Cuba's northeastern offshore: a witness to geodynamics evolution of the northern boundary of the Caribbean plate

Alana OLIVEIRA DE SA[1], Sylvie LEROY[1], Elia d'ACREMONT[1], Sara LAFUERZA[1], and Bernard MERCIER DE LÉPINAY[2]

[1]Sorbonne Université, CNRS-INSU, Institut des Sciences de la Terre Paris, ISTeP, F-75005 Paris, France
[2]Université Côte d'Azur-CNRS-OCA, Géoazur, France

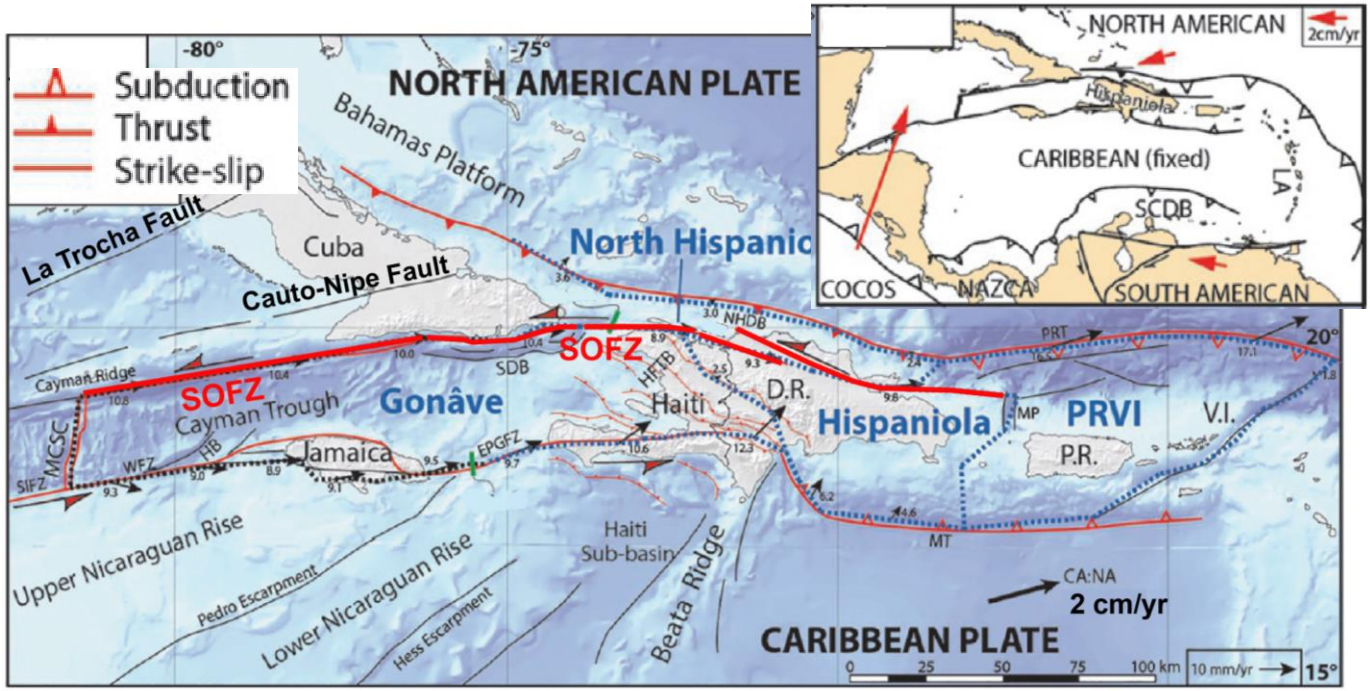
Northern Caribbean Plate Boundary

- The northern boundary between the Caribbean plate and the North American plate is characterized by an oblique collision

- Eastward escape of the Caribbean plate Septentrional-Oriente strike slip fault zone (**SOFZ**)

- Diachronous collision with the Bahamas Bank

Migration of the northern Caribbean boundary by successive southward jumps of major strike-slip faults



Geodynamic setting of the Caribbean. (Modified from Wessels, 2019)

The northeastern Cuban Coast

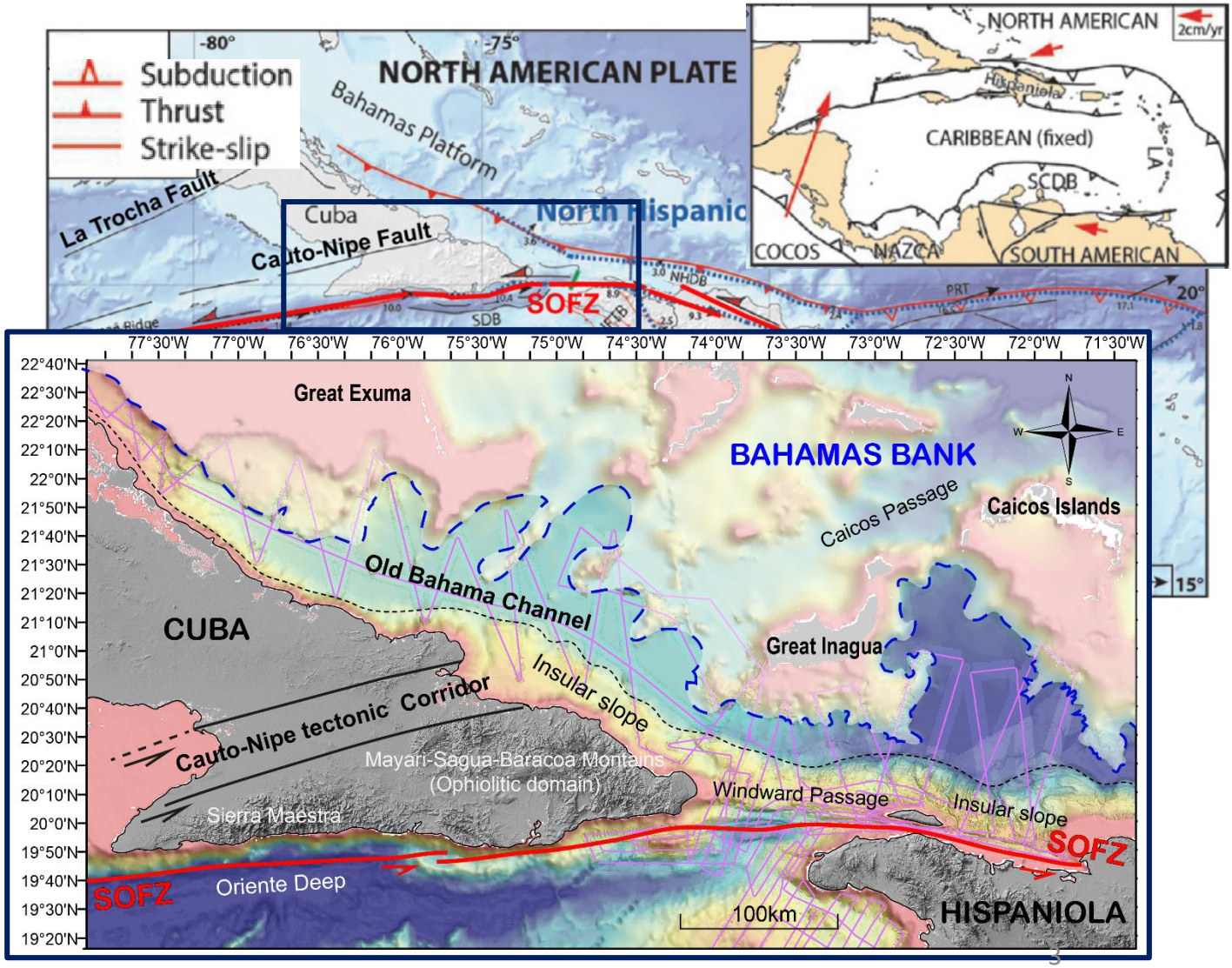
- The northern boundary between the Caribbean plate and the North American plate is characterized by an oblique collision

