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MONA CAMPUS
JAMAICA, WEST INDIES



CARIBBEAN GEODIVERSITY

Sherene James-Williamson, PhD

The University of the West Indies, Mona

IGCP 692/718

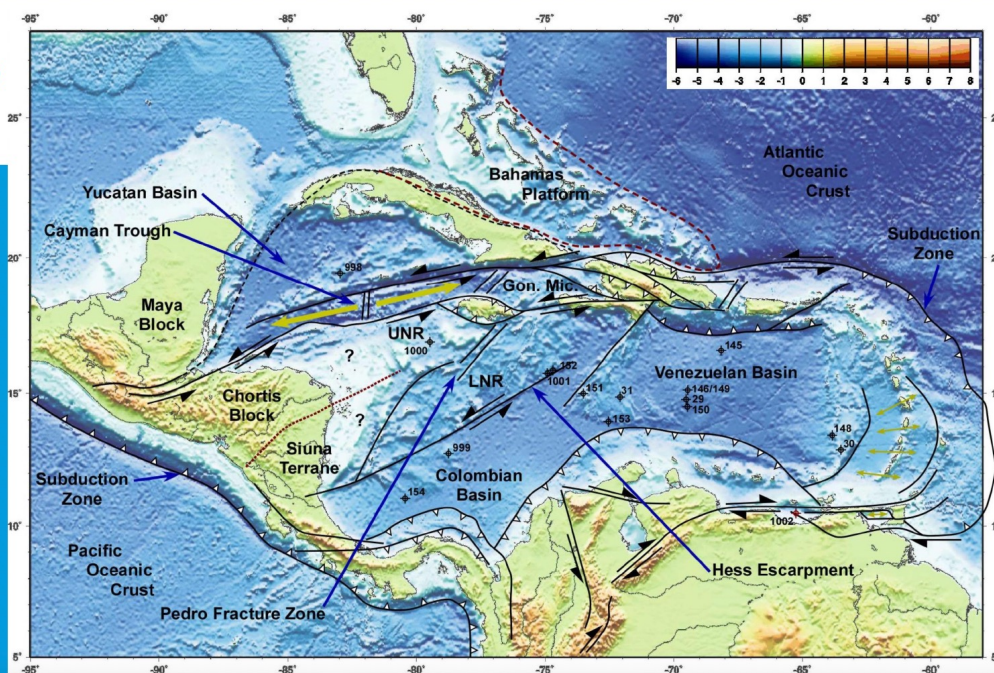
Geodiversity Workshop 4 – Latin America & the Caribbean

May 27, 2022



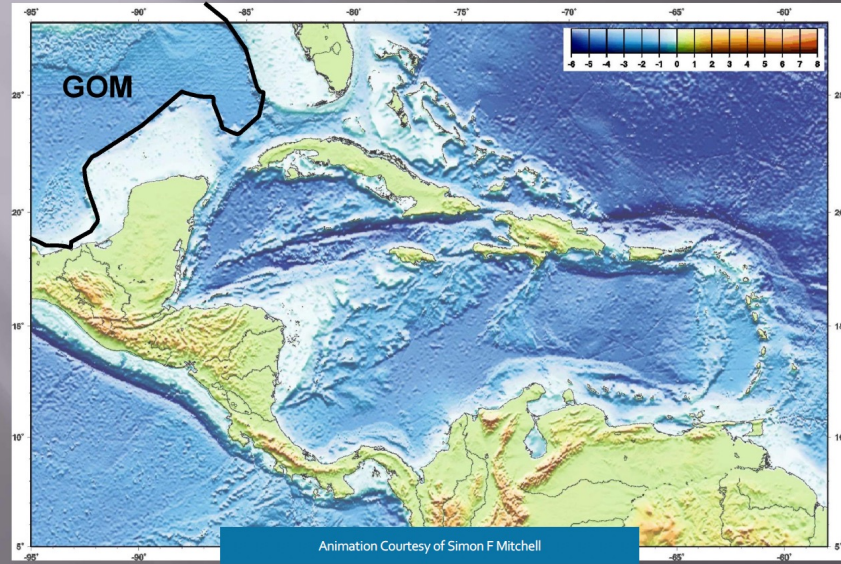
GEOGRAPHY OF THE CARIBBEAN

MAP

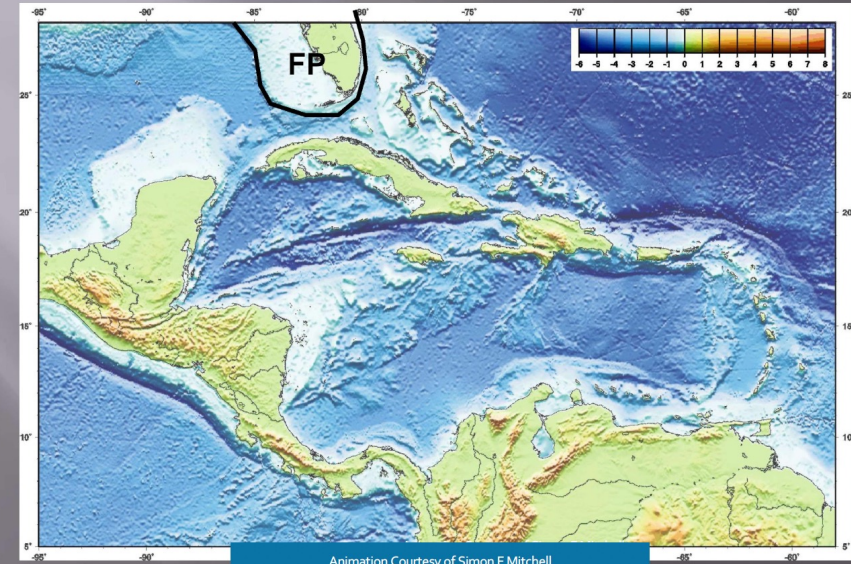


TECTONIC FEATURES OF THE CARIBBEAN

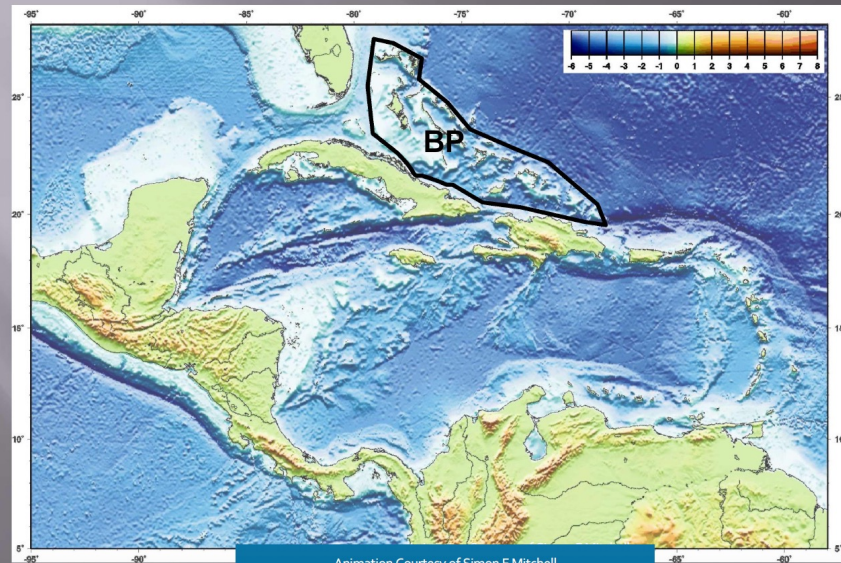
Gulf of Mexico: An oceanic basin consisting of stretched and thinned continental crust in the north and south and Upper Jurassic to Lower Cretaceous oceanic crust between. Thinned continental crust is overlain by Triassic to Middle Jurassic red beds and Jurassic evaporites. Margins were carbonate platforms (Jurassic-Cretaceous) and clastic deltas (Mississippi) and deep sea fan systems (Cenozoic).



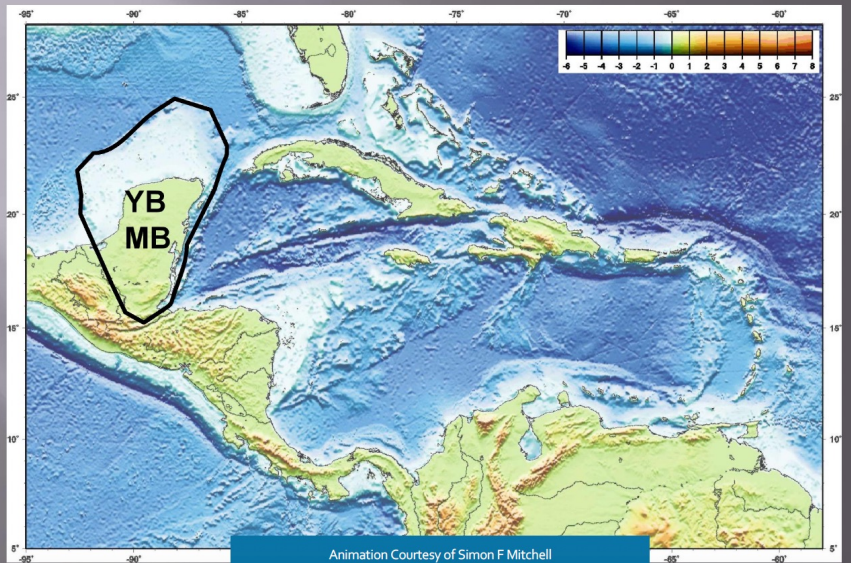
Florida Platform: 6,000-7,000 m of Middle Jurassic to Recent carbonate deposits resting on basement.



