of lack of major exploration efforts and modern seismic data, the complex evolution of the Caribbean plate since the Late Cretaceous, and poor understanding on the origin, quality, and distribution of source and reservoir rocks, it is not clear how much the hydrocarbon potential of the Caribbean region is becoming a challenge for explorationists. However, the presence of oil indicator plays, oil and gas seeps, geochemical data, oil fields (Barbados, Cuba, etc.), and giant gas fields (offshore northern South America) around all margins of the Caribbean plate, the increasing need for more reserves and the strategic location to US and European markets makes the Caribbean region a more attractive target for current and future exploration.

By integrating thousands of km of old and new 2D seismic data, together with existing well and surface data, we present a regional overview of key areas for exploration in the Caribbean region. Key areas include:

- Cuban Eocene foreland basin and southern Gulf of Mexico Paleogene wedge
- Nicaraguan Rise region
- Offshore Caribbean margin of Colombia
- Grenada and Tobago basins
- Barbados accretionary prism.

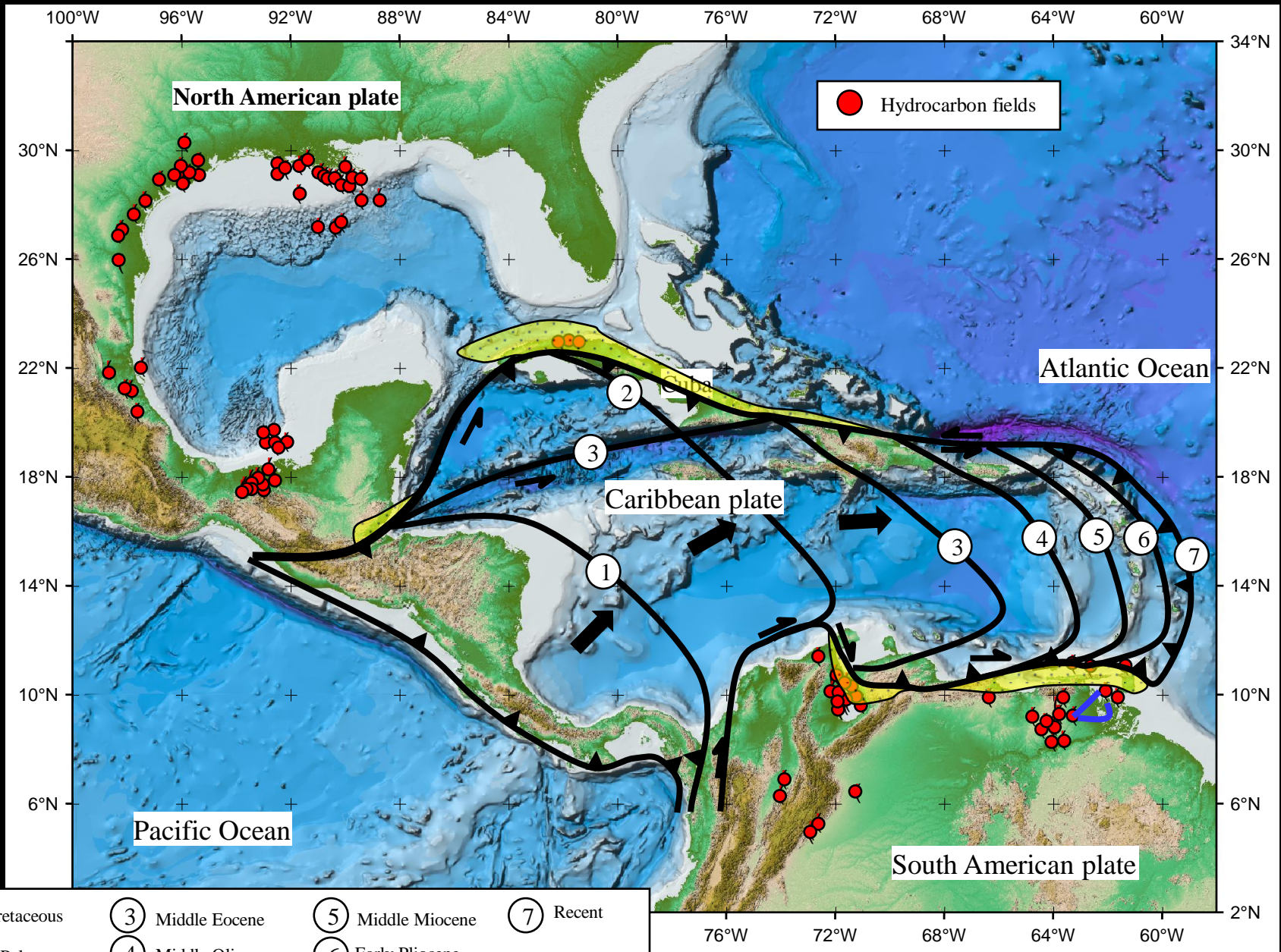
On all these regions, a common factor that makes them attractive is their location at the edges of the Caribbean plate along areas of collision with the passive margins of North and South America which contain proven source rocks and large continental paleodrainages for good quality reservoir rocks.

Hydrocarbon exploration plays in the greater Caribbean region and neighboring provinces

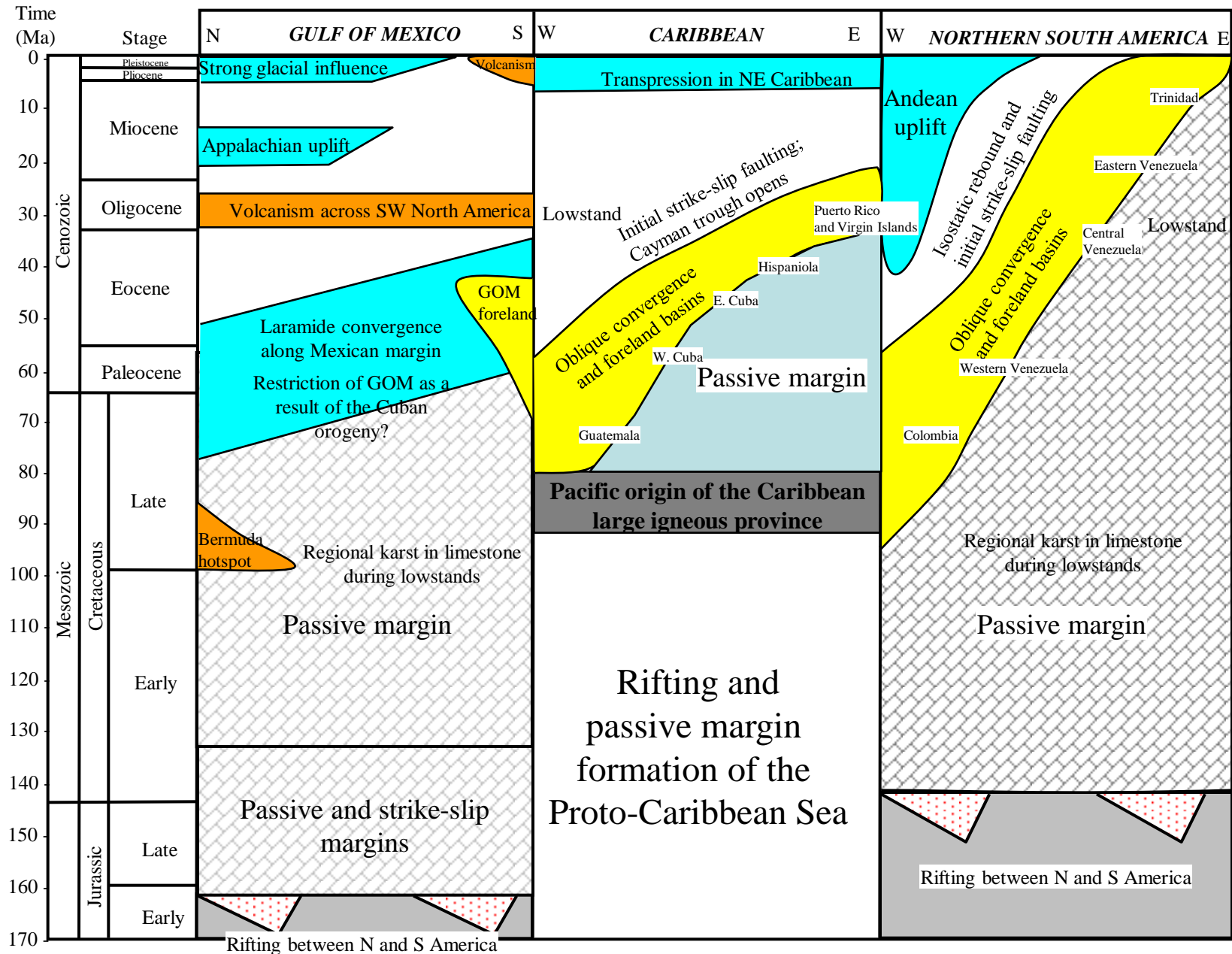


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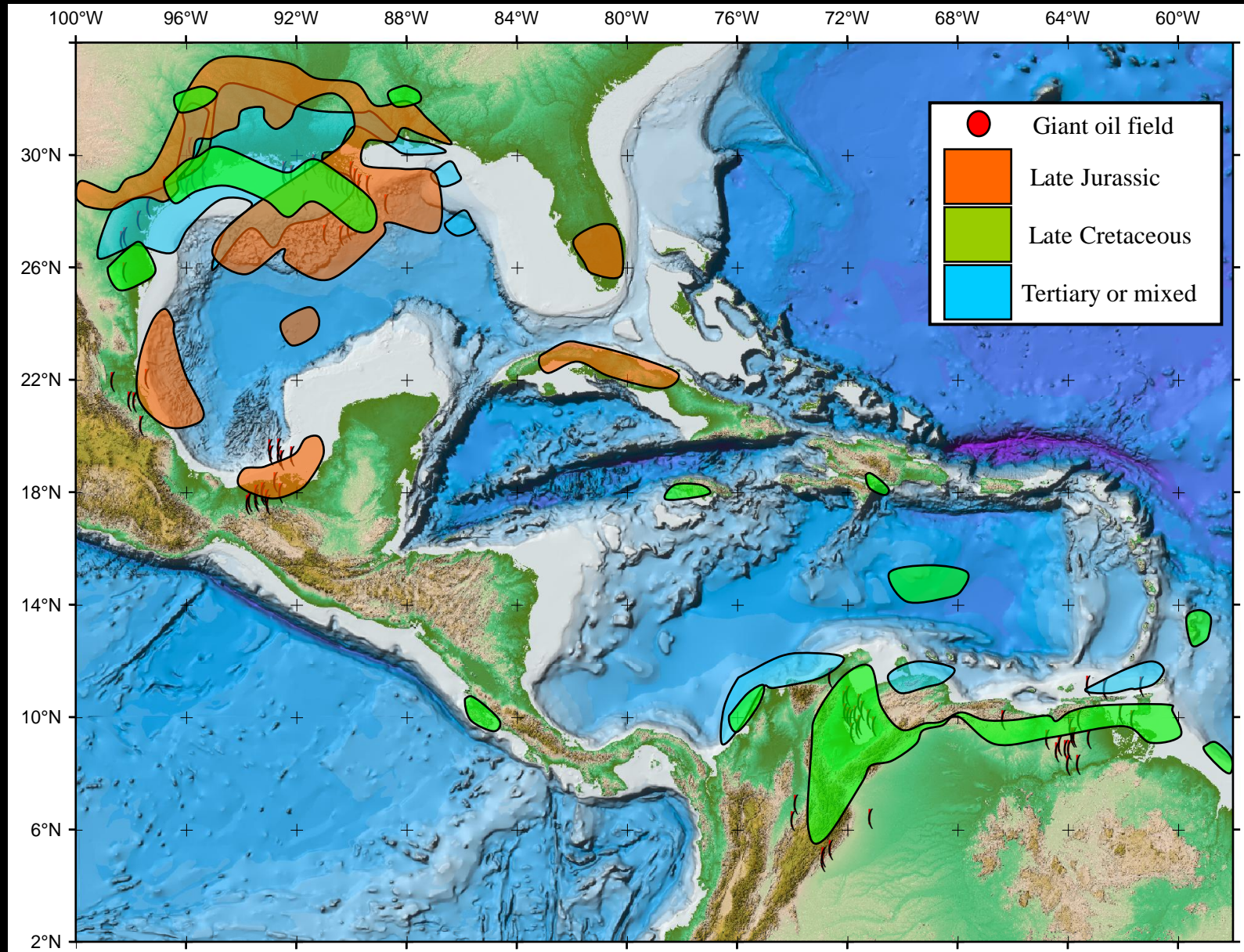
Economic significance of Caribbean region and neighboring areas