- Eastward escape of the Caribbean plate Septentrional-Oriente strike slip fault zone (**SOFZ**)

- Diachronous collision with the Bahamas Bank

Migration of the northern Caribbean boundary by successive southward jumps of major strike-slip faults

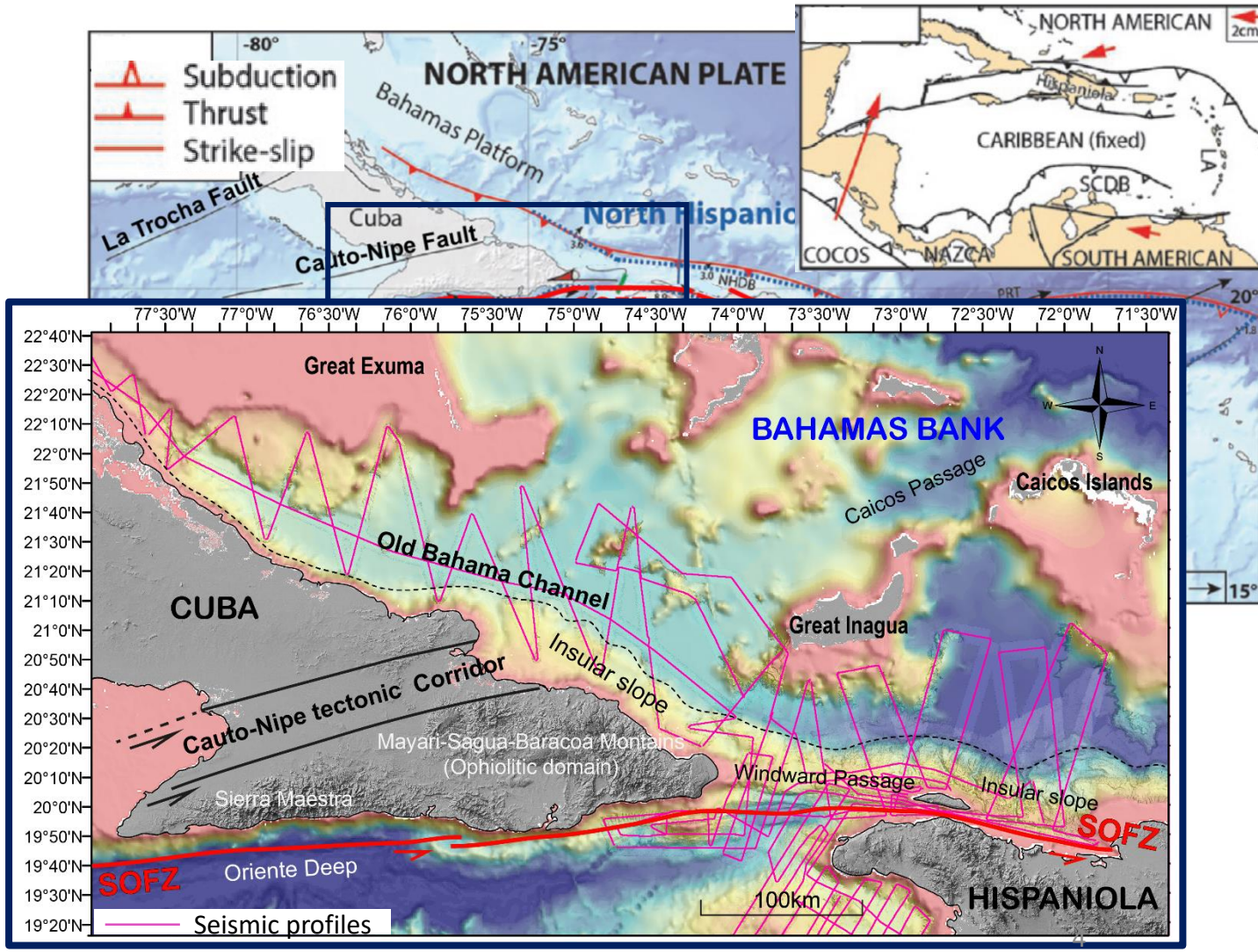
This presentation will focus on the tectonic evolution of the northeastern Cuban Coast