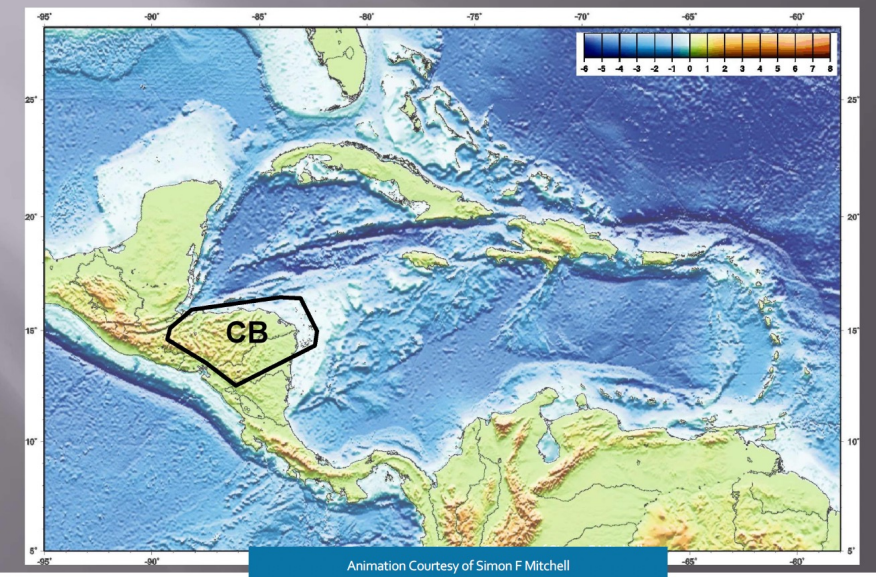
Bahamas Platform: Up to 10,000 m of Middle Jurassic to Recent carbonate deposits resting on extended basement.



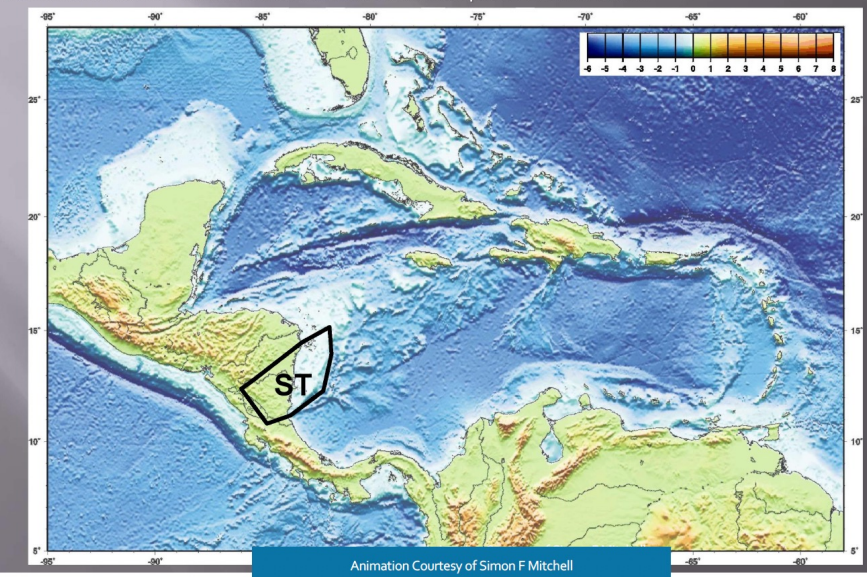
Yucatan (Maya) Block: A basement block with schists, marbles, quartzite and granitoides, overlain by Upper Carboniferous to Permian sedimentary and volcanic rocks. Jurassic red-beds are overlain by Cretaceous carbonate platform deposits. The Chicxulub impact site lies on the northern part of the block.



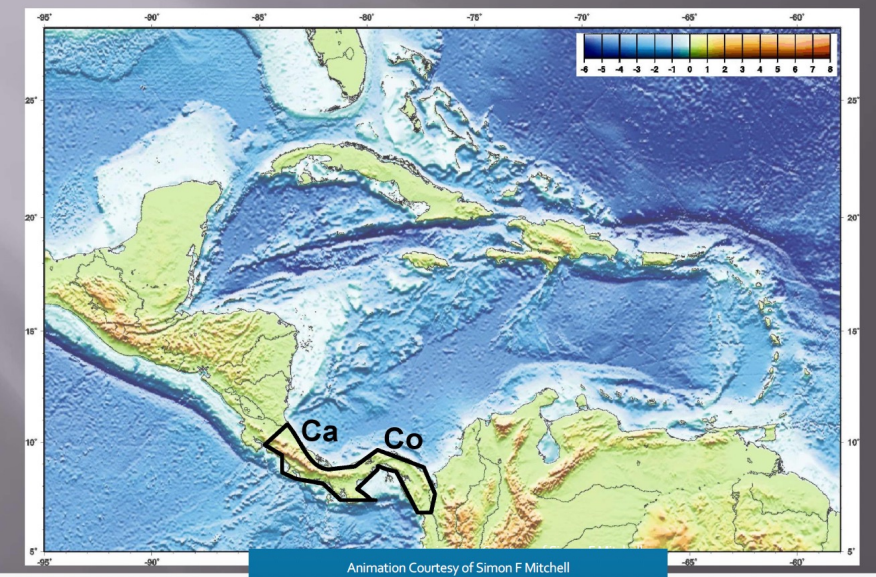
Chortis Block: A basement block with Paleozoic metamorphics and Mesozoic plutons, overlain by Jurassic to Lower Cretaceous red-beds and extensive Lower Cretaceous (Aptian and Albian) carbonate platform deposits. In the west, there are extensive Cenozoic volcanic deposits.



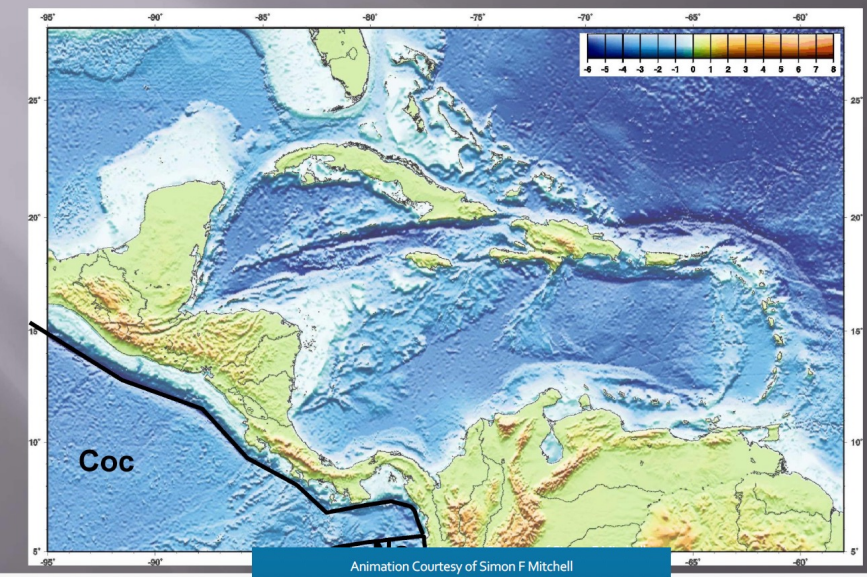
Siuna Terrane: A Jurassic to Lower Cretaceous ophiolite complex of serpentinite mélange with greenschist blocks and red ribbon-bedded radiolarites overlain by lower to middle Cretaceous deep water turbidites passing upwards into shallow-water limestones, followed by andesitic to dacitic pyroclastic flows and tuffs. The terrane was thrust to the N or NW over the Chortis Block in the Campanian at about 75 Ma.