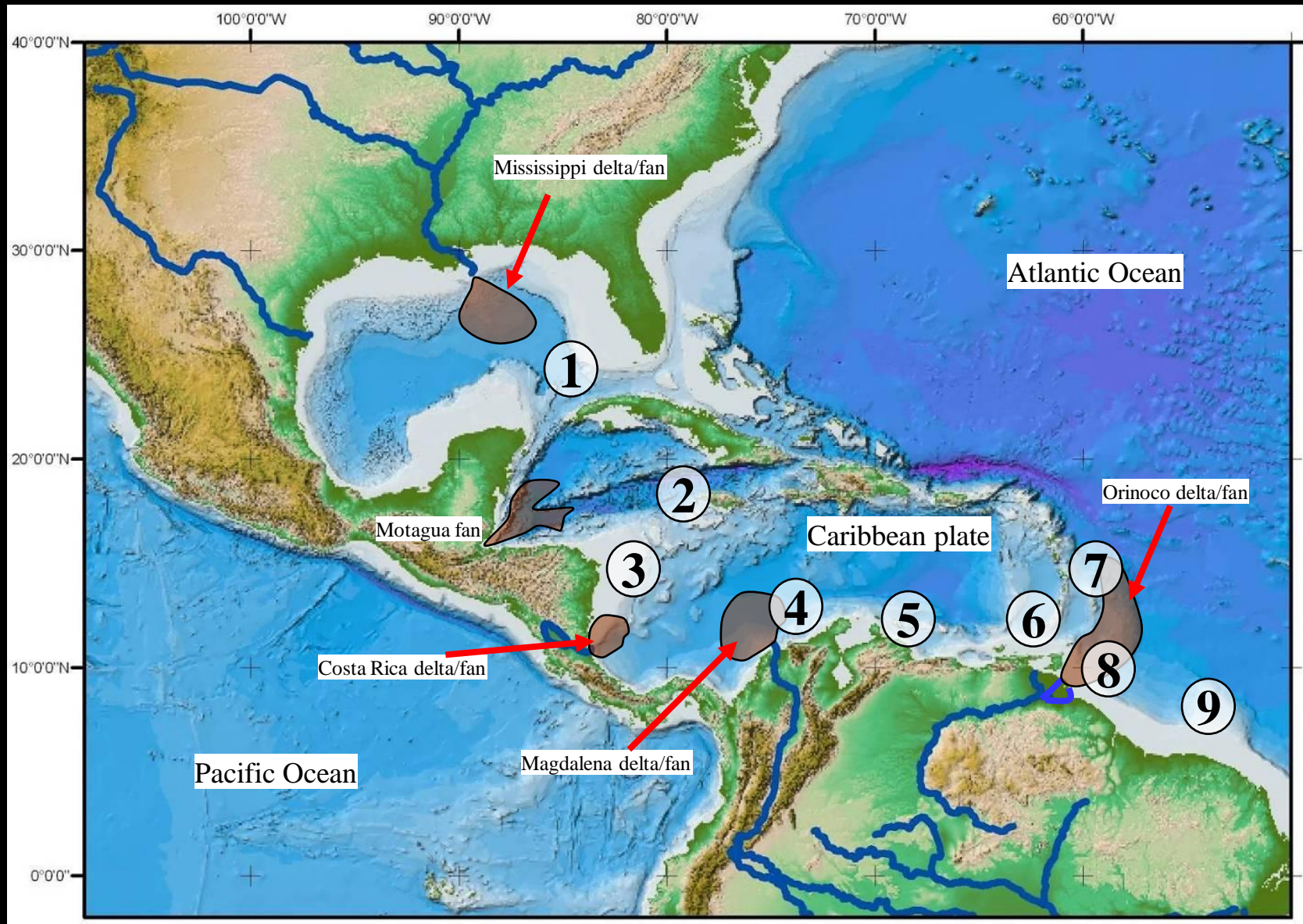
Tectonic phases at the Americas-Caribbean scale