Map of the study are in the northern Caribbean plate boundary

Data

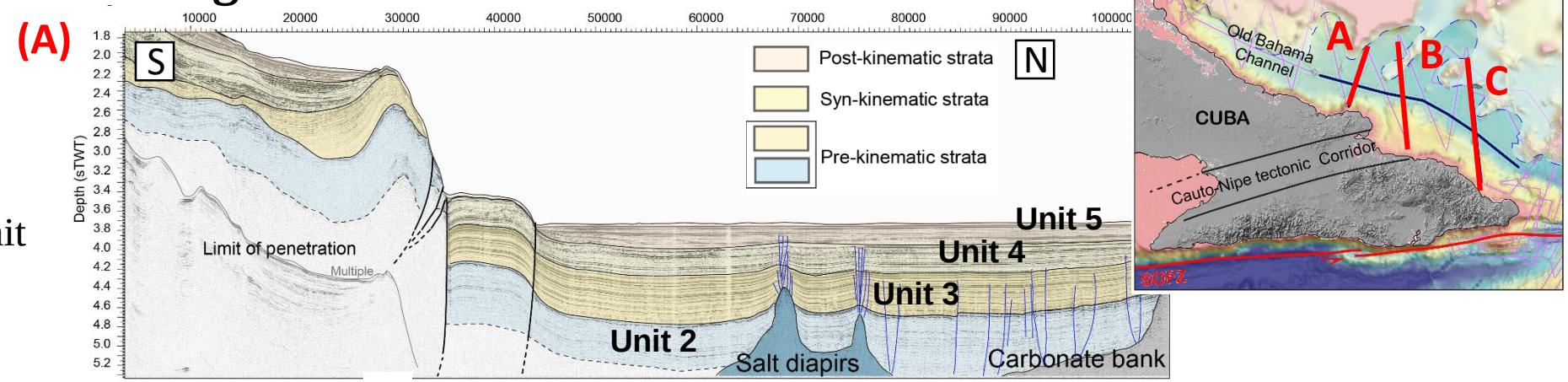
- **HAITI-SIS 1–2** (2012–2013)
  - Multichannel seismic reflection
  - Multibeam bathymetric data



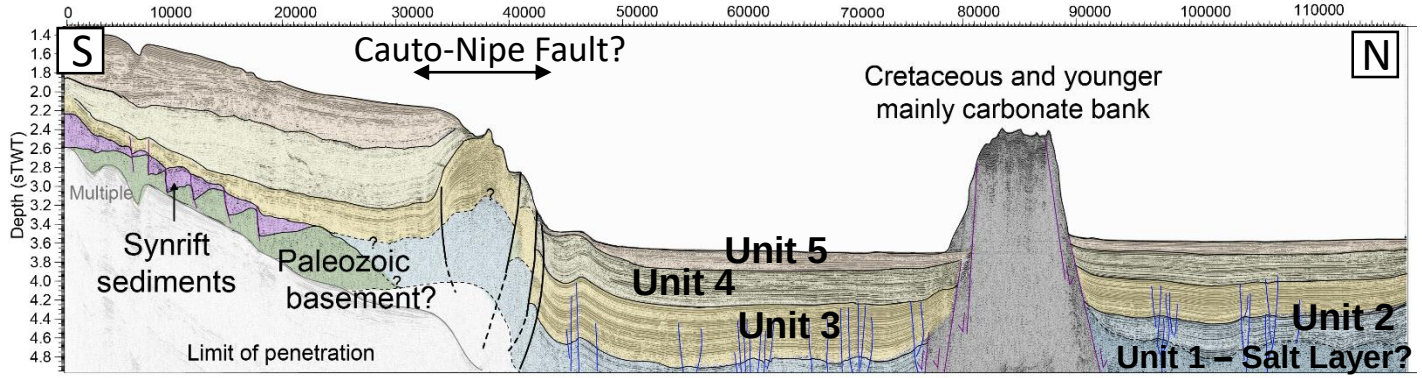
Map of the study are in the northern Caribbean plate boundary

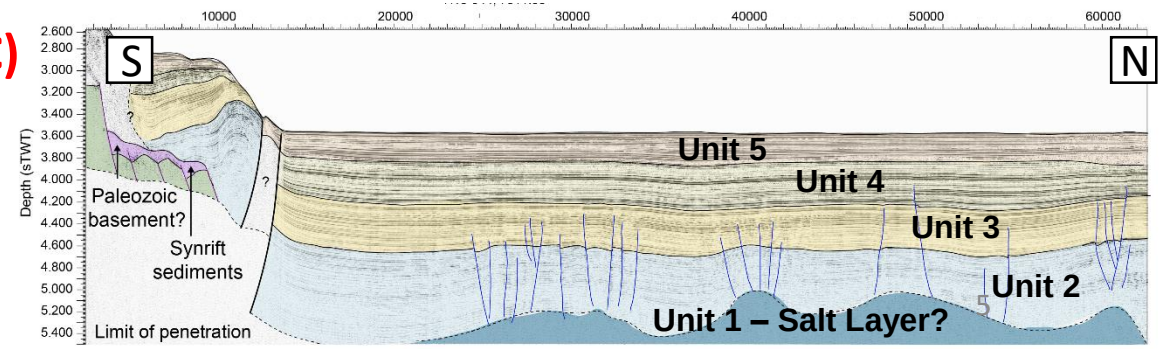
Seismic lines interpretation along the northeastern Cuban Coast

- 5 seismic units:
  - Unit 1, Unit 2, Unit 3, Unit 4, and Unit 5



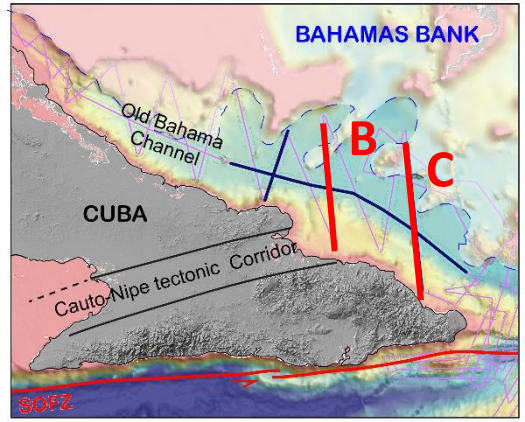
- Unit 1 (transparent facies): Salt layer?
- Unit 2 and Unit 3: Folded (pre-kinematic)
- Unit 4 : Folded (syn-kinematic)
- Most recent unit 5 is not folded (Post-kinematic)