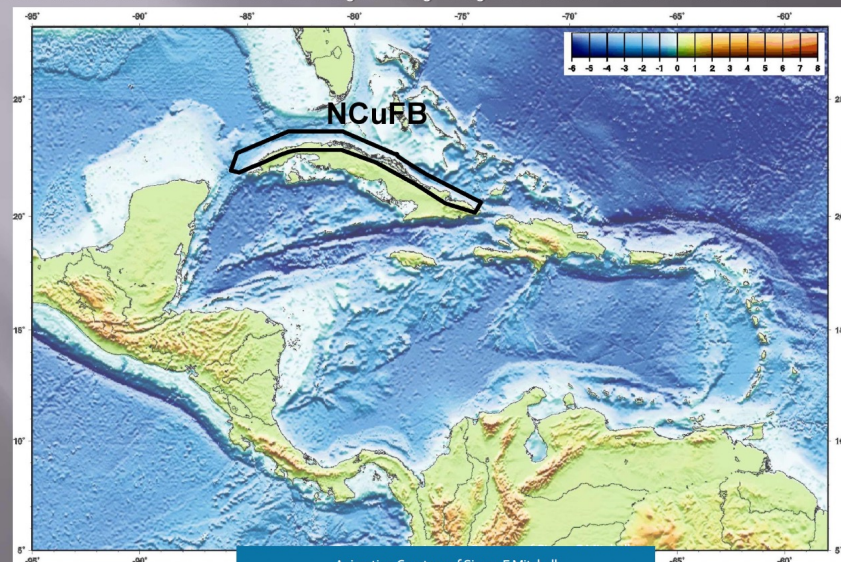
Panama Block (Choco and Chortega Blocks): A basement of late Cretaceous (CLIP) plateau basalts overlain by a late Cretaceous to Paleogene volcanic arc. Various exotic (Pacific) terranes have been accreted to the Pacific side of the block by subduction processes.



Nazca and Cocos Plates: Pacific oceanic plates that are being subducted beneath Central America and South America forming the Middle America Trench.

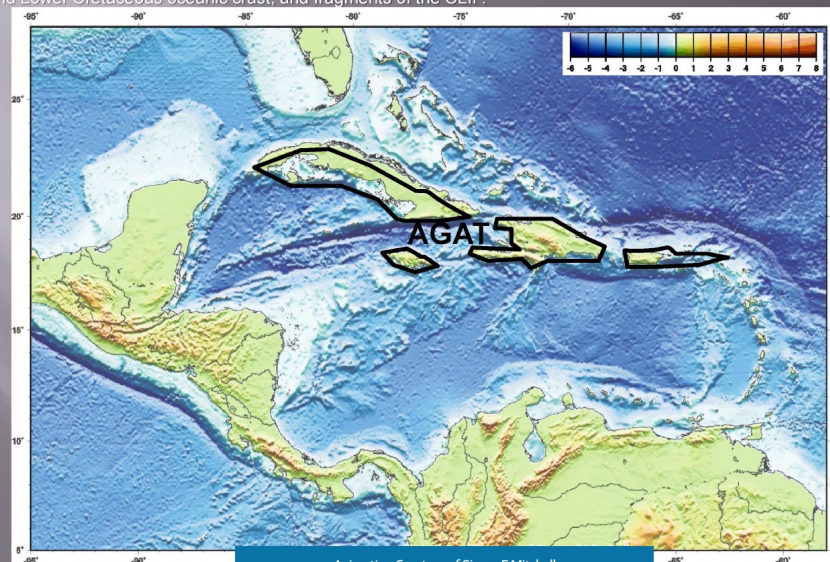


North Cuban Fold Belt: A fault and thrust belt along the northern margin of Cuba containing fragments of the North American passive margin, ophiolites and proto-Caribbean oceanic sedimentary rocks. The sequence was prototyped as an accretionary wedge in front of the Greater Antilles Island Arc and by the collision between the arc and North America. Blueschists in the belt give a range of ages from about 140 Ma to about 50 Ma.



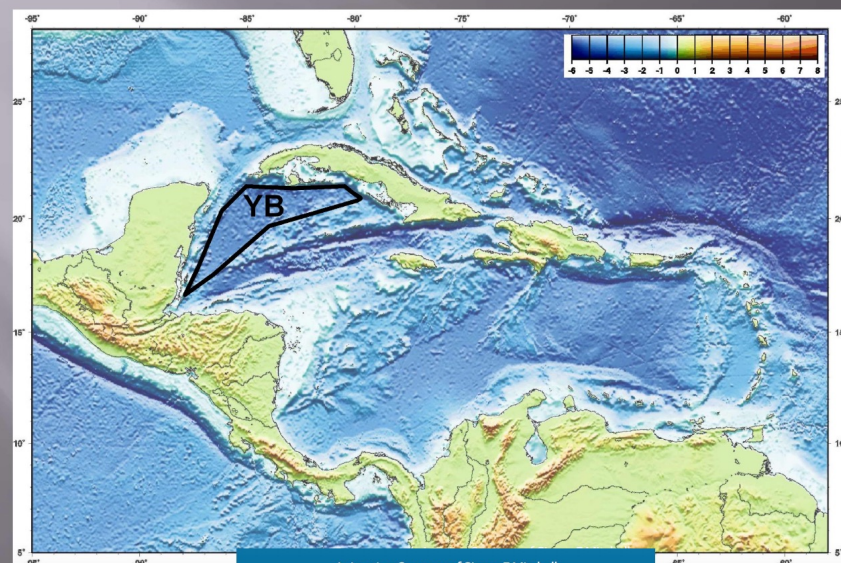
Animation Courtesy of Simon F Mitchell

Accreted Greater Antilles Terranes: The Greater Antilles (Cuba, Jamaica, Hispaniola, Puerto Rico and the Virgin Islands) represent a series of accreted Cretaceous to Paleogene terranes overlain by platform carbonates and clastics deposited in rift basins. The accreted terranes include extensive island arc volcanic and associated sedimentary sequences, dissected ophiolite complexes with fragments of Proto-Caribbean and Pacific Jurassic and Lower Cretaceous oceanic crust, and fragments of the CLIP.



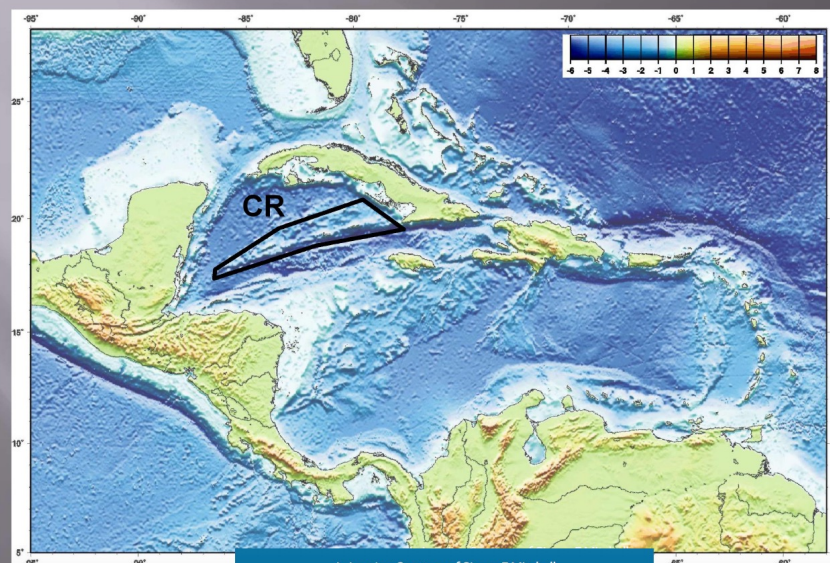
Animation Courtesy of Simon F Mitchell

Yucatan Basin: A basin bordered to the south by the Cayman Ridge, to the north by the Cuba, and to the west by the Yucatan (Maya) block. The western part of the basin is underlain by oceanic crust.



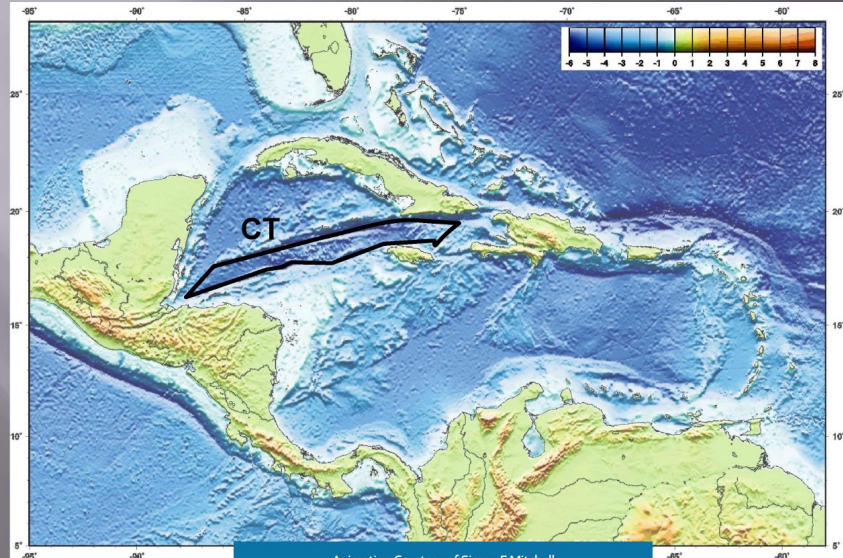
Animation Courtesy of Simon F Mitchell

Cayman Ridge: A structural high to the north of the Cayman Trough of which the Cayman Islands are the only emergent part.