Controls on known source rock distribution

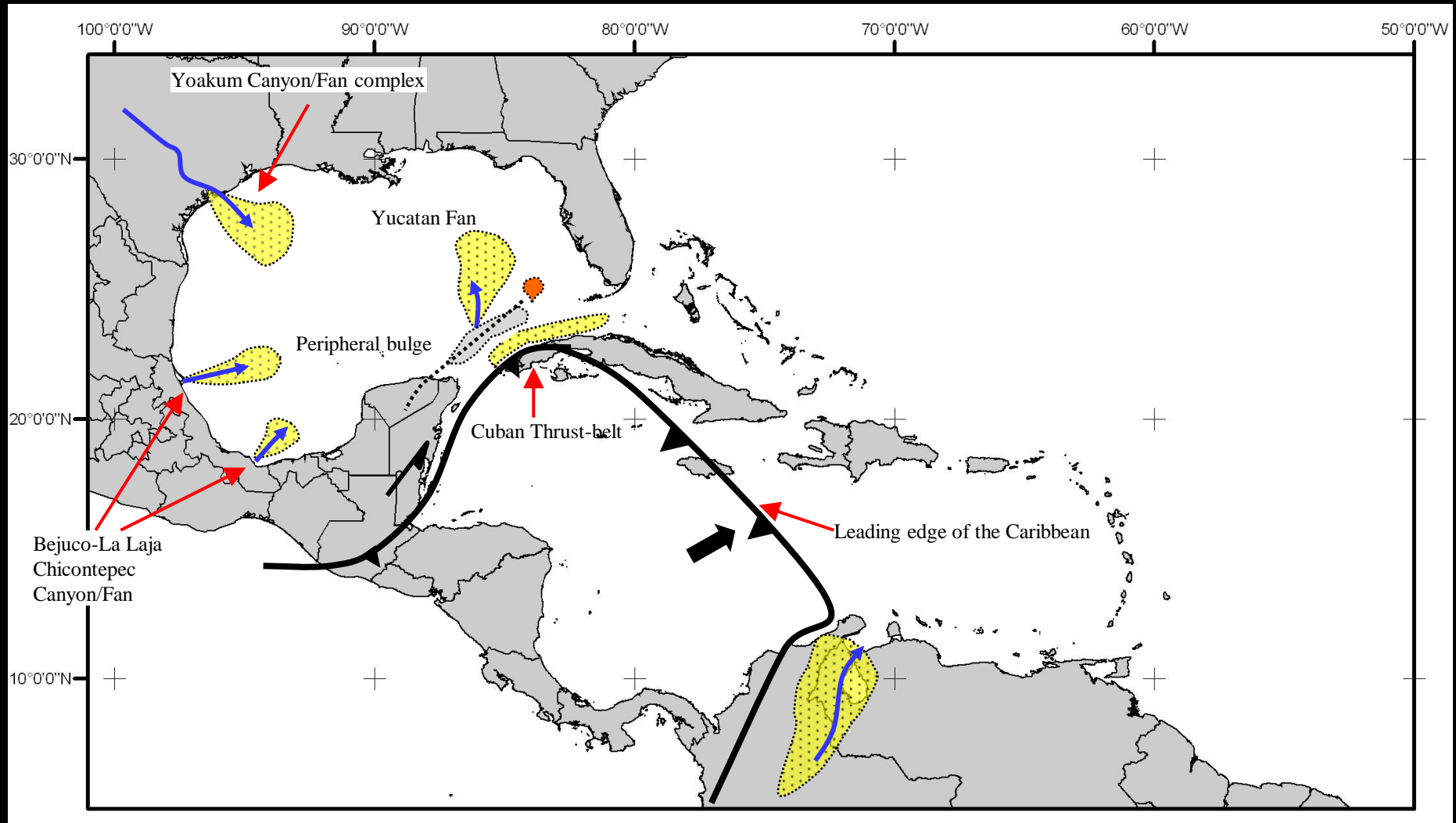


Present-day continental-scale drainage systems



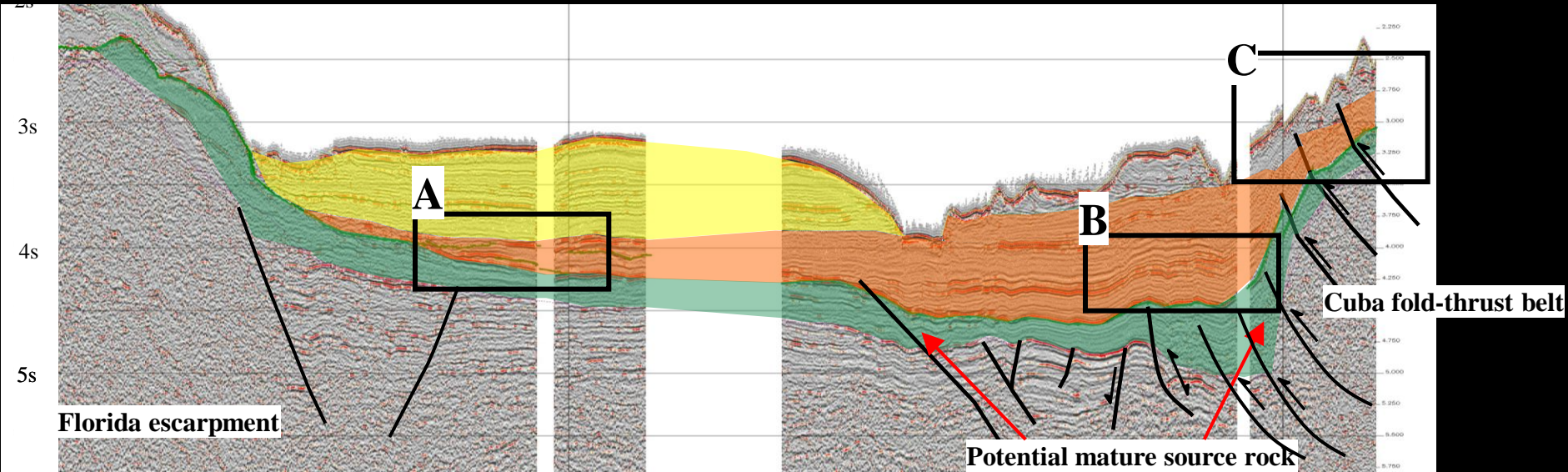
Cuba foreland basin

Paleogene wedges- thrust

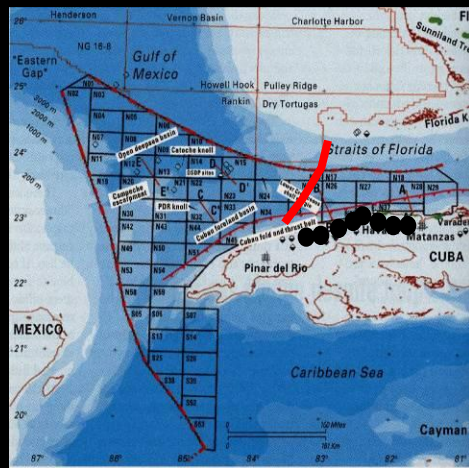


Petroleum system of the Cuban foreland basin

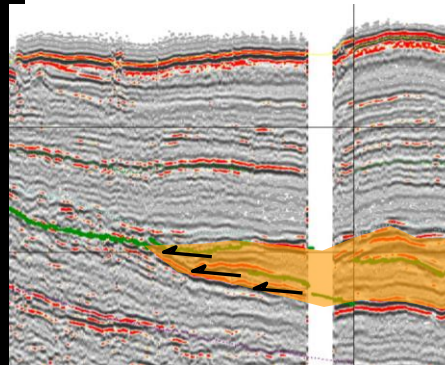
SSW



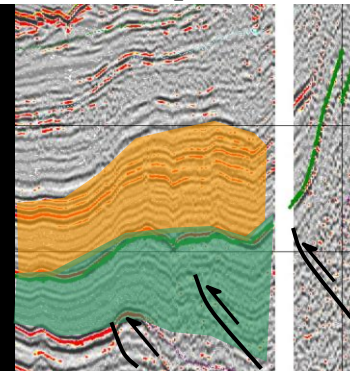
Offshore Cuba bid blocks



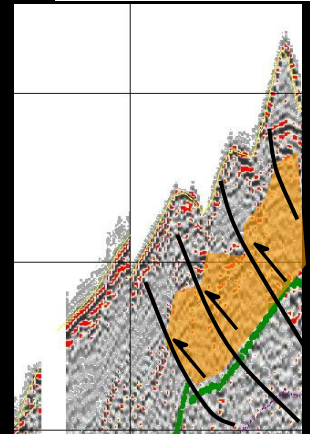
A. Stratigraphic Eocene trap



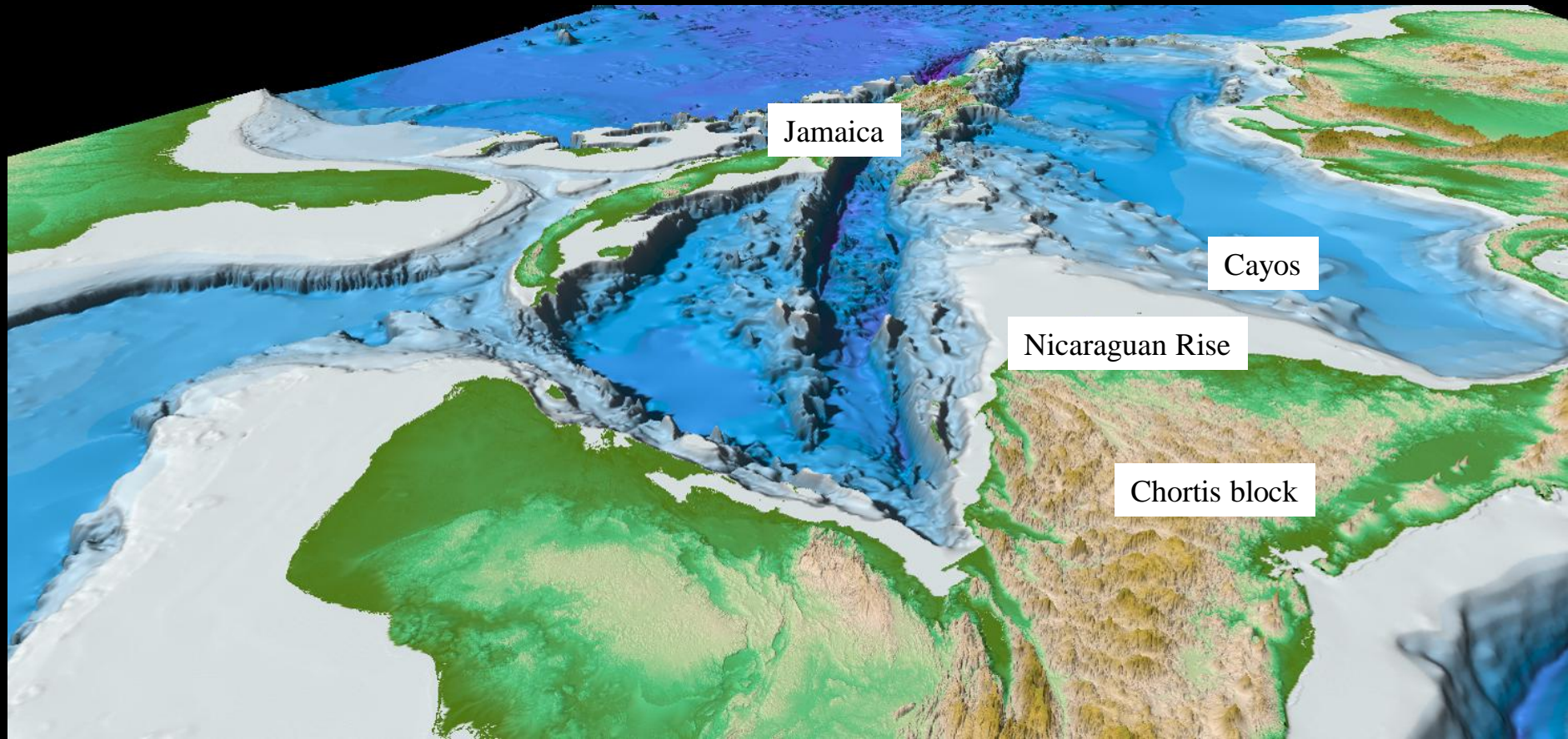
B. L. Cret. carbonate highs and Eoc. deep fold-thrust belt