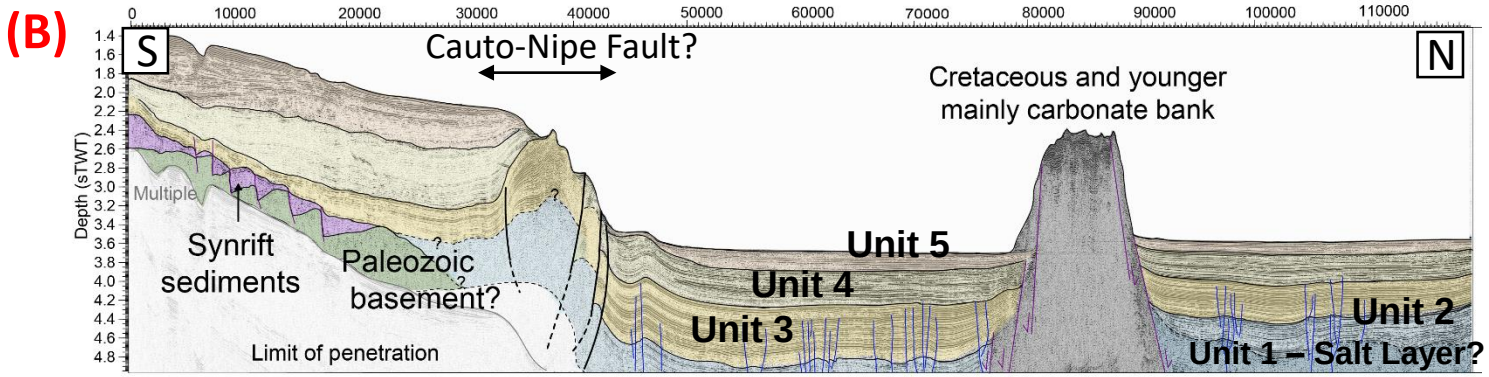


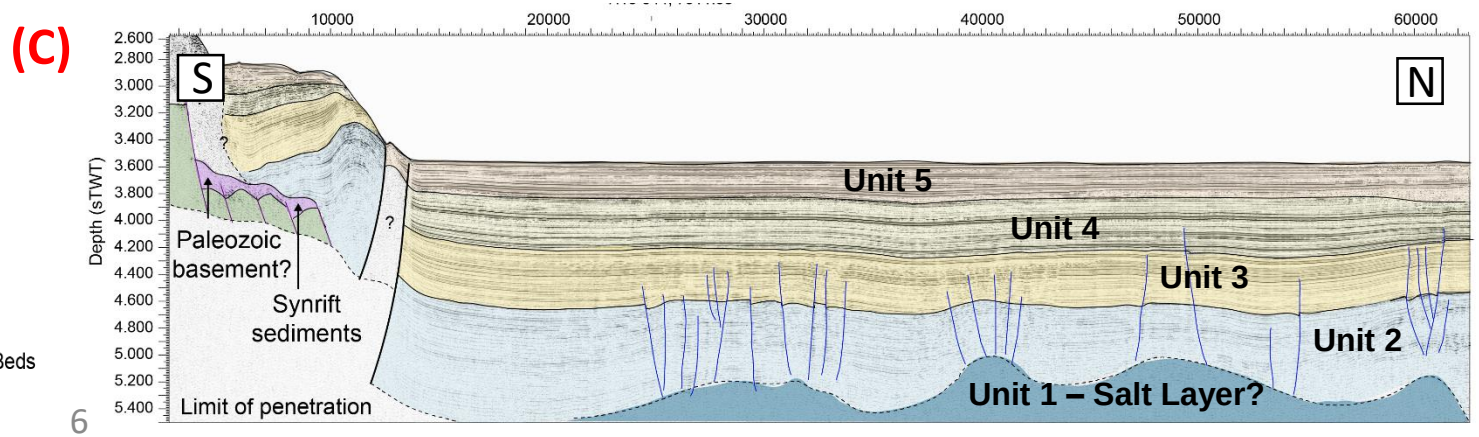
The deformation of these units reveals the major deformation episodes that affected the sedimentary cover in Cuba

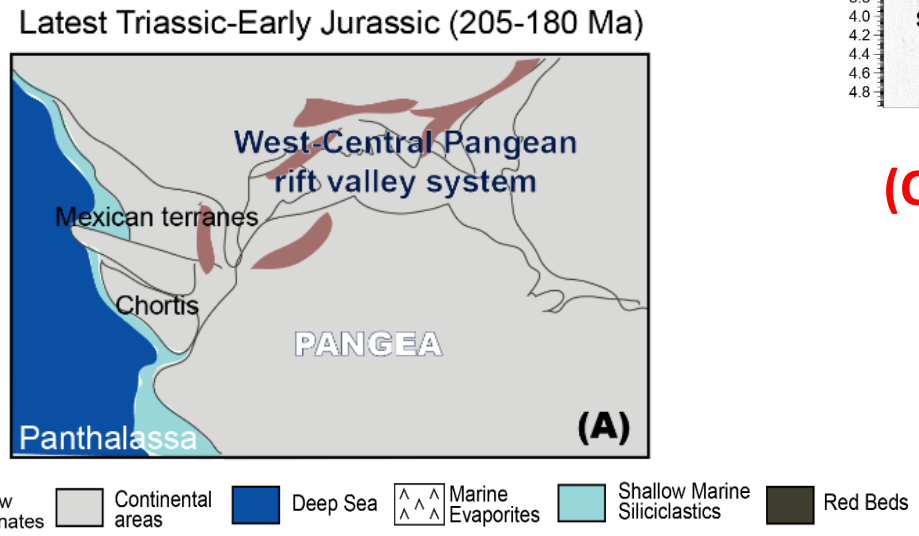
Deformation Events in northeastern offshore Cuba