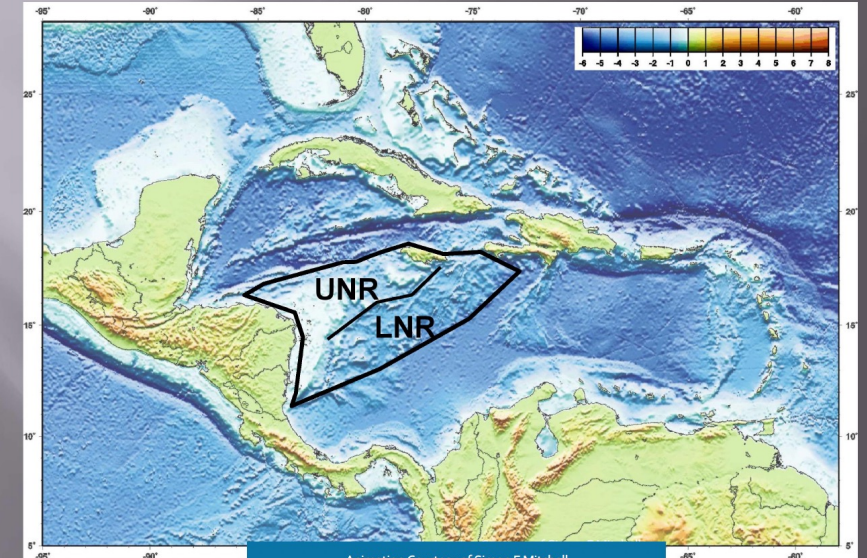
Animation Courtesy of Simon F Mitchell

Cayman Trough: A ENE-WSW trending basin which is the deepest part of the Caribbean and contains the Cayman Spreading Centre.



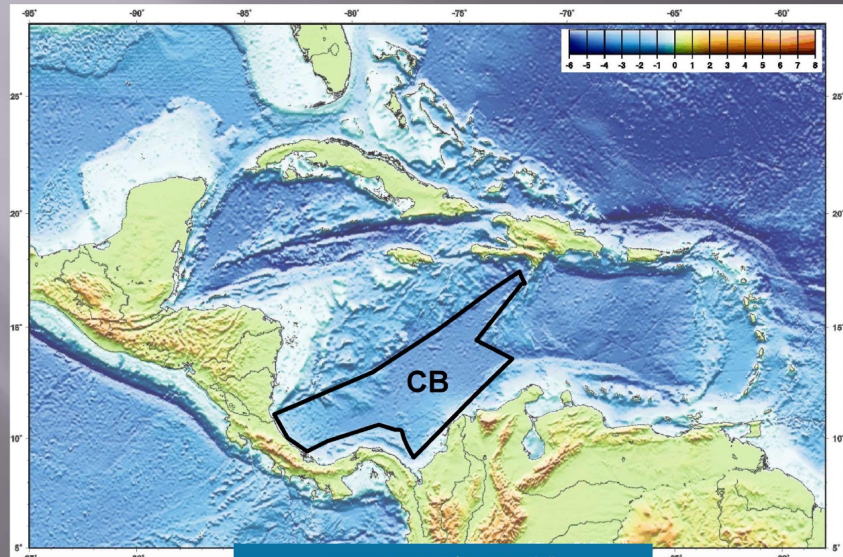
Animation Courtesy of Simon F Mitchell

Nicaraguan Rise: A complex relatively shallow-water rise that lies between the Cayman Trough to the northwest, and the Colombian Basin to the southeast. The southeastern margin is the Hess Escarpment, and the Lower Nicaraguan Rise (to the southeast) is separated from the Upper Nicaraguan Rise (to the northwest) by the Pedro Fracture Zone.



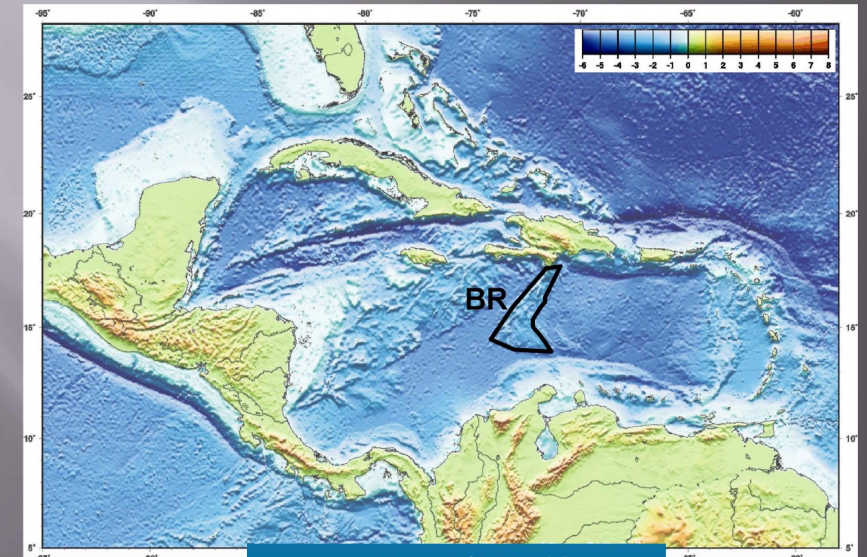
Animation Courtesy of Simon F Mitchell

Colombian Basin: A large abyssal plain between the Nicaraguan Rise to the NW and the Beata Ridge and South America to the east. It extends to depths of 4,000-4,400 m and receives extensive deep-water sediments from the Magdalena and Panama-Costa Rica fans that lie on its southern margin.



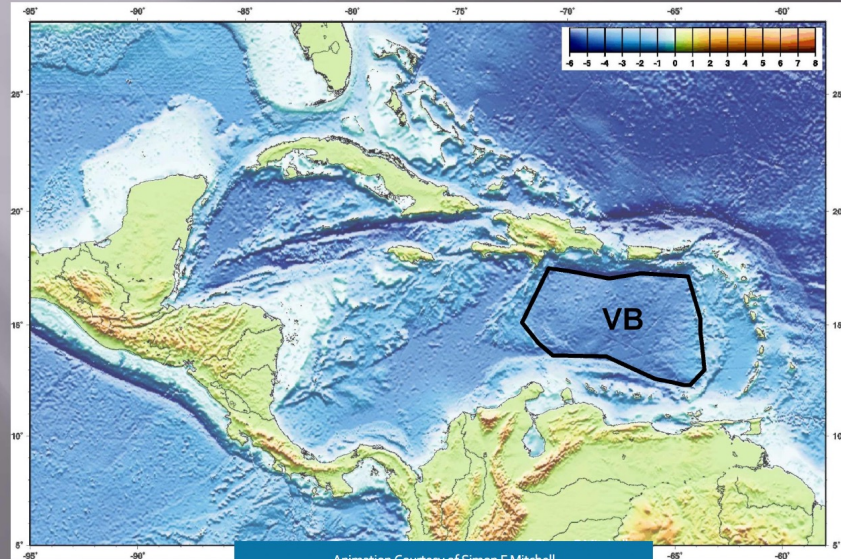
Animation Courtesy of Simon F Mitchell

Beata Ridge: A structural high with a relief of 2,000 m extending south from Hispaniola, and separating the Colombian and Venezuelan basins. The Beata Ridge is separated from the Southern Caribbean Deformed Belt by the Aruba Gap.



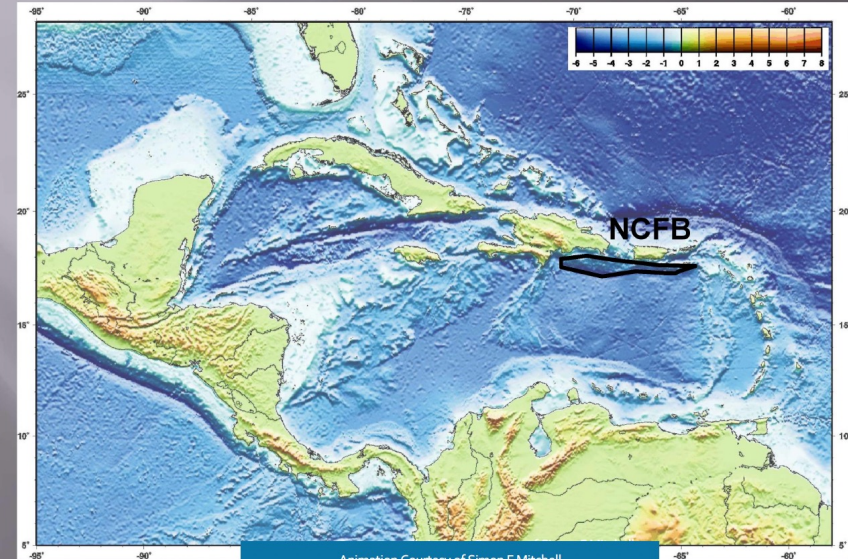
Animation Courtesy of Simon F Mitchell

Venezuelan Basin: A large deep basin bordered by the Northern Caribbean Deformed Belt to the north, the Aves Ridge to the east, the Southern Caribbean Deformed Belt to the south, and the Beata Ridge to the west. The basin floor shows a smooth profile due to deep-water sediment (turbidite) accumulation.