C. Eoc. Shallow fold-thrust belt



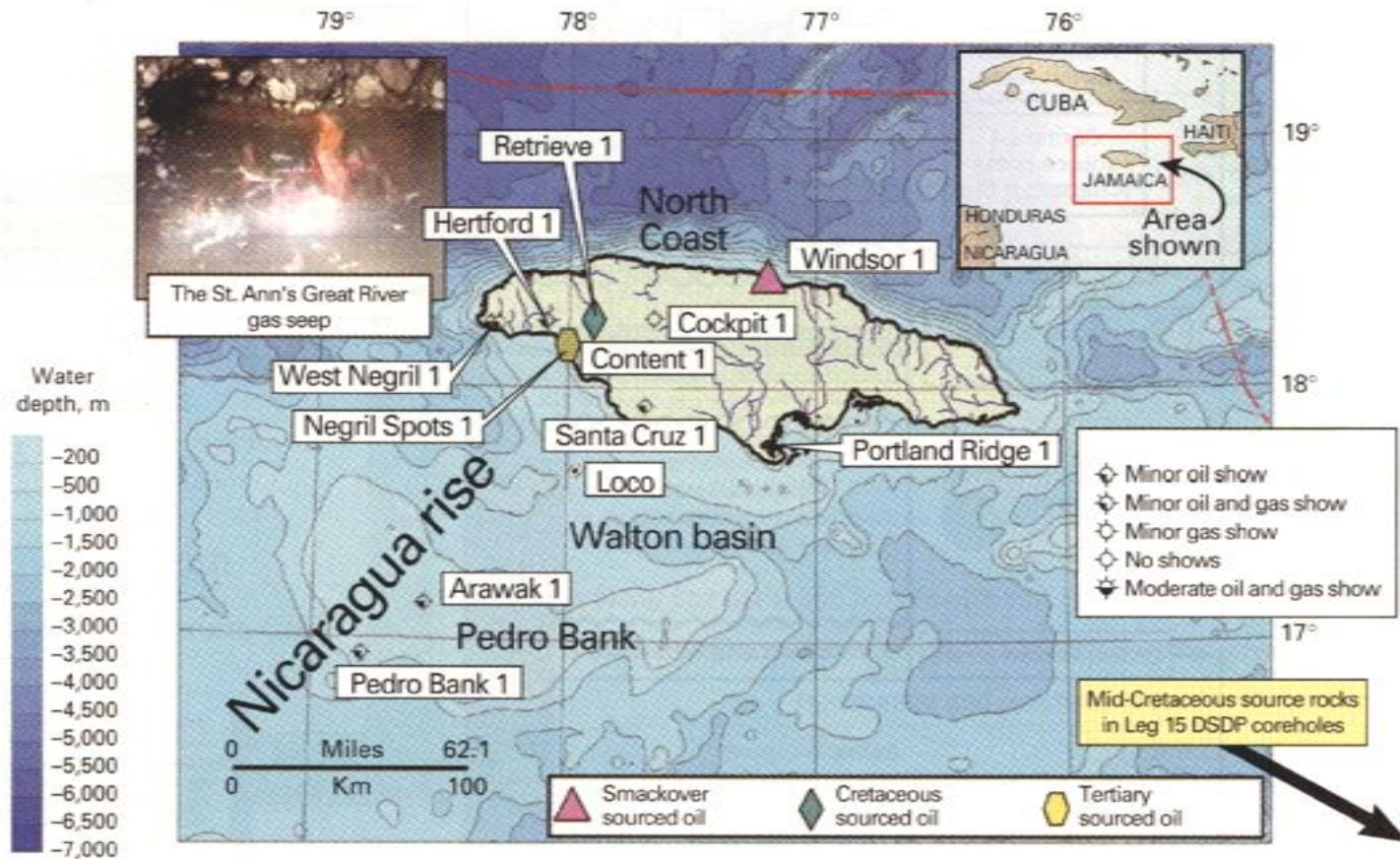
Nicaraguan Rise



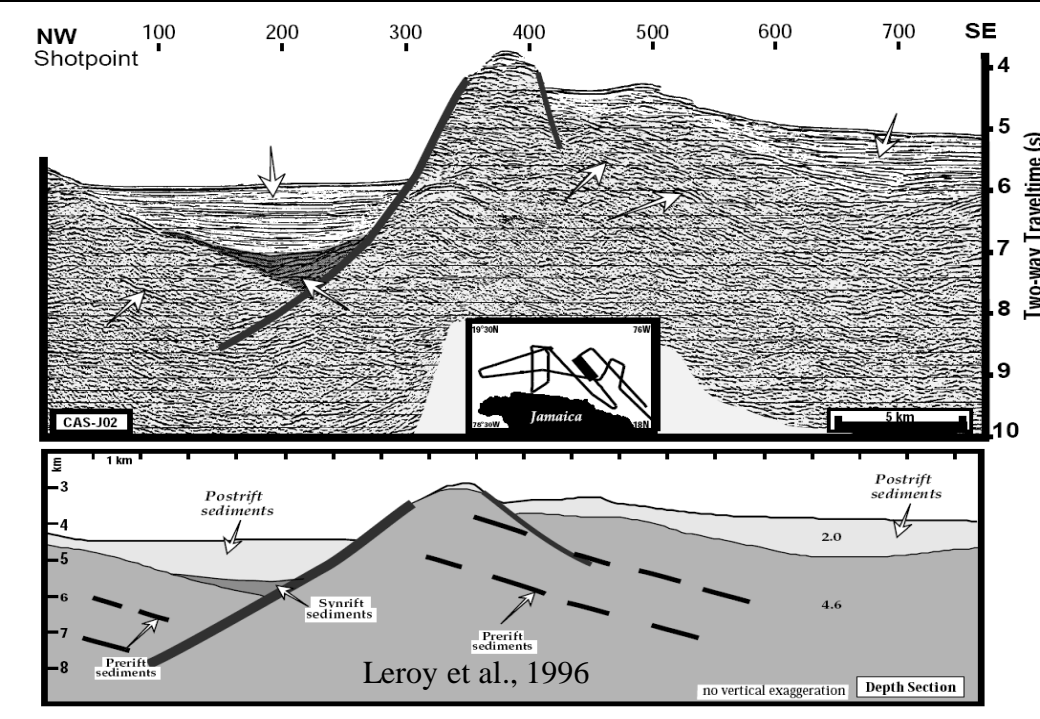
Jamaica source rocks

WELL SHOWS IN AND OFF JAMAICA

Fig. 1



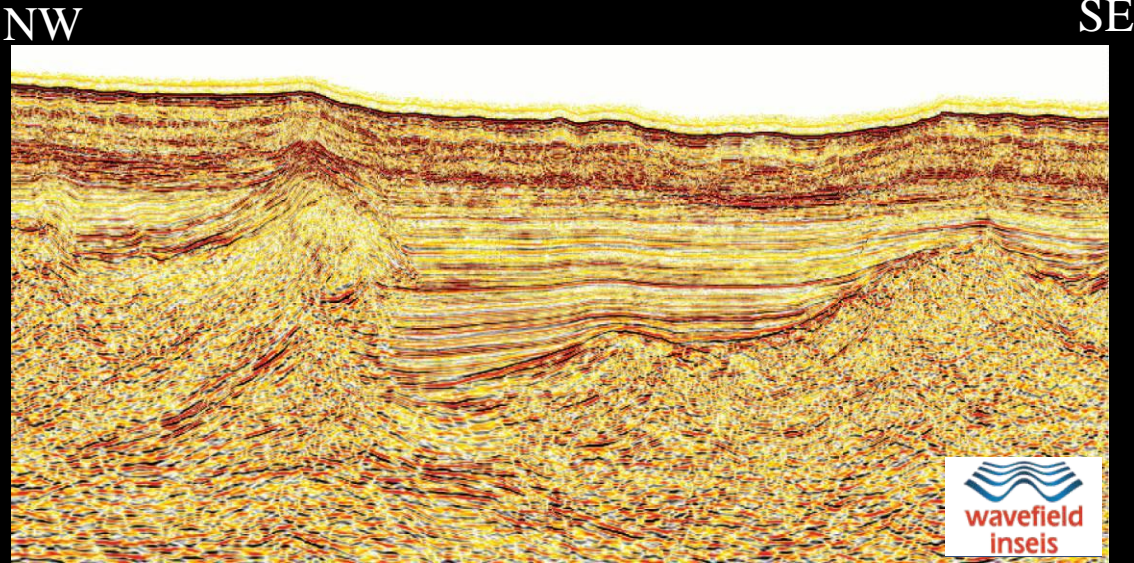
A. Offshore Jamaica basins



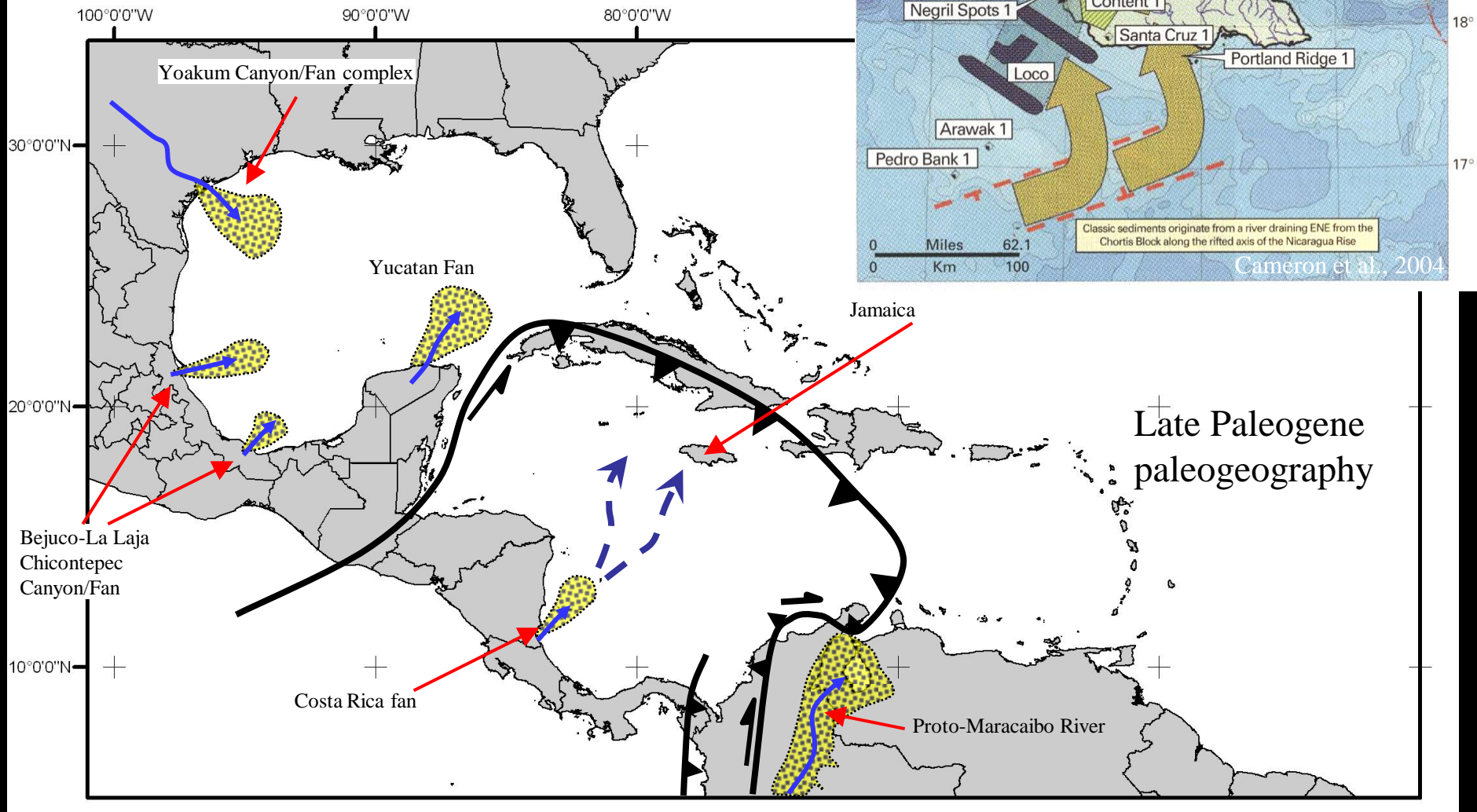
Nicaragua Rise Mesozoic?-Paleogene rifted basins and Neogene inversion



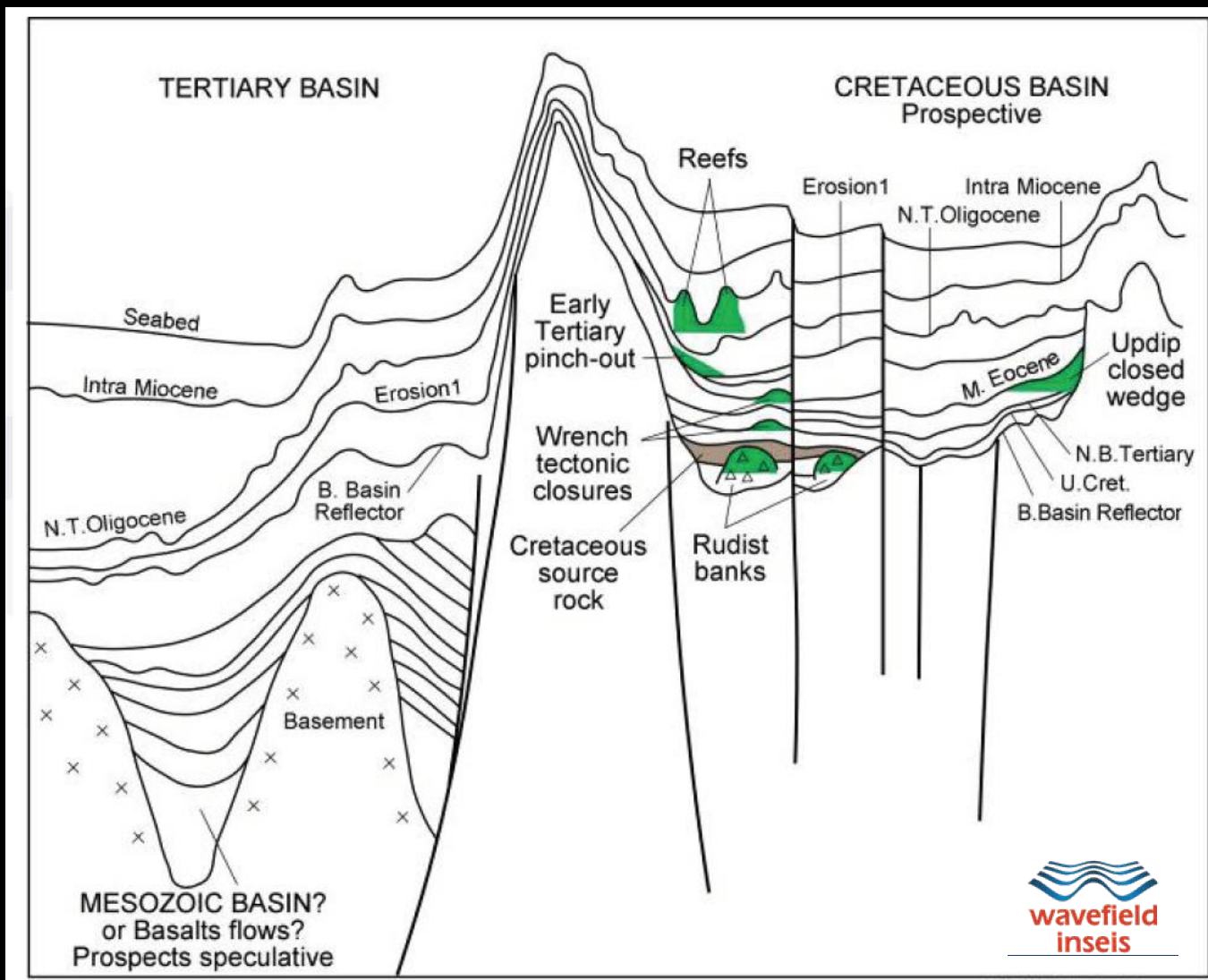
B. Cayos basin area



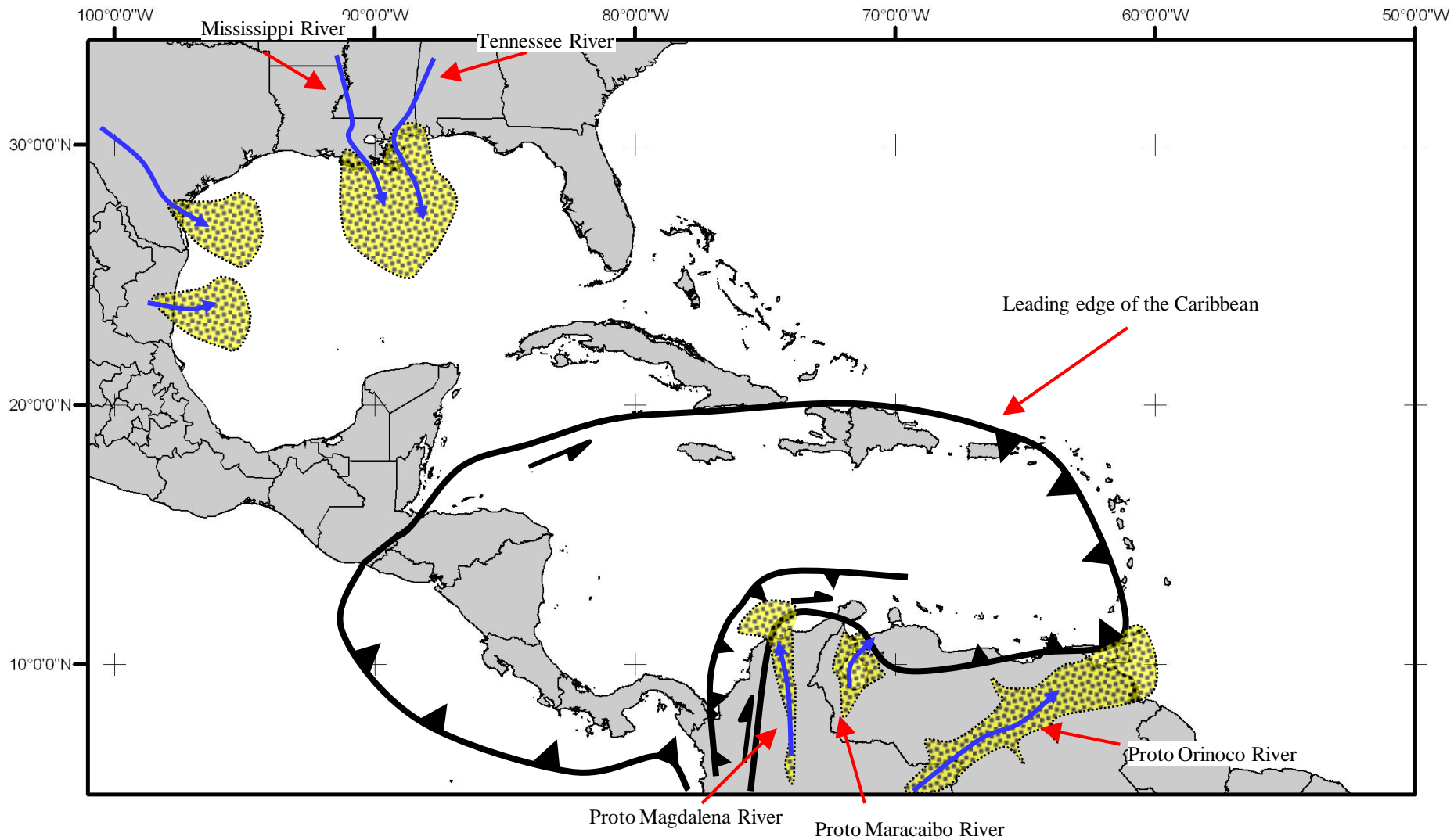
Provenance of reservoir rocks for the Nicaraguan Rise-Jamaica region