- Rifting
  - In the Late Triassic, rifting began between North America and Africa and then between North and South America.
  - A Rift valley system developed along what is now the east coast of North America and through the Gulf of Mexico
  - Evidences on seismic profiles:
    - Presence of tilted blocks
    - Syn-rift sediments



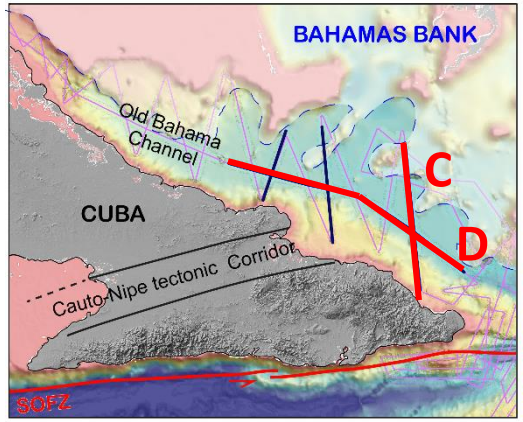


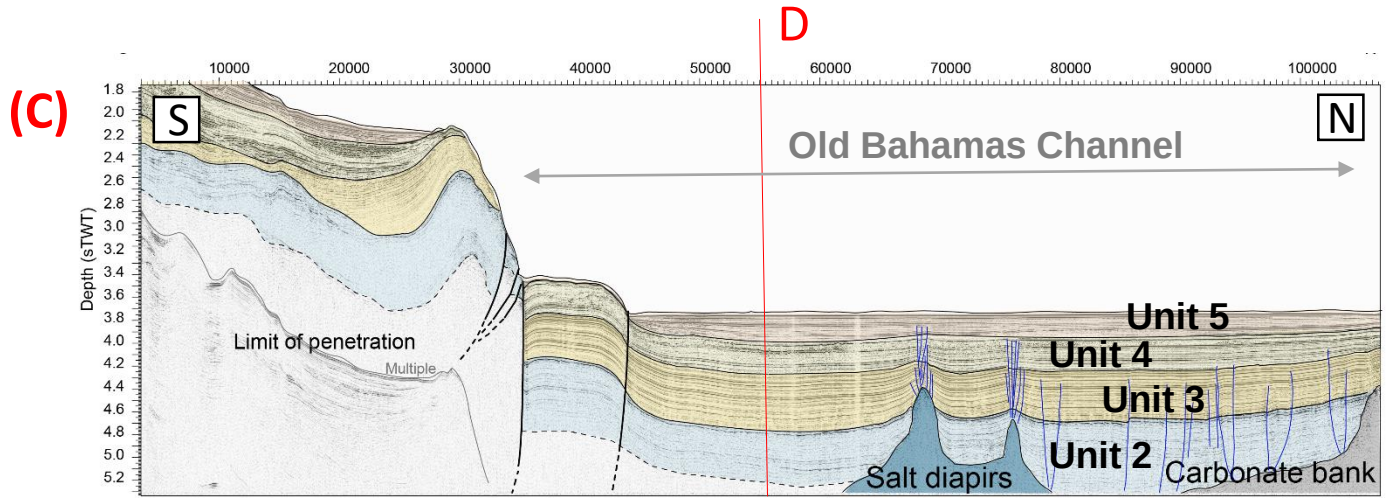


(Modified from Iturralde-Vinent, 2003)

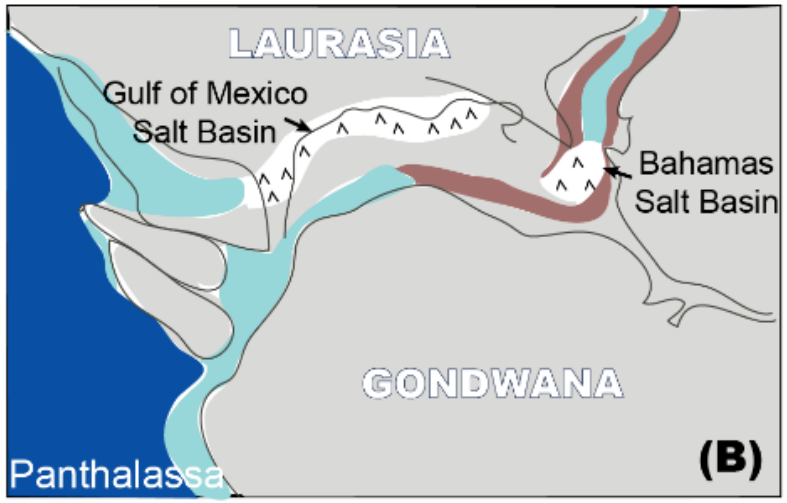
Deformation Events in northeastern offshore Cuba