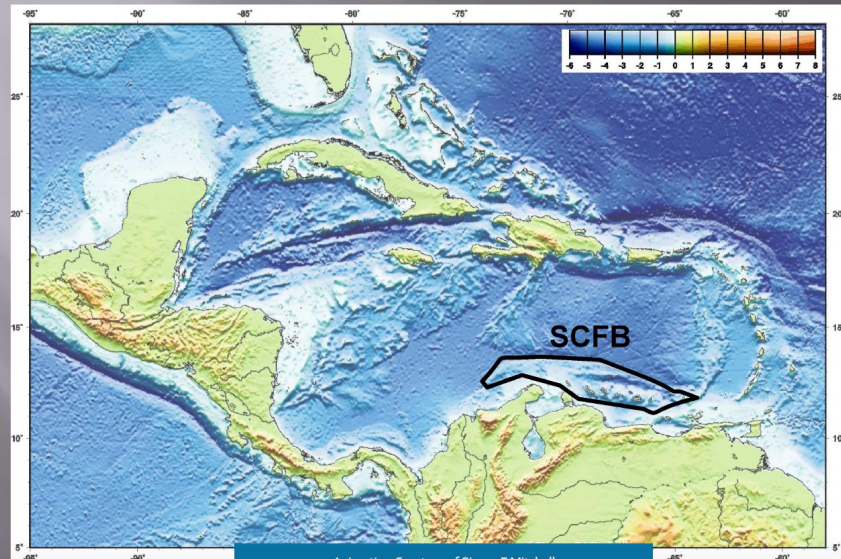
Animation Courtesy of Simon F Mitchell

Northern Caribbean Fold Belt: A fold and fault belt between Hispaniola/Puerto Rico and the Venezuelan Basin. Related to the Caribbean Plate being thrust under Hispaniola/Puerto Rico.



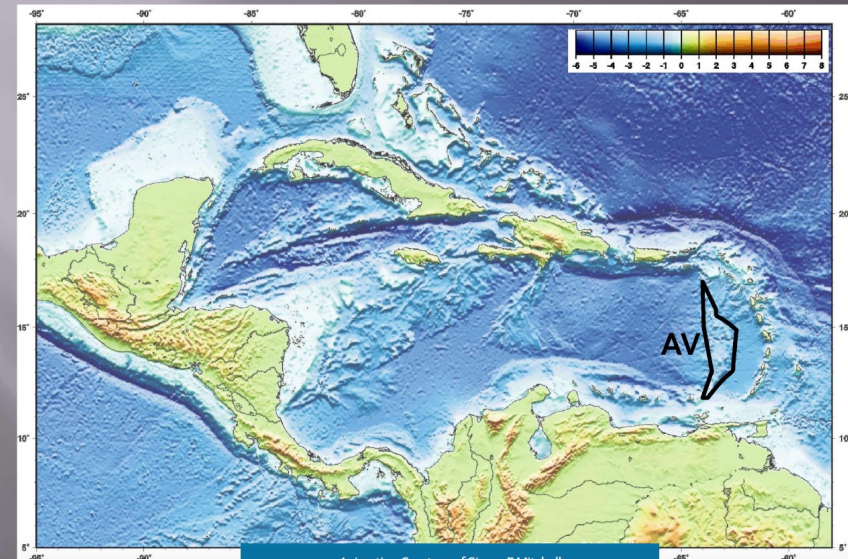
Animation Courtesy of Simon F Mitchell

Southern Caribbean Fold Belt: A fold and thrust belt between Venezuela and the Venezuelan Plate, including a series of Basins (e.g., Aruba Basin, Curacao Trough, Bonaire Basin); formed by the underthrusting of the Caribbean Plate beneath Venezuela. Basement highs with Cretaceous and Paleogene volcanic and sedimentary rocks form a series of islands (ABC Islands, Venezuelan Antilles).



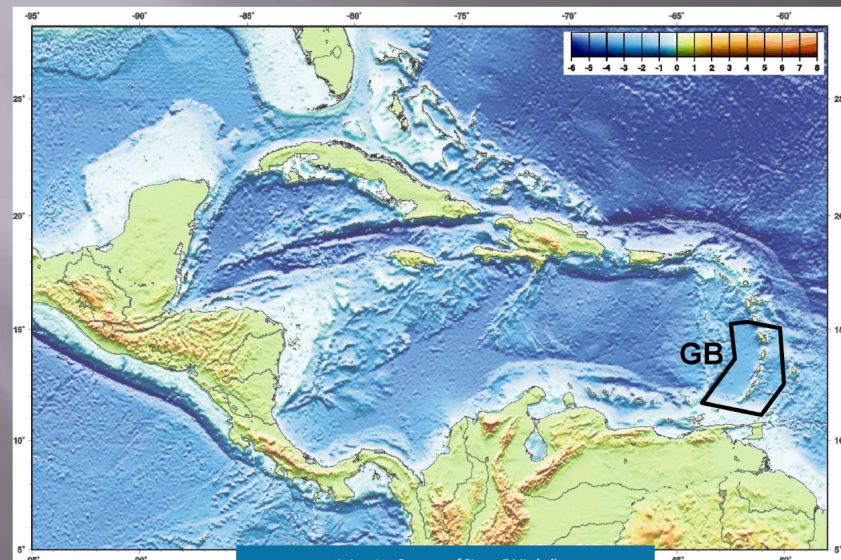
Animation Courtesy of Simon F Mitchell

Aves Ridge: A plateau with a width of 50 to 150 km separating the Grenada Basin in the east from the Venezuelan Basin in the west. Comprises a Cretaceous to Paleocene basement of basalts, andesites and granites (an older magmatic arc), overlain by 1,500 m of Paleocene to Recent sediments.



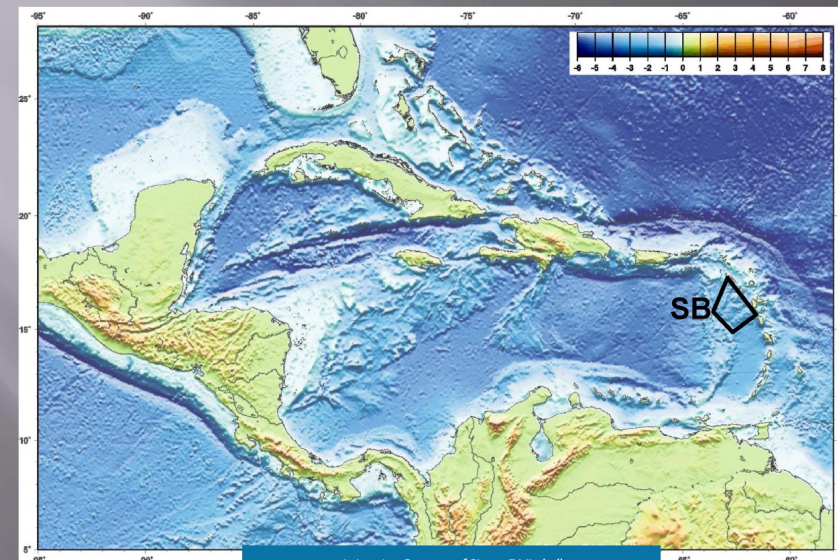
Animation Courtesy of Simon F Mitchell

Grenada Basin: An extensional basin composed of oceanic basement between the southern part of the Aves Ridge and the Tobago forearc, with maximum depths of up to 3,000 m in the south.



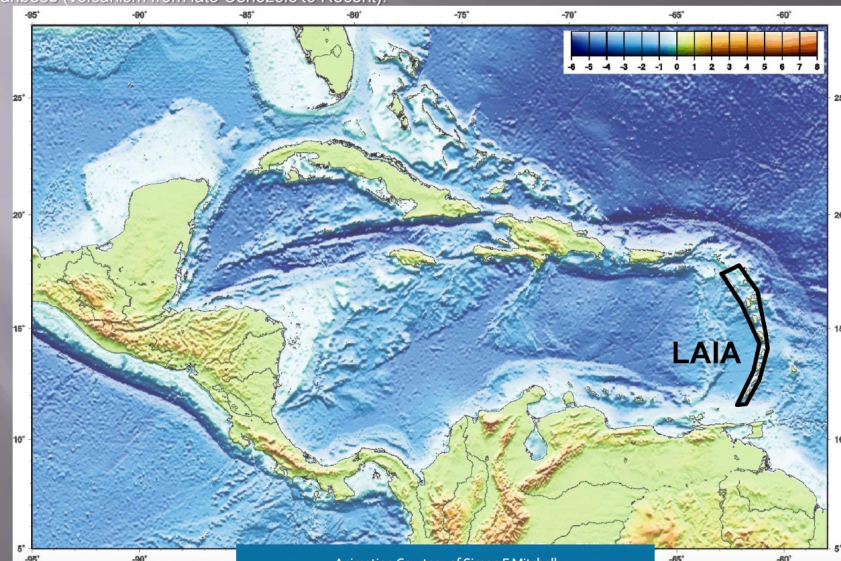
Animation Courtesy of Simon F Mitchell

Saba Bank: A platform connecting the northern Aves Ridge and Lesser Antilles Arc with a Cretaceous basement and a Cenozoic cover.