Possible petroleum system along the Nicaraguan Rise Jamaica- Cayos transect

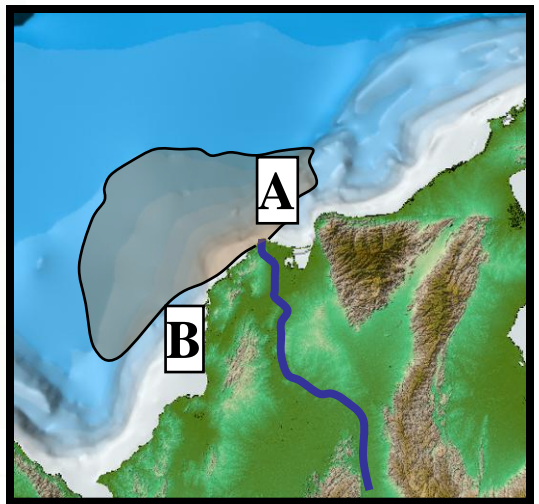
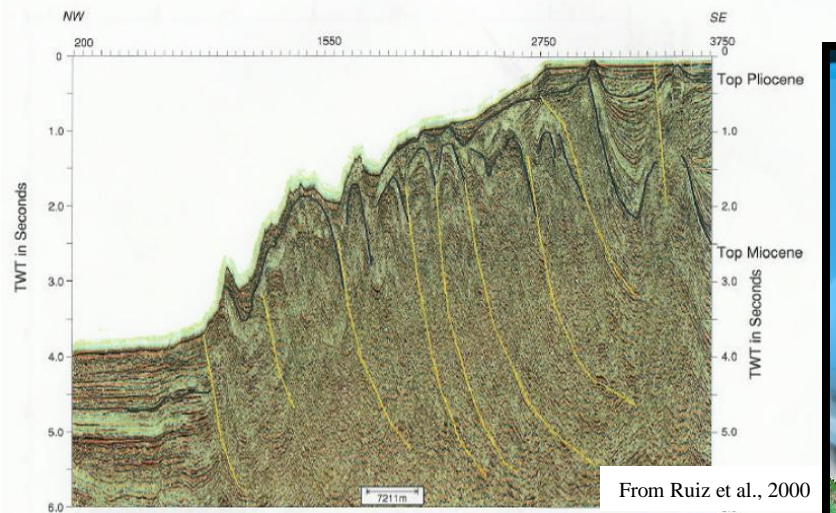


Continental scale Miocene paleodrainage



Offshore northwestern Colombia

A. Deformed Sinu belt

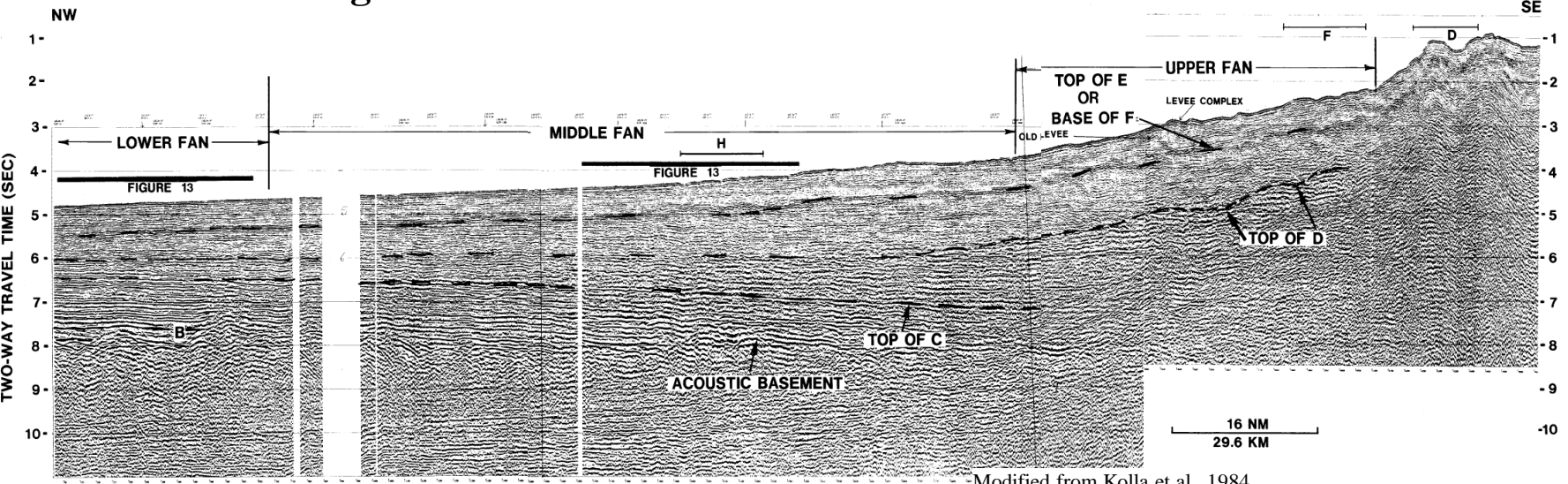


Source rock:
Late Cretaceous Cansona formation and Paleogene terrigenous rocks

Reservoir Rocks:

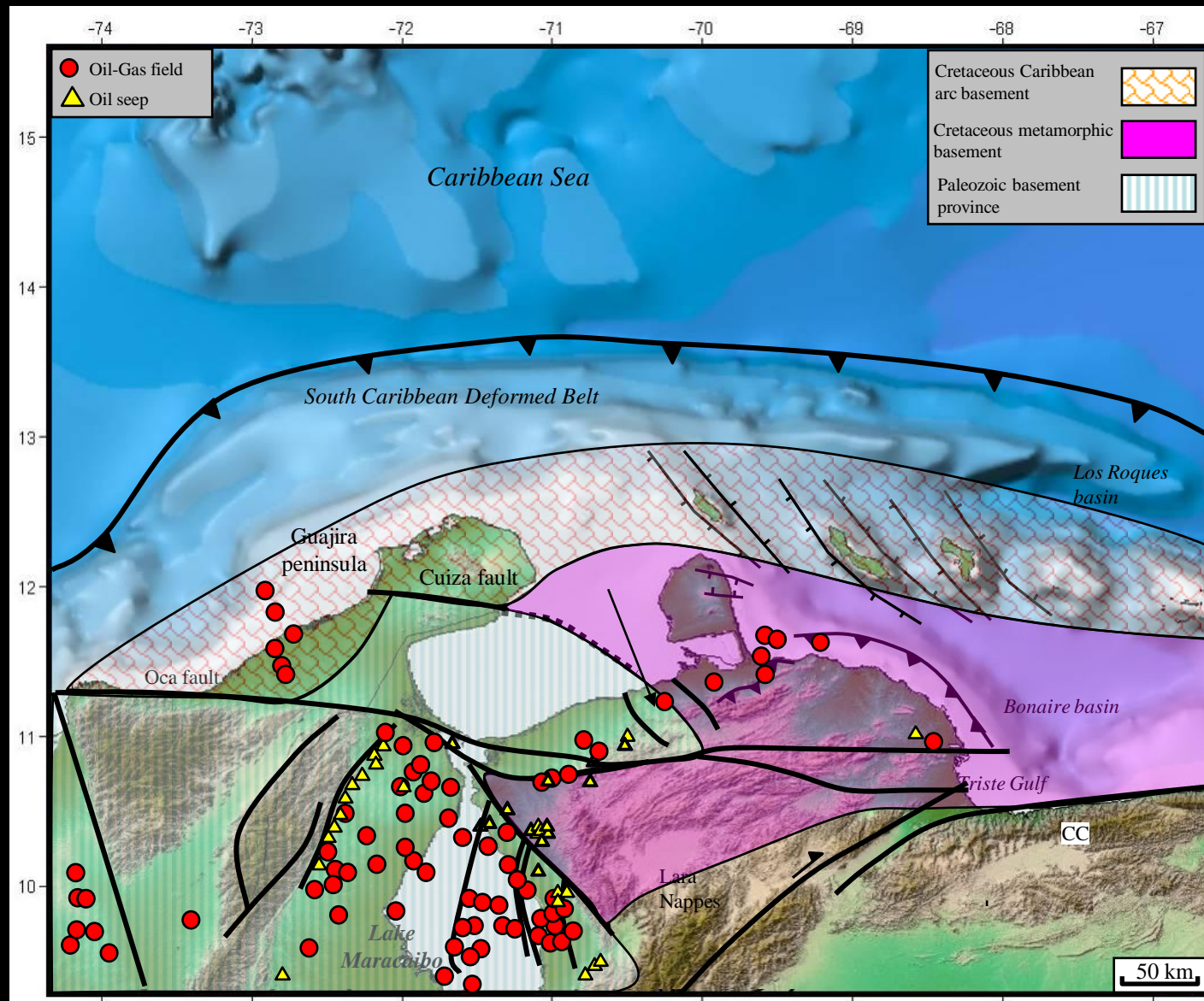
- Miocene-Pliocene sediments derived from the Magdalena delta
- Localized Paleogene sediments derived from the Central Cordillera of Colombia and Santa Marta massif

B. Undeformed Magdalena Fan

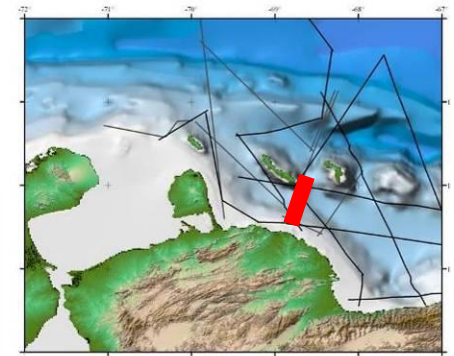
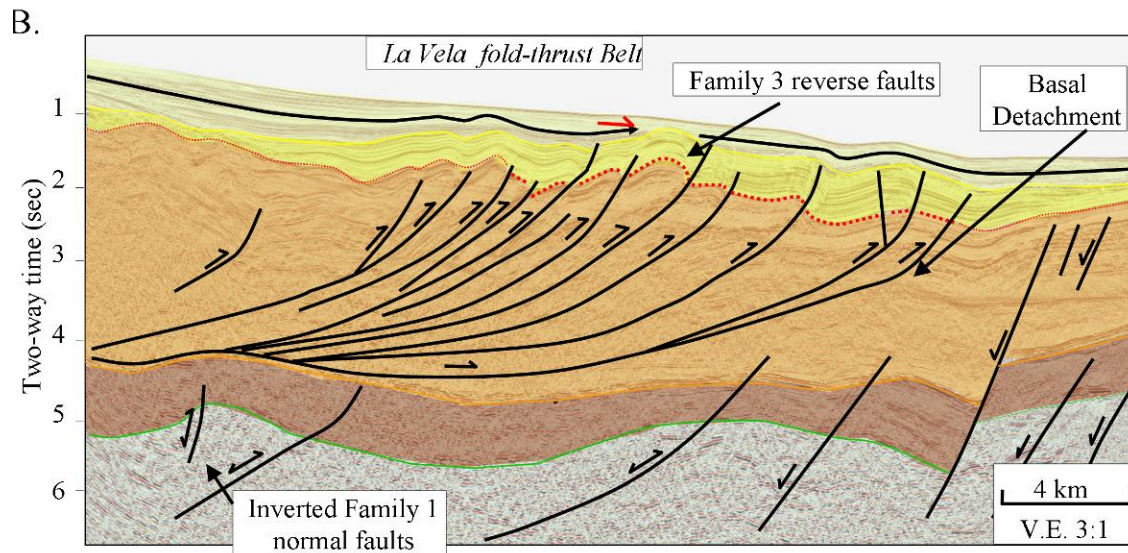
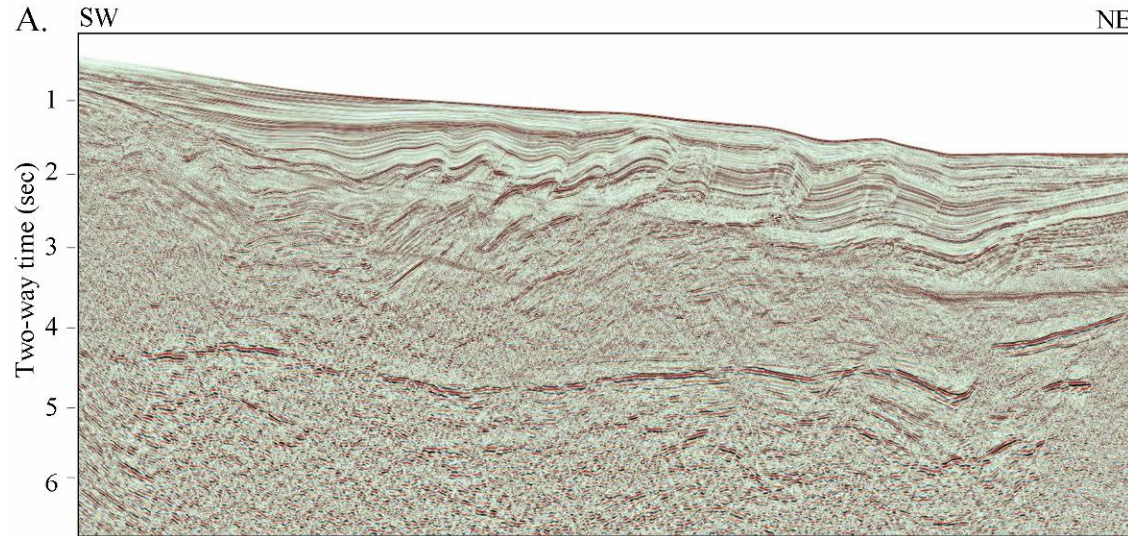