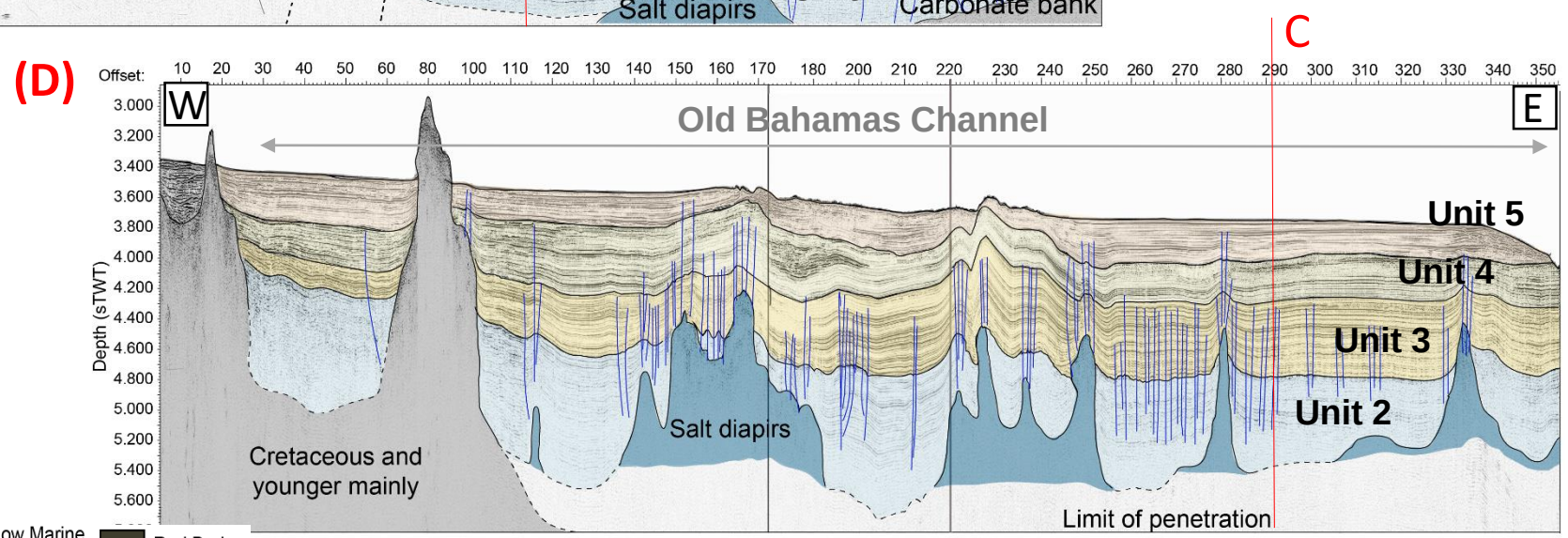
- Salt basin
  - Diapirs on the Old Bahamas channel





Middle Jurassic
Aalenian/Callovien (175-155 Ma)





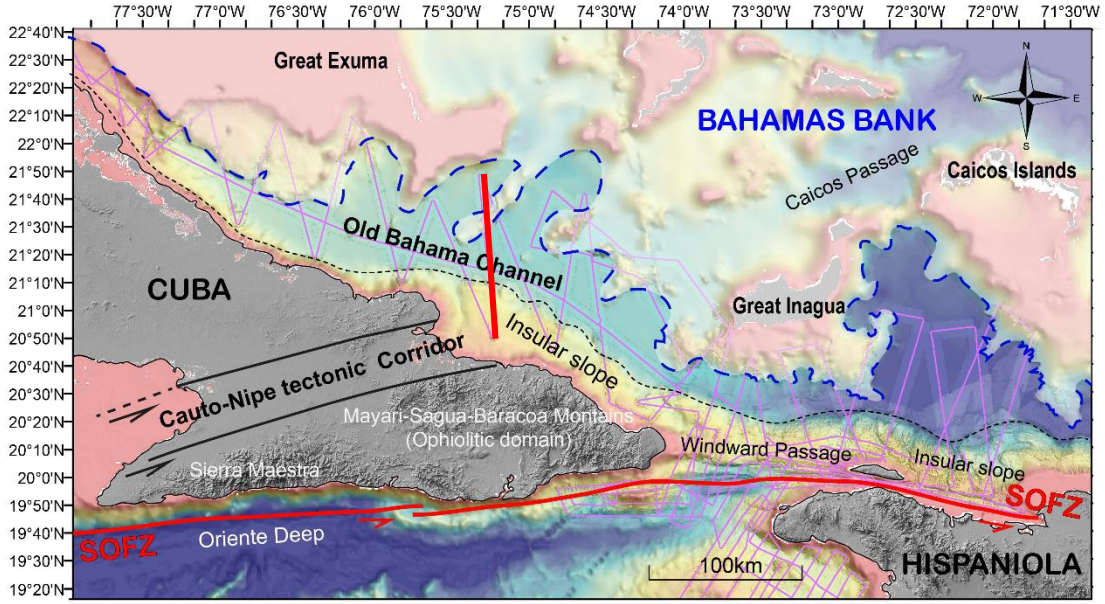
Shallow Carbonates | Continental areas | Deep Sea | Marine Evaporites | Shallow Marine Siliciclastics | Red Beds

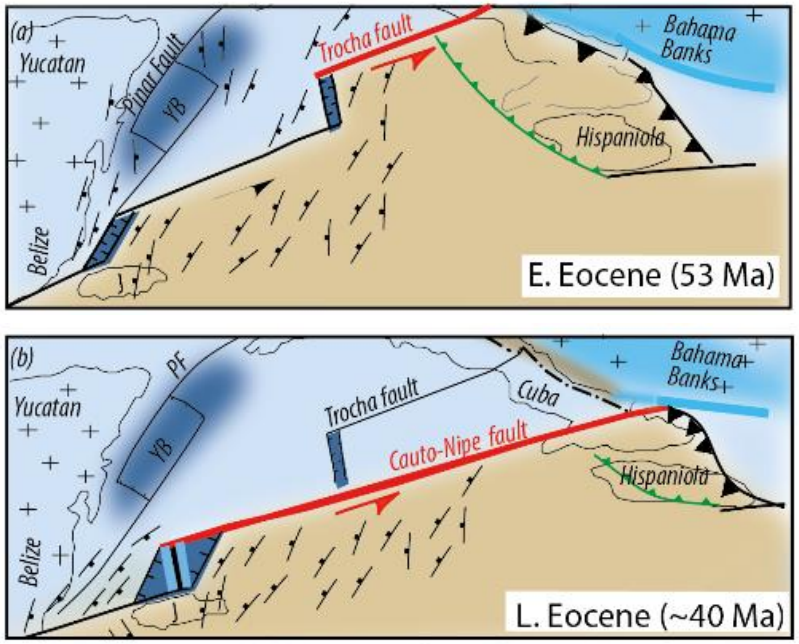
(Modified from Iturralde-Vinent, 2003)