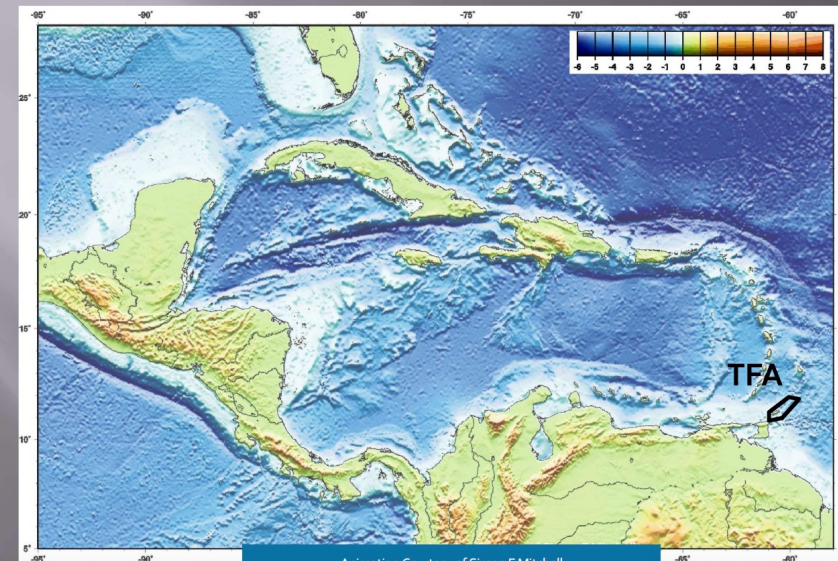
Animation Courtesy of Simon F Mitchell

Lesser Antilles Island Arc: An 850 km chain of islands extending from Grenada in the south to the Anegada Passage in the north. It consists of two arcs. From Martinique southwards, the arcs are superimposed and contain a sedimentary-volcanic sequence ranging from middle Eocene to Recent. North of Martinique, an eastern older arc, the Limestone Caribbees (inactive for the last 28 Ma), is separated from a western younger arc, the Volcanic Caribbees (volcanism from late Cenozoic to Recent).



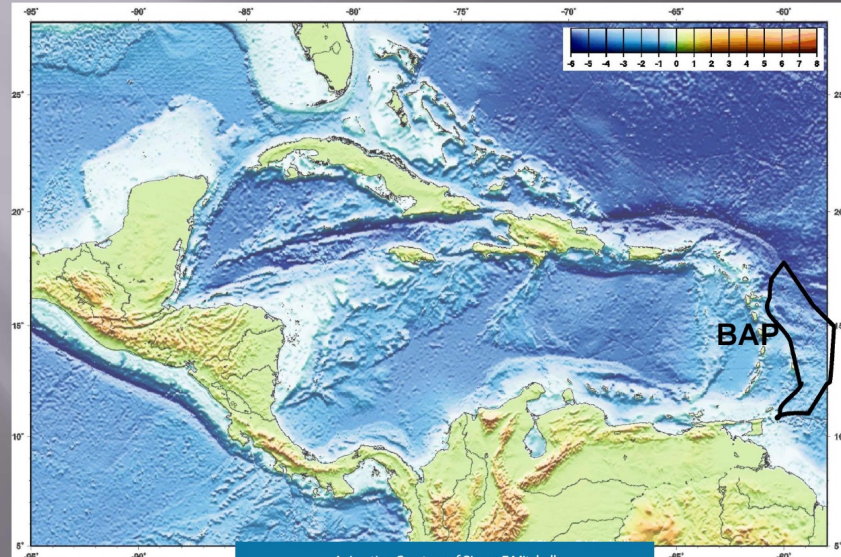
Animation Courtesy of Simon F Mitchell

Tobago Forearc Terrane: Cretaceous arc rocks and intrusives.



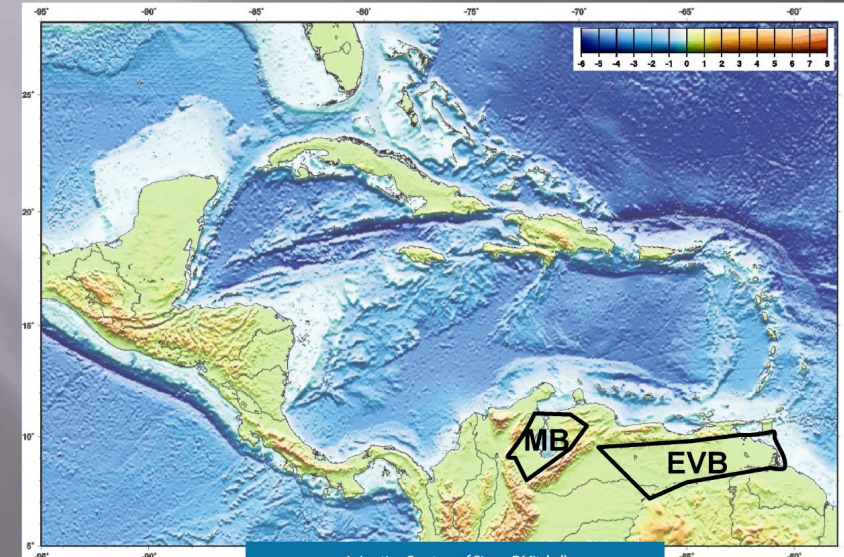
Animation Courtesy of Simon F Mitchell

Barbados Accretionary Prism: Series of Cretaceous and Cenozoic deep-water sediment deposited on the Atlantic and Proto-Caribbean Plate that have been scraped off and accumulated in an accretionary wedge in front of the Lesser Antilles Arc.



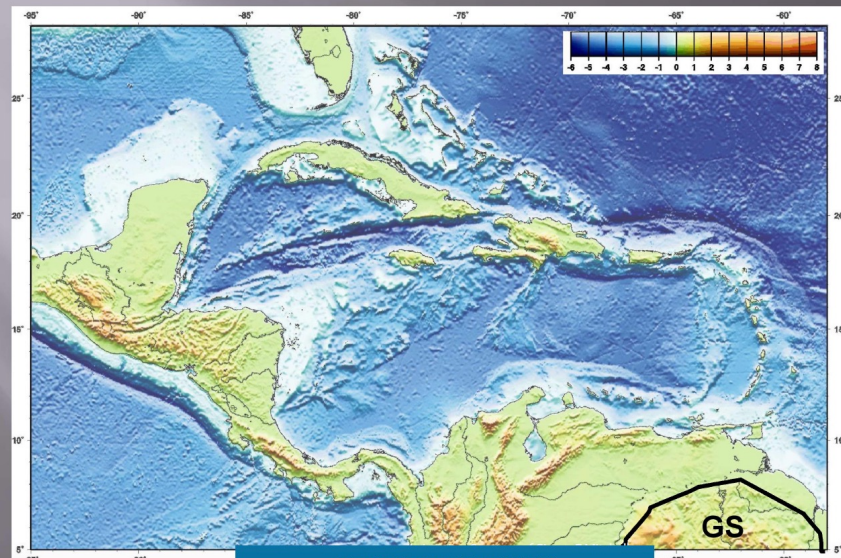
Animation Courtesy of Simon F Mitchell

Northern South American Basins: A series of basins along the northern margin of South America including the Maracaibo Basin and the East Venezuelan Basin that were created by crustal loading in front of the advancing Caribbean Plate. The basins contain thick Cenozoic clastic successions and contain extensive oil reservoirs produced from extensive Cretaceous (Turonian to Santonian) source rocks (La Luna Formation).



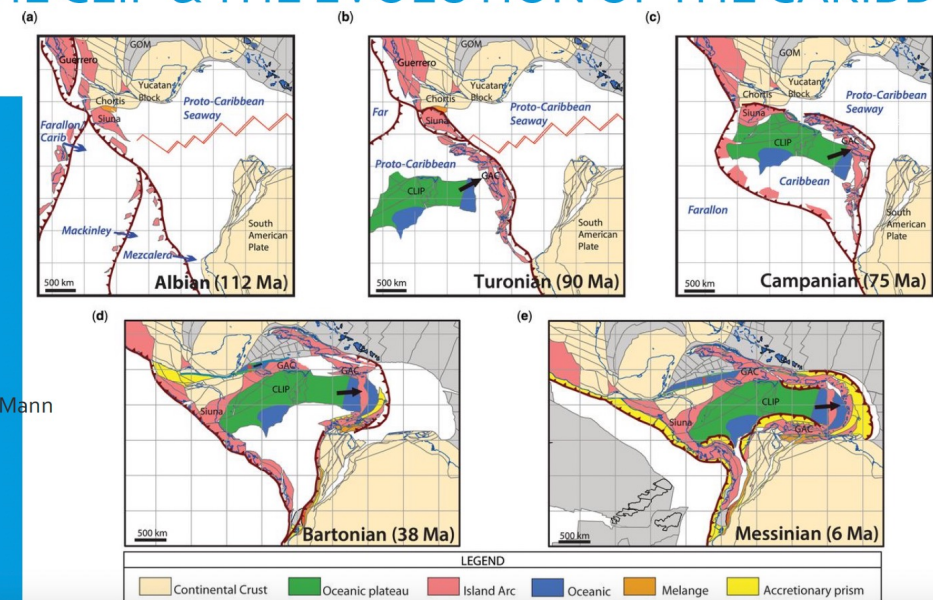
Animation Courtesy of Simon F Mitchell

Guiana Shield: An extensive uplifted Precambrian series of metamorphic rocks in north-eastern South America that supplies extensive sediments to the Atlantic ocean and the basins flanking the northern margin of Venezuela.