Offshore northwestern Venezuela

Hydrocarbon provinces controlled by basement type



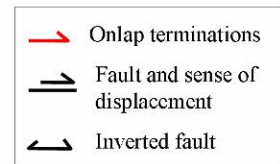
La Vela fold and thrust belt



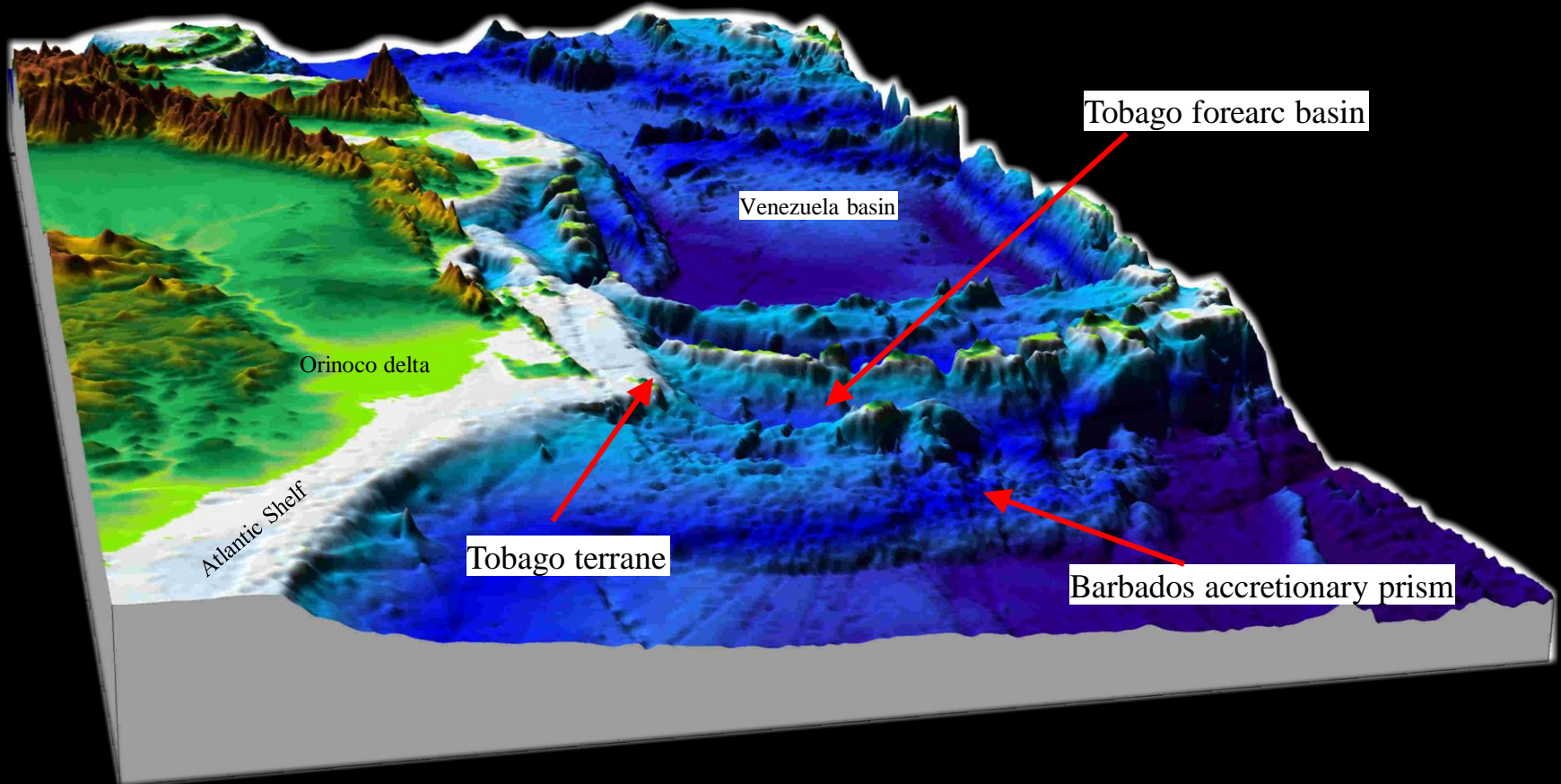
NEOGENE	PLIOCENE - PLEISTOCENE	S4
	LATE	S3
	MIDDLE	
	EARLY	S2
CRET PALEOGENE	OLIGOCENE	S1
	EOCENE	
CRET	BASEMENT	

Reservoir rocks: shallow marine clastic and carbonate rocks

Source rock: terrigenous shales

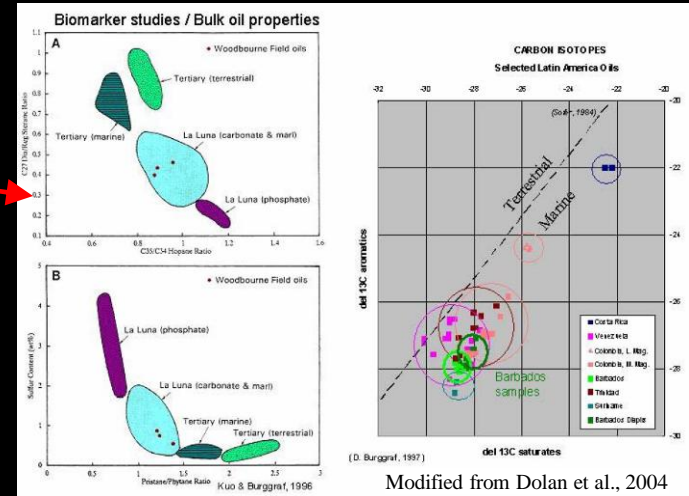
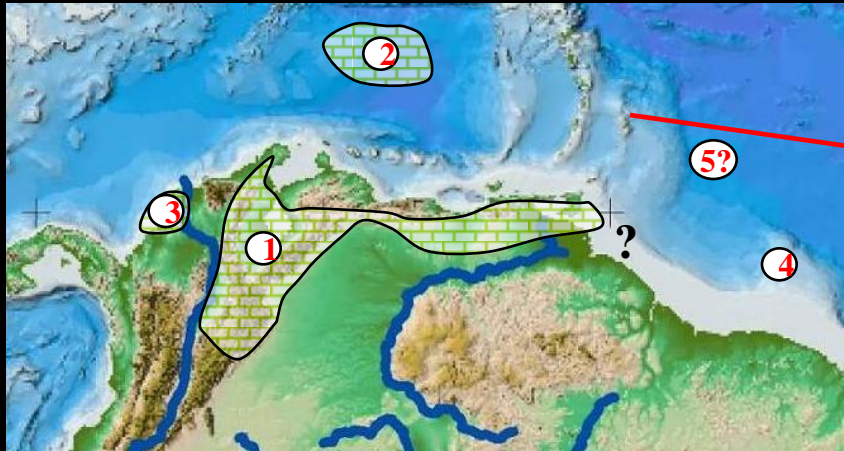


Barbados accretionary prism and neighboring areas



Potential source rocks in the Barbados accretionary prism region

Cretaceous marine source rock? From where?



1 La Luna Fm. type source rock



2 Deep Venezuelan basin: Turonian of ~ 6% avg. TOC

	<p>UNIT VI (630.30 to 738.30 m) RADIOLARIAN LIMESTONE</p> <p>UNIT VII (738.30 to 762 m T.D.) DIABASE and LIMESTONE</p>	<p>Subunit a. (630.30 to 721.00 m) RADIOLARIAN LIMESTONE, gray (630 to 692 m) and varicolored (692 to 721 m). Abundant chert and ash layers. Occurrence of dark carbonaceous layers and increasing microfractures with depth.</p> <p>Subunit b. (721.00 to 738.30 m) LIMESTONE, MARL-STONE, CLAYSTONE, variegated.</p> <p>Subunit a. (738.30 to 739.63 m) DIABASE SILL, upper.</p> <p>Subunit b. (739.63 to 740.00 m) FORAM LIMESTONE slightly metamorphosed.</p> <p>Subunit c. (740.00 to 762.00 m T.D.) DIABASE, lower.</p>
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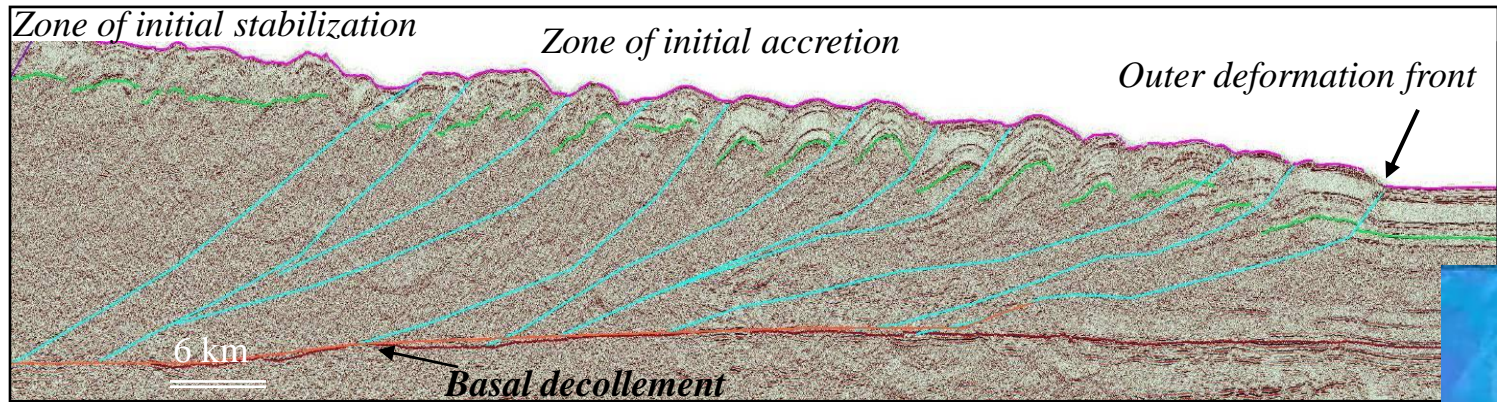
3 Cretaceous Cansona Fm. in western Colombia?

4 Cretaceous shales on the Demerara Rise?

5 Undiscovered Cretaceous source rocks deposited in the Atlantic basin?

Accretionary prism: seal capacity and trap size?