7

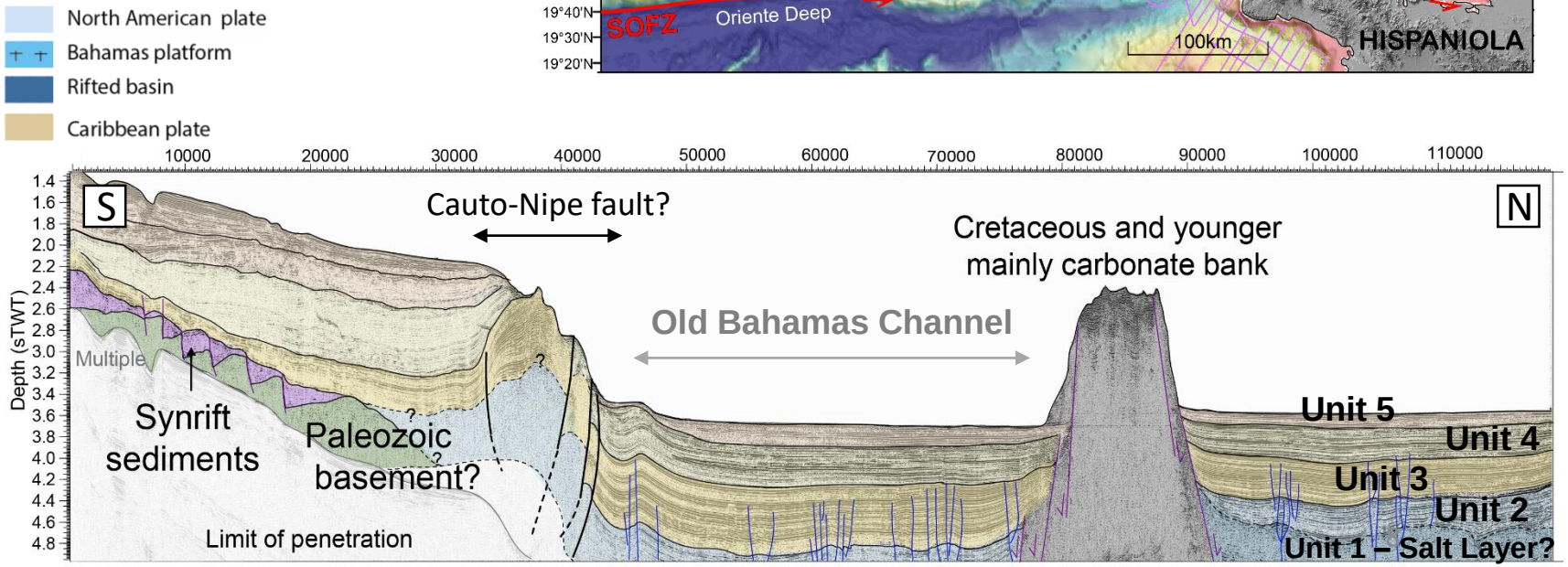
Deformation Events in northeastern offshore Cuba

- Units 2 and 3 were deposed in quiet conditions
- Late Paleocene: Collision with the Bahamas banks
  - Folding of Units 2 and 3
  - Deposition and folding of unit 4



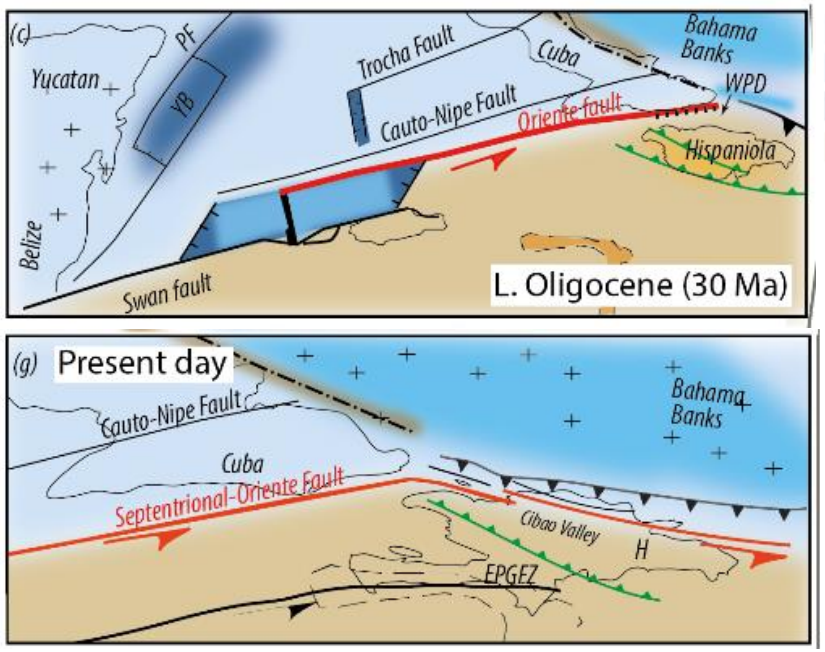


(Modified from Oliveira de Sá et al., 2021)