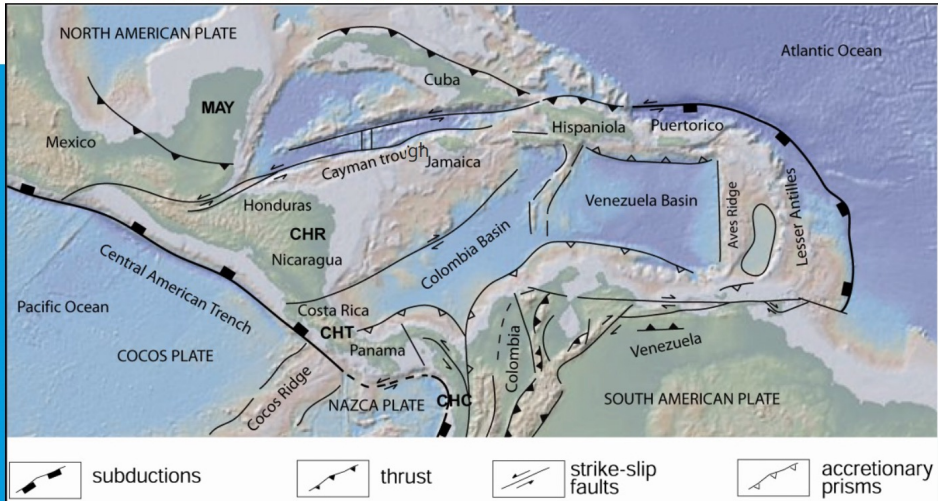
Animation Courtesy of Simon F Mitchell

THE CLIP & THE EVOLUTION OF THE CARIBBEAN



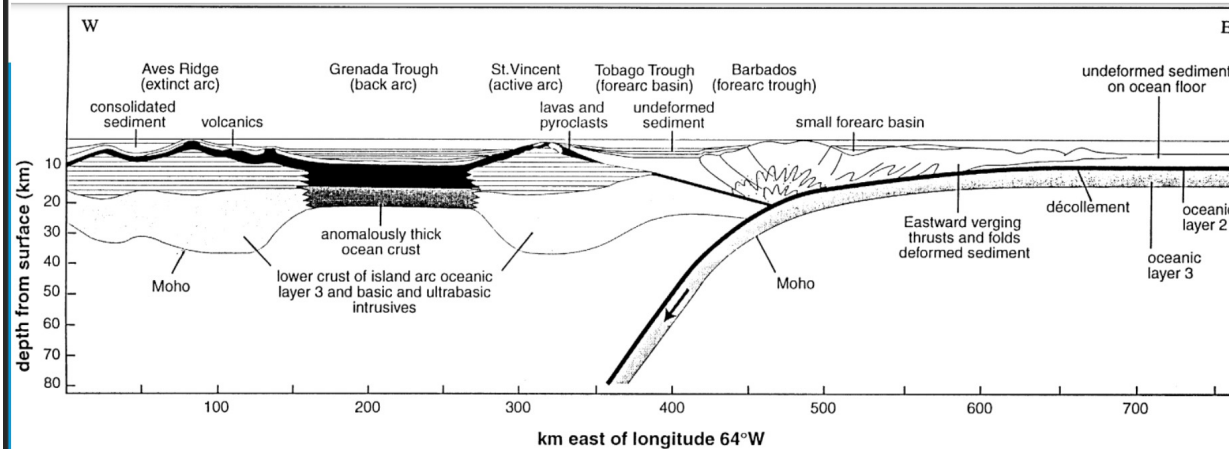
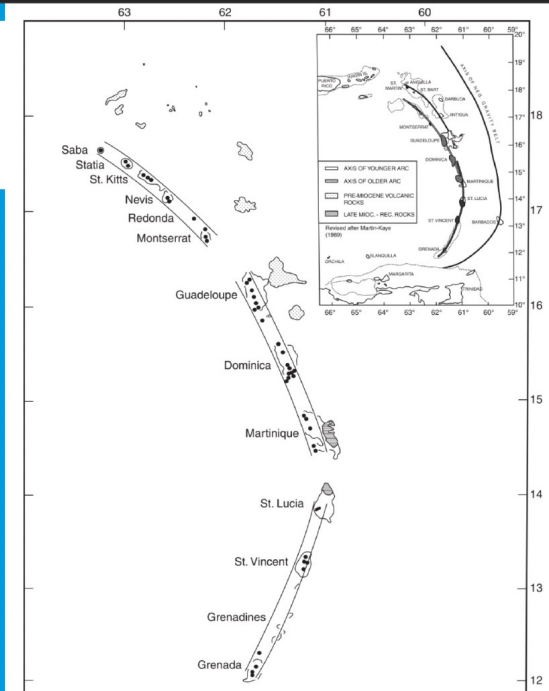
Romito & Mann
2020

SUBDUCTION & SPREADING



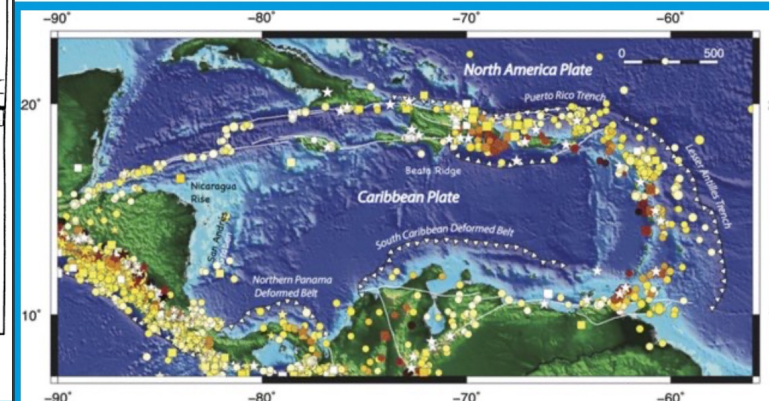
MAY= Maya block; CHR= Chortis block; CHT= Chorotega block; CHC= Choco block

Jackson 2013

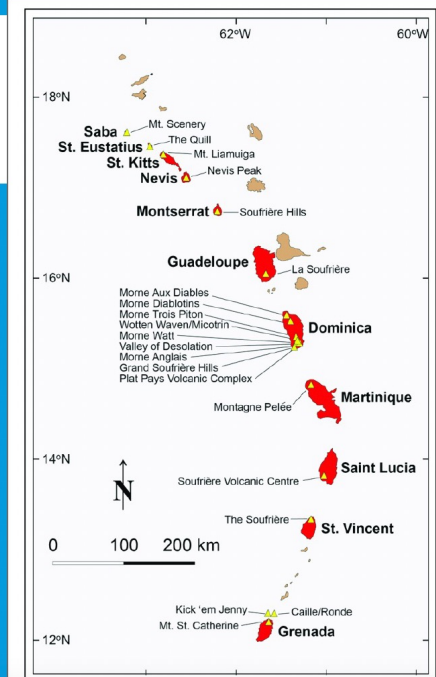


Westbrook et al., 1984

VOLCANISM & SEISMICITY



Chachón-Barrantes et al 2018



Lindsay & Robertson 2018



LA SOUFRIÈRE, GUADELOUPE



In Guadeloupe geothermal-powered electricity production began in 1996, with total production increasing to 15 MW once a second plant was built in 2003. Electricity generated here accounts for 5% of total generation in Guadeloupe, with the country looking to develop a 3rd plant.

THE ROSEAU

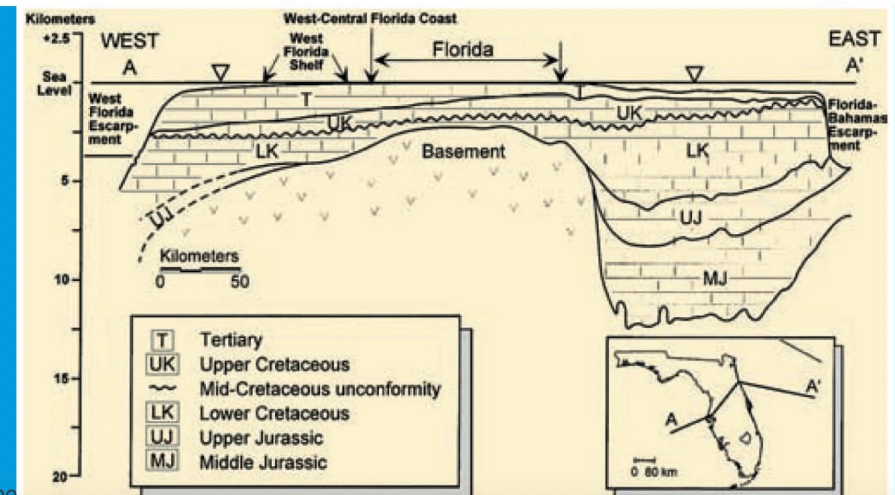
The site is expected to be completed in 2022 and supply 120 MW of electricity to 23,000 homes.

