Coastal geology of Bluefields Bay, Westmoreland Parish, Jamaica: Successions of non-marine to marine debris flows in an active tectonic setting

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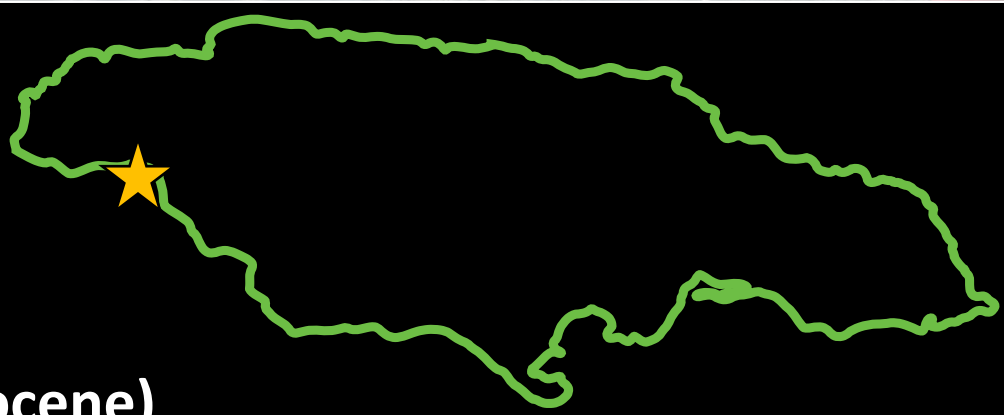
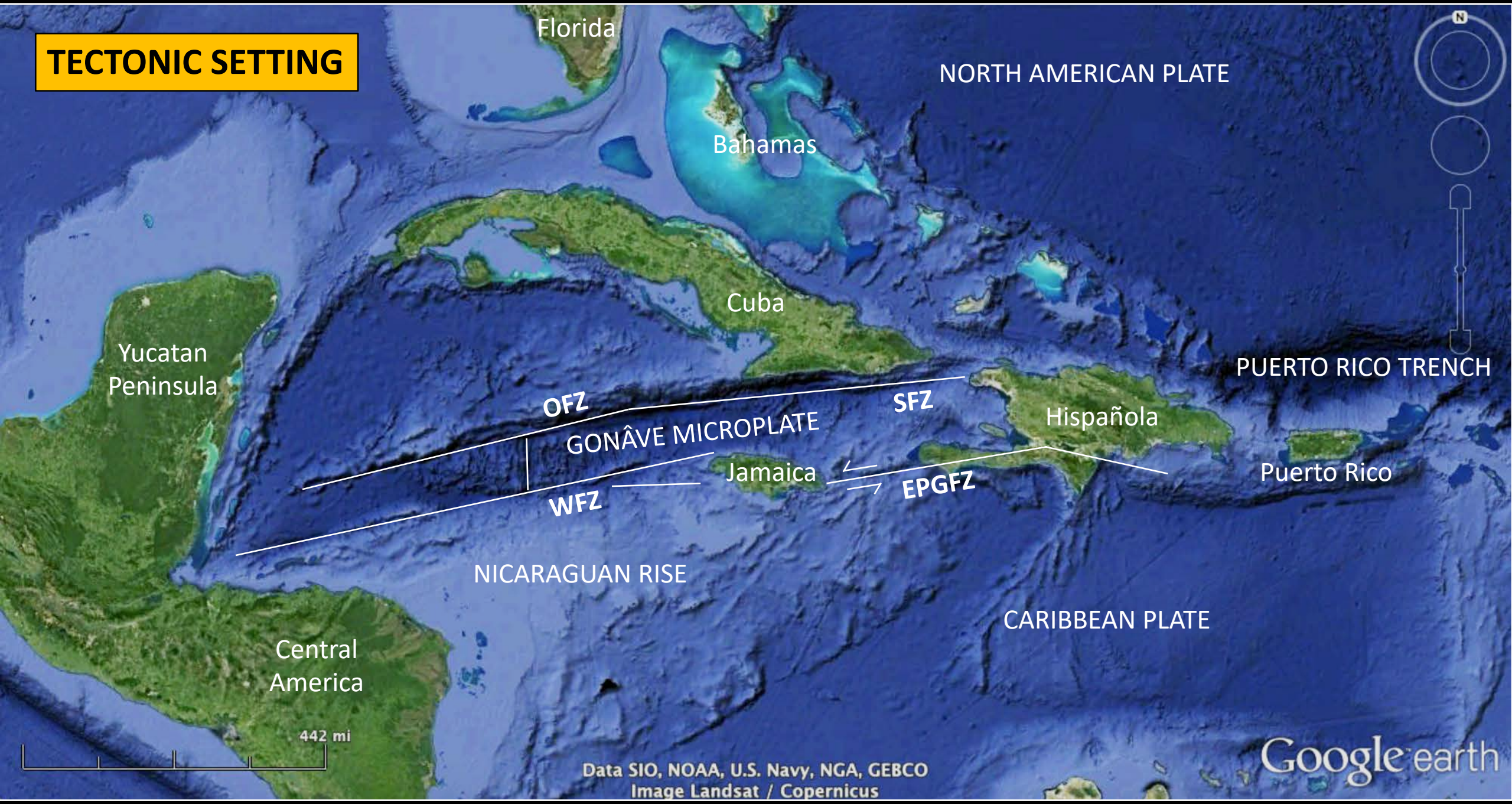