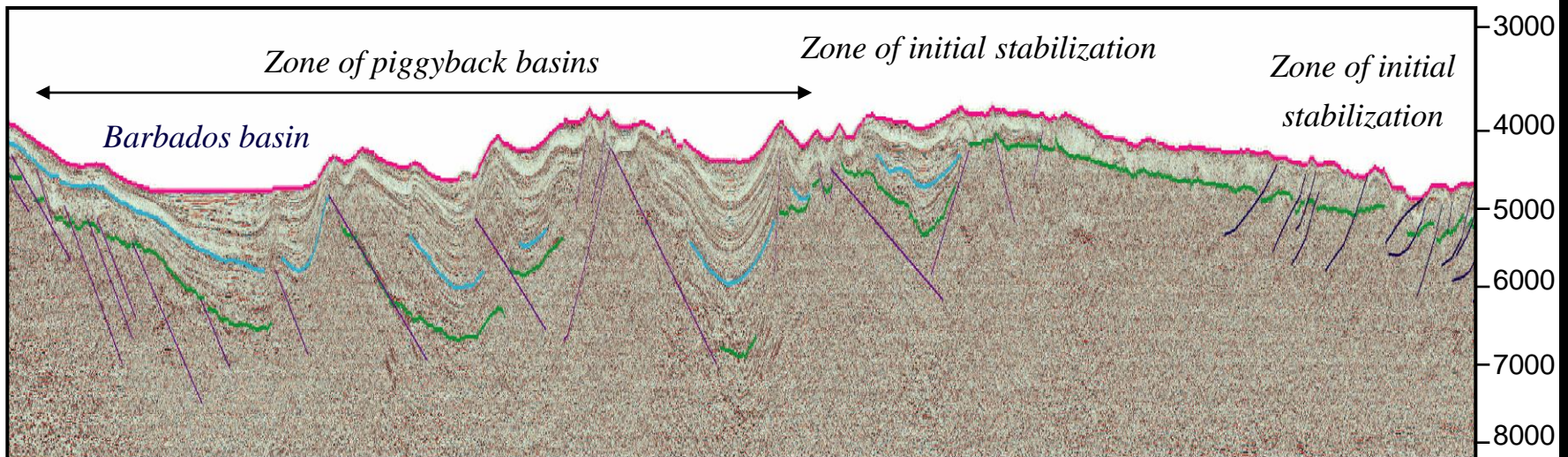
Area of initial accretion (broad zone of imbricate thrust)



Modified from Chaderton et al., 2004



Area of stabilization (piggyback basins)



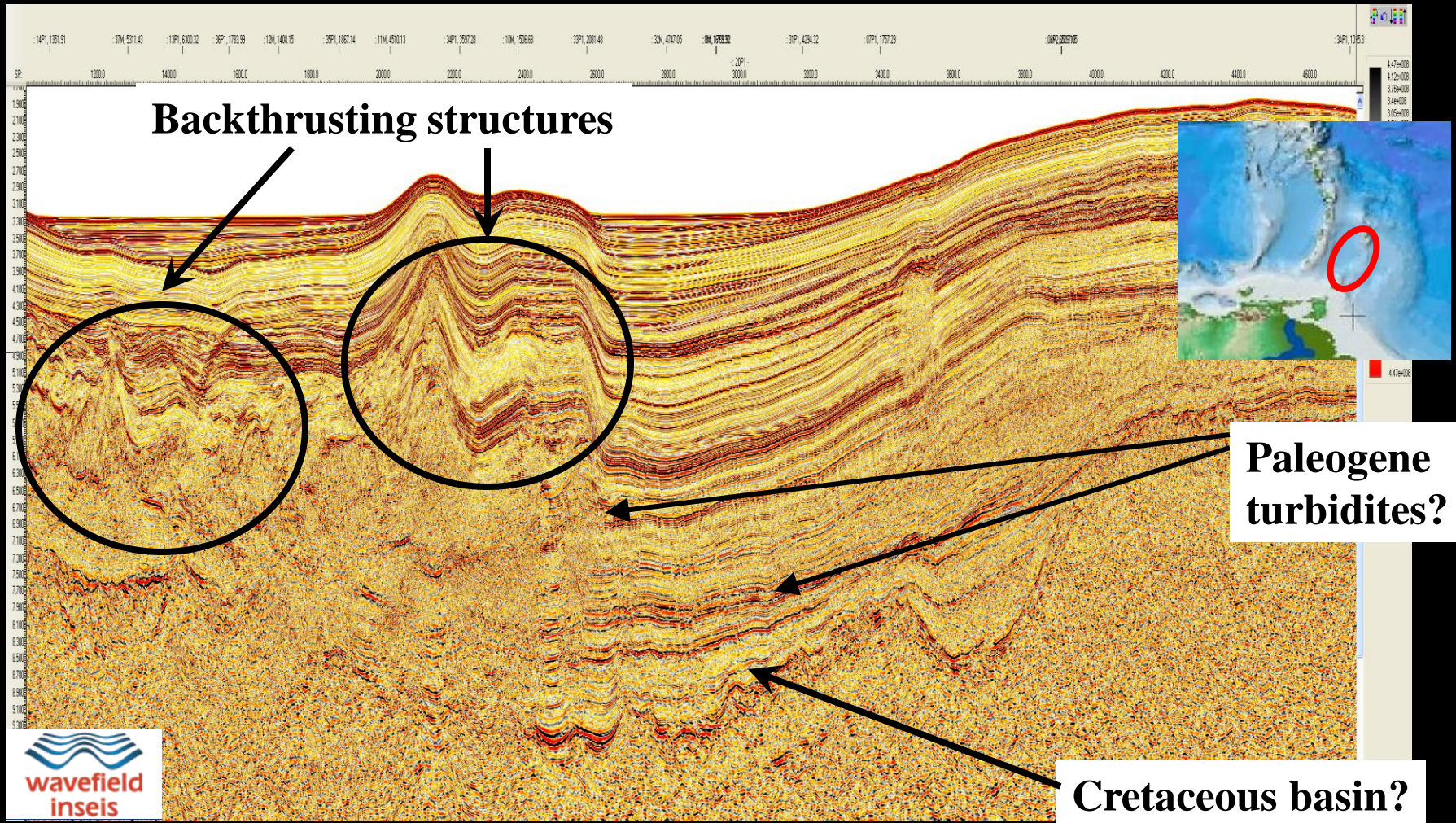
Modified from Chaderton et al., 2004

Tobago forearc basin

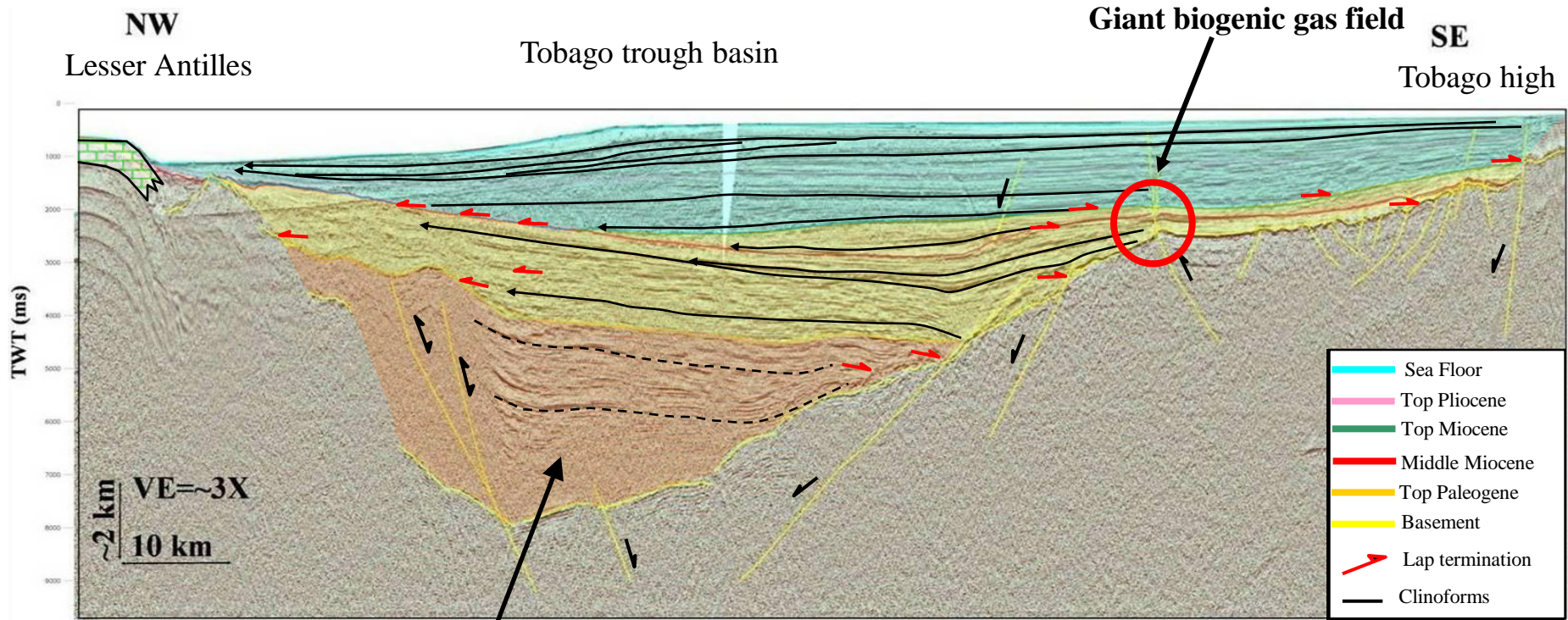
Backthrusting structures in the Paleogene section and deep Cretaceous basin?

S

N

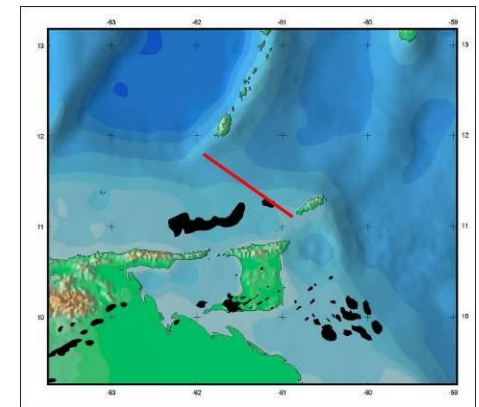


Tobago forearc basin and Tobago terrane



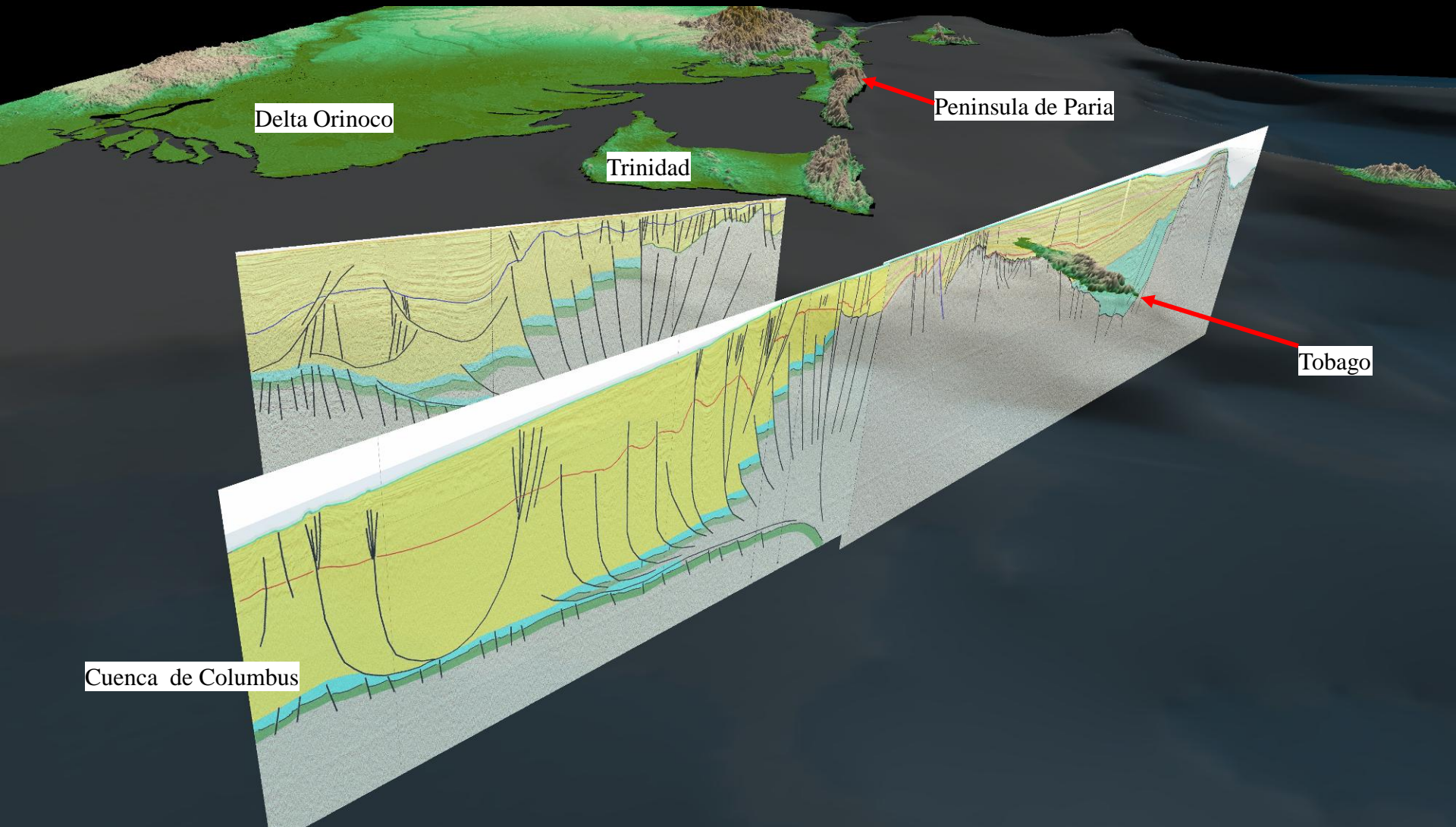
Paleogene: Potential source and reservoir rocks