Surplus electricity is to be supplied to Martinique and Guadeloupe through undersea cables.

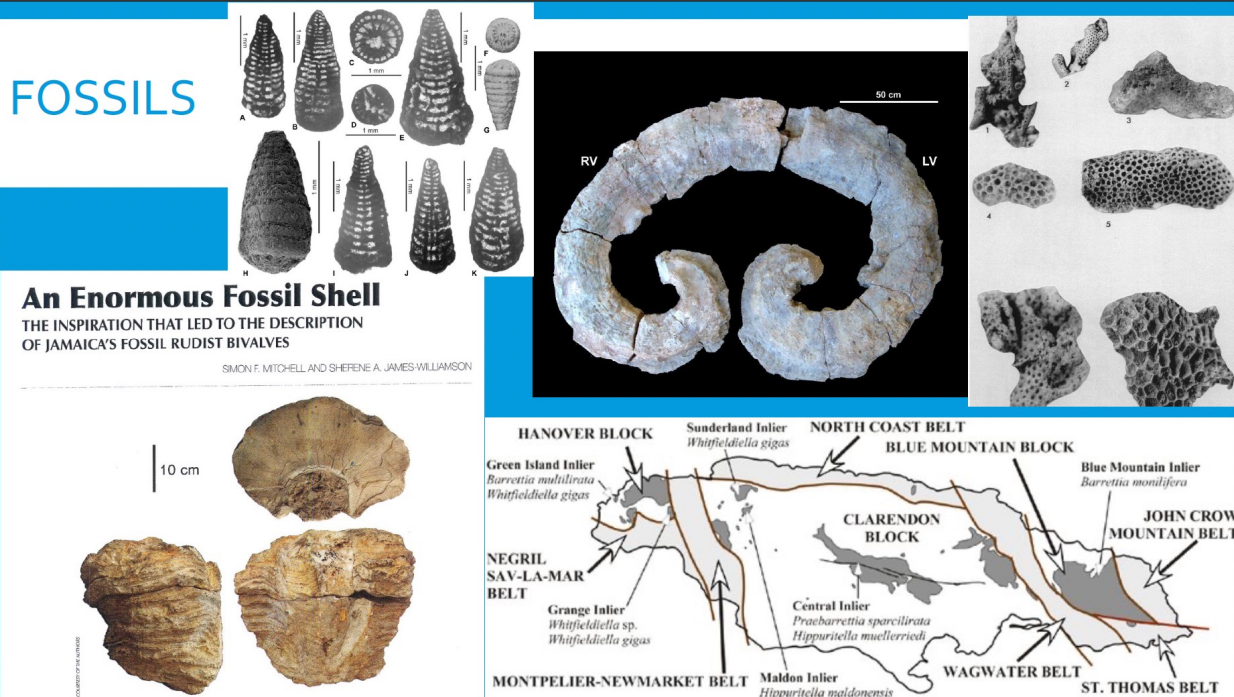
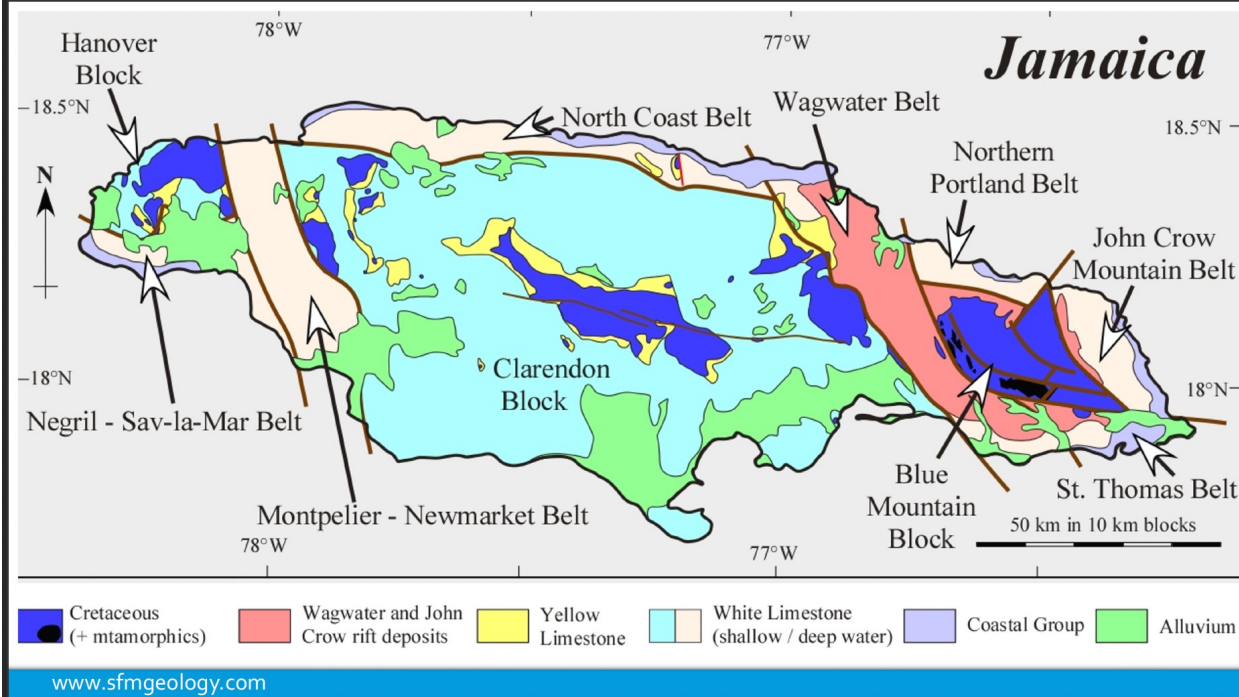
This will reduce the cost of electricity for customers.



CARBONATE PLATFORMS



A. Hine, 2009.



Fort Delgrés, Guadeloupe
<https://www.flickr.com/photos/dauidstanleytravel/49839856402/in/photostream/>



St Marks Anglican Church,
Mandeville, Jamaica: Jamaica
Gleaner



BIODIVERSITY & ENDEMISM

Regional geological and biogeographic events have promoted diversity on many fronts in the Caribbean.

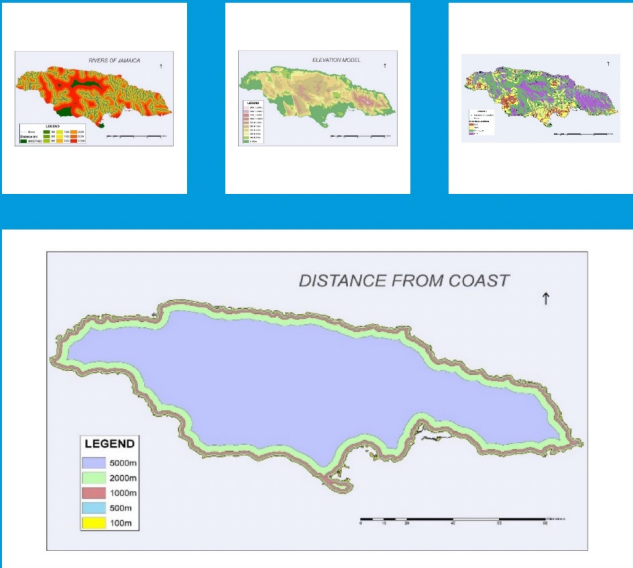
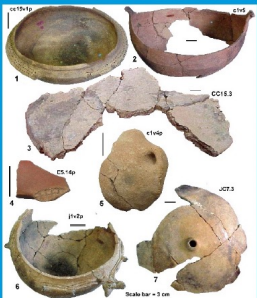
Along with the Caribbean’s social history during the last 500 years (influx of settlers), these biogeographic events have contributed to shaping the region’s biological diversity, with a mix of native and exotic species.

Study area	Number of vascular plant species	Number of medicinal plants	% of endemism
Belize	4423	64	19
Jamaica	2746	116	31
Haiti	4685	161	30
Mexico	30 000	5000	52
Nicaragua	5796-7000	229	19
Panama	8500-9000	265	19
Cuba	6015	101	53
Puerto Rico	2128	172	10
Dominican Republic	4685	200	30

Numbers of vascular plant species, estimated number of medicinal plants and percentages of endemism for all the surveyed communities
(Torres-Aviles, 2015)

PEOPLE & LANDSCAPE

- Predictive Modelling of Pre-Columbian settlements
- James-Williamson et al in prep.



NATURAL HAZARDS & DISASTERS



CONCLUSION

- The Caribbean is a very diverse region due to its regional tectonics
- Its diversity impacts the physical features & biodiversity
- The geology of the region impacts heritage & culture
- Geodiversity of the Caribbean impacts the built environment
- All aspects of Caribbean geodiversity can lead to resilience

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- Sherene.jameso2@uwimona.edu.jm