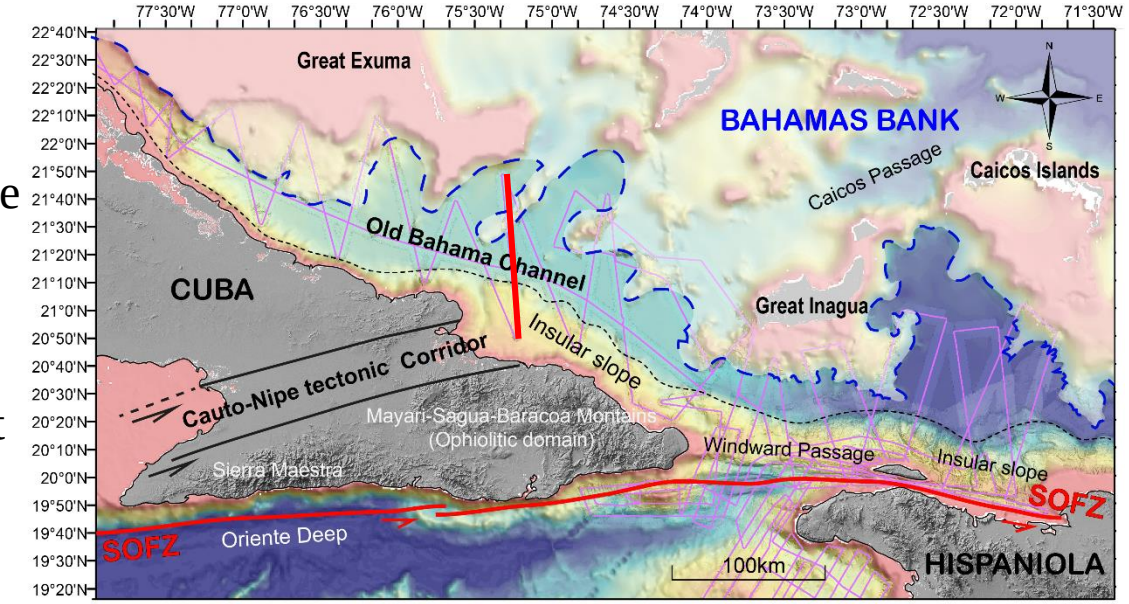


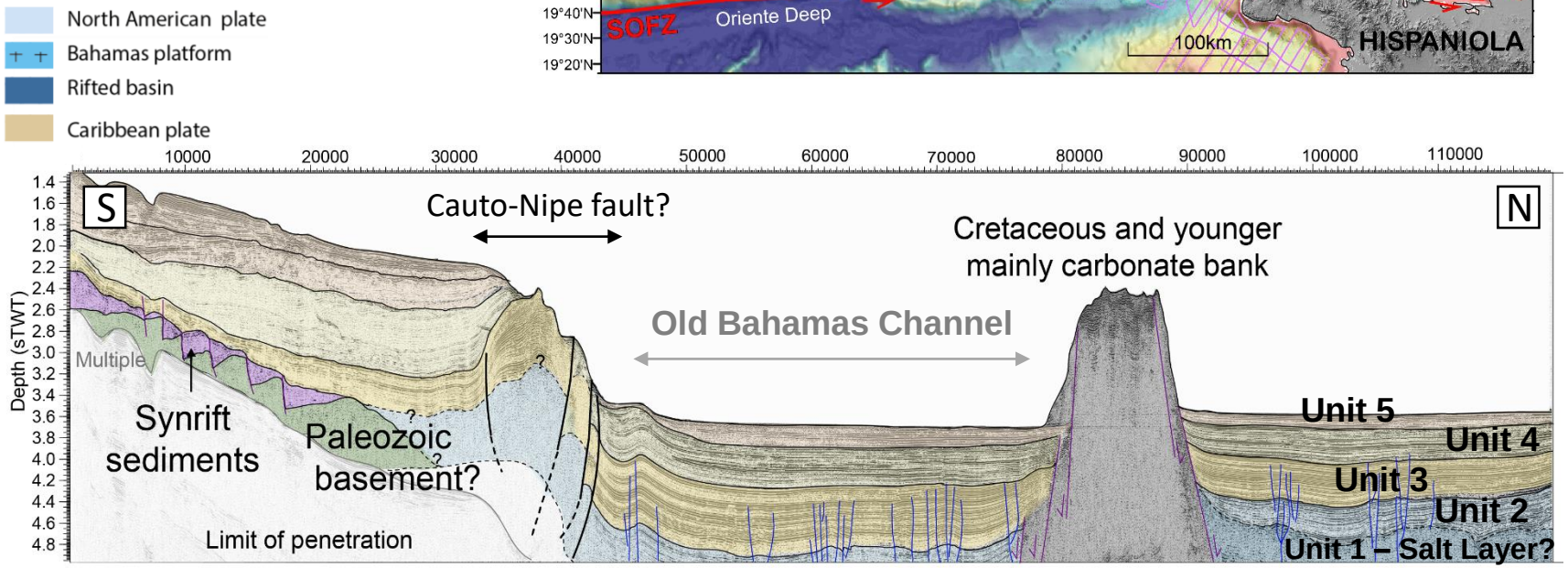
Deformation Events in northeastern offshore Cuba

- Folding continues until Unit 5 deposition
- Late Oligocene:
  - The Cauto fault is abandoned by the emplacement of the Oriente fault which begins to shift the Hispaniola and Cuba blocks.
- Pliocene:
  - Collision of Hispaniola with the Bahamas
  - The Oriente fault system splayed eastward to form the current Septentrional-Oriente Fault .



(Modified from Oliveira de Sá et al., 2021)





Conclusions

- The stratigraphic study of the seismic profiles in northeastern Cuban coast reveals the major deformation episodes that affected the sedimentary cover in Cuba since the start of the central Pangean rift valley system.

- Tectono-sedimentary evolution in Cuba provides:
  - New insights for the diachronous migration of the northern Caribbean Plate boundary, and also
  - New constraints to improve the knowledge of the geodynamics of the Caribbean plate.

Thank you for your attention!

➢ **Contact:** alana.oliveira_de_sa@sorbonne-universite.fr

References

Iturralde-Vinent, M.A. (2003). The Conflicting Paleontologic versus Stratigraphic Record of the Formation of the Caribbean Seaway in C. Bartolini, RT. Buffier, and J. Blickwede, eds., The Circum-Gulf of Mexico and the Caribbean: Hydrocarbon habitats, basin formation and plate tectonics: American Association of Petroleum Geologists Memoir, no. 79, p.75-88.

Oliveira de Sá, A., d'Acremont, E., Leroy, S., & Lafuerza, S. (2021). Polyphase deformation and strain migration on the Septentrional-Oriente Fault Zone in the Windward Passage, northern Caribbean plate boundary. *Tectonics*, *40*. https://doi.org/10.1029/2021TC006802

Wessels, R. J. F. (2019). Chapter 15-strike-slip fault systems along the Northern Caribbean plate boundary. In J. C. Duarte (Ed.), Transform plate boundaries and fracture zones, pp. 375–395. Elsevier. https://doi.org/10.1016/B978-0-12-812064-4.00015-3