None or little indication of Cretaceous source rocks in this part of the Tobago basin



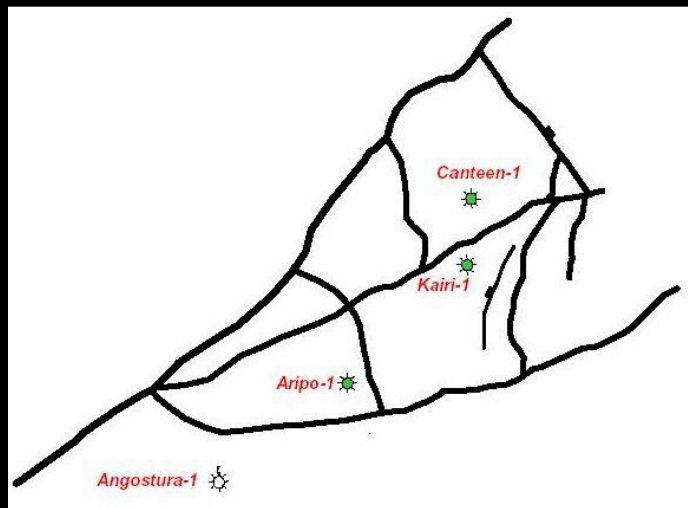
Offshore eastern Trinidad

Neogene-Recent foreland basin

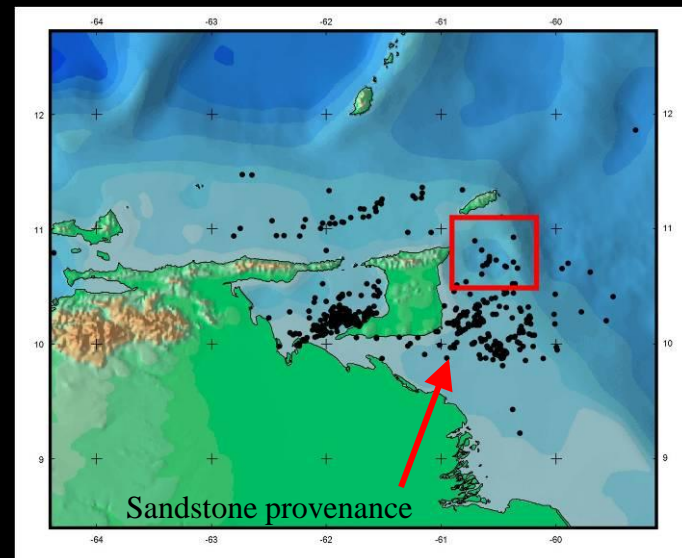
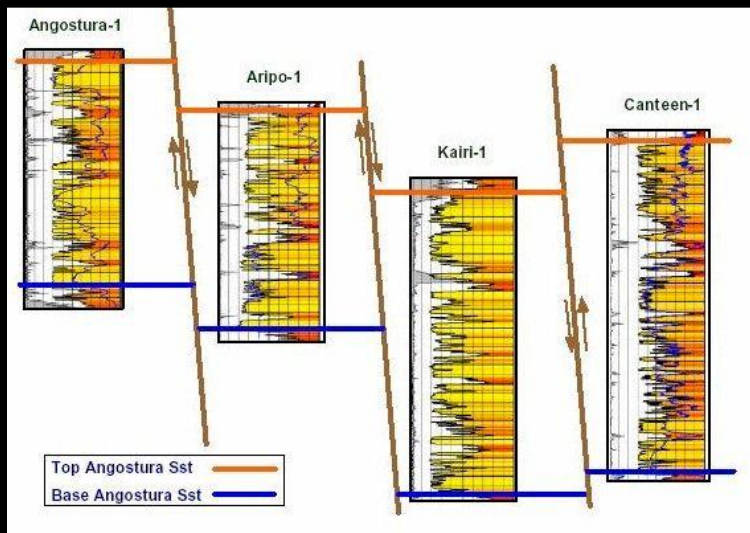


Need better data to understand structural and stratigraphic complexity

Oligocene sandstone reservoirs of the eastern offshore area: Angostura field



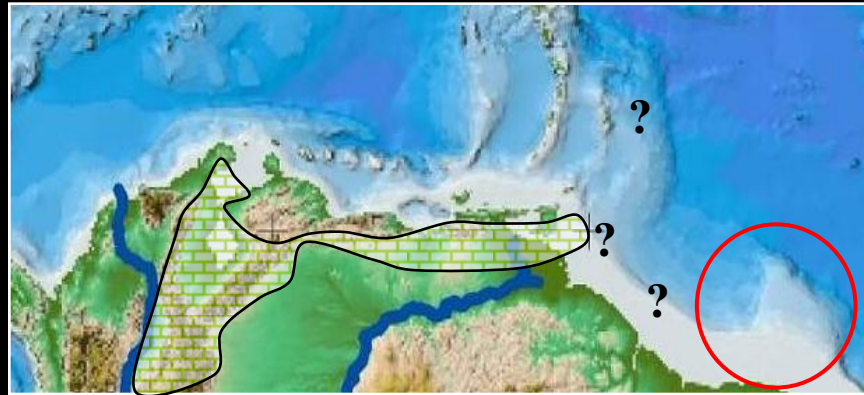
http://www.gstt.org/oil_gas/FIELDS/oil&gas%20of%20T&T.htm



Angostura Sandstone:
Early Oligocene
Porosity: 15-20%
Permeability: 50-2000mD
Water saturation: 15-25%
Net to gross: 40-60%

Offshore Suriname

Does this part of the passive margin contain the same potential source rock as in northern South America (e.g. La Luna-Querecual, Naparima Fms.)?



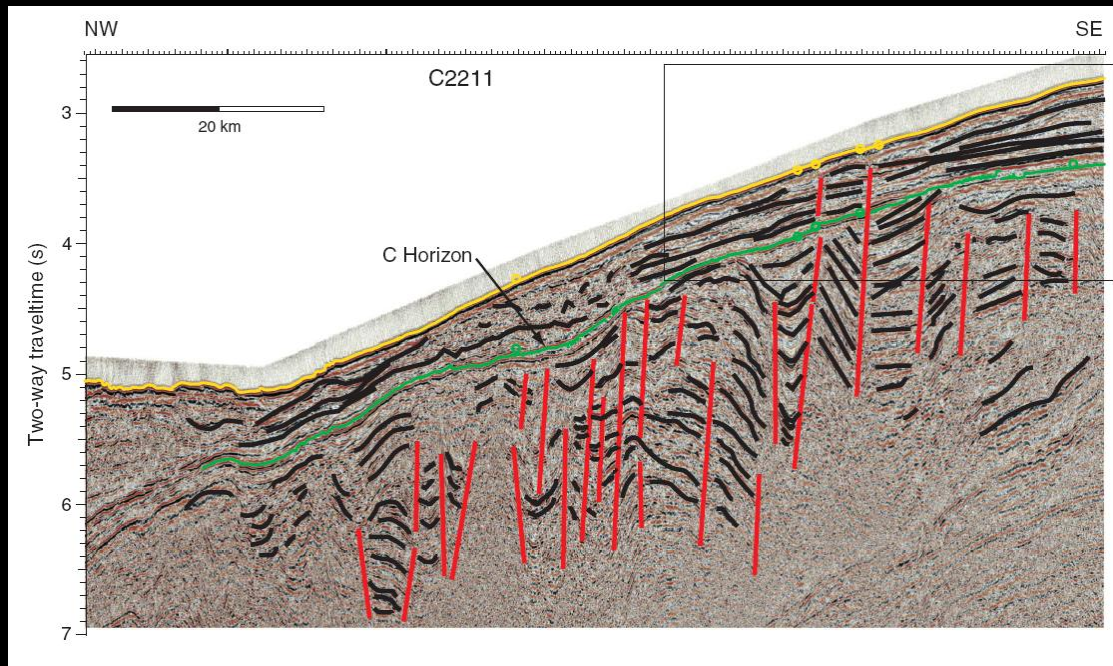
Source rocks:

Jurassic and Cretaceous

Reservoir rocks:

-Jurassic synrift
deposits

-Cretaceous carbonates
-Cenozoic shelf and
deep water sandstones



DEMERARA RISE:
EQUATORIAL
CRETACEOUS AND
PALEOGENE
PALEOCEANOGRAPHIC
TRANSECT,
WESTERN ATLANTIC
SITES 1257-1261

Other offshore frontier areas

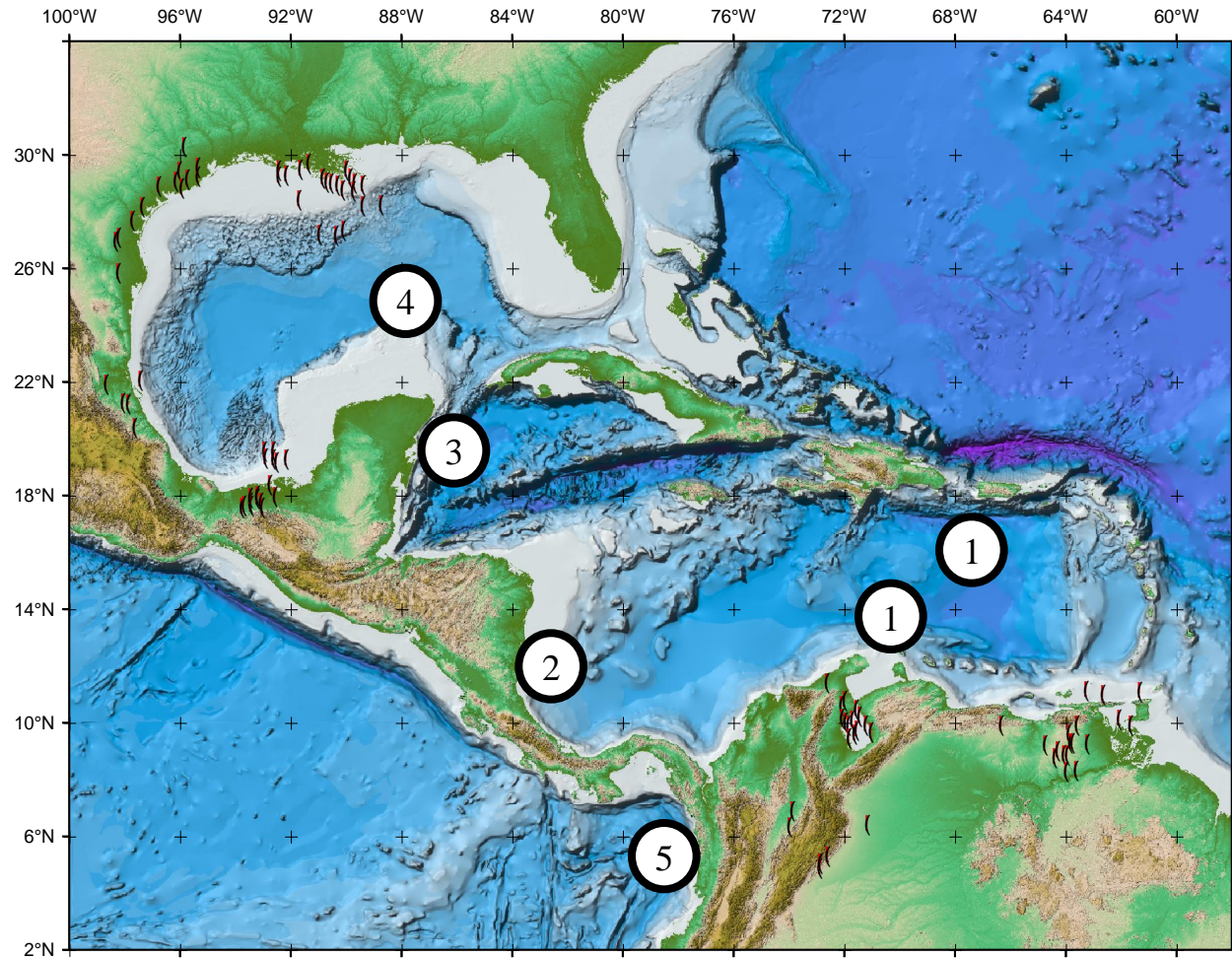
1) South Caribbean and Muertos deformed belt

2) Deep Costa Rica fan

3) Deep Yucatan basin fan

4) Yucatan fan – S. GOM

5) Atlantic margin of Colombia



Conclusion

Many opportunities for exploration in the Caribbean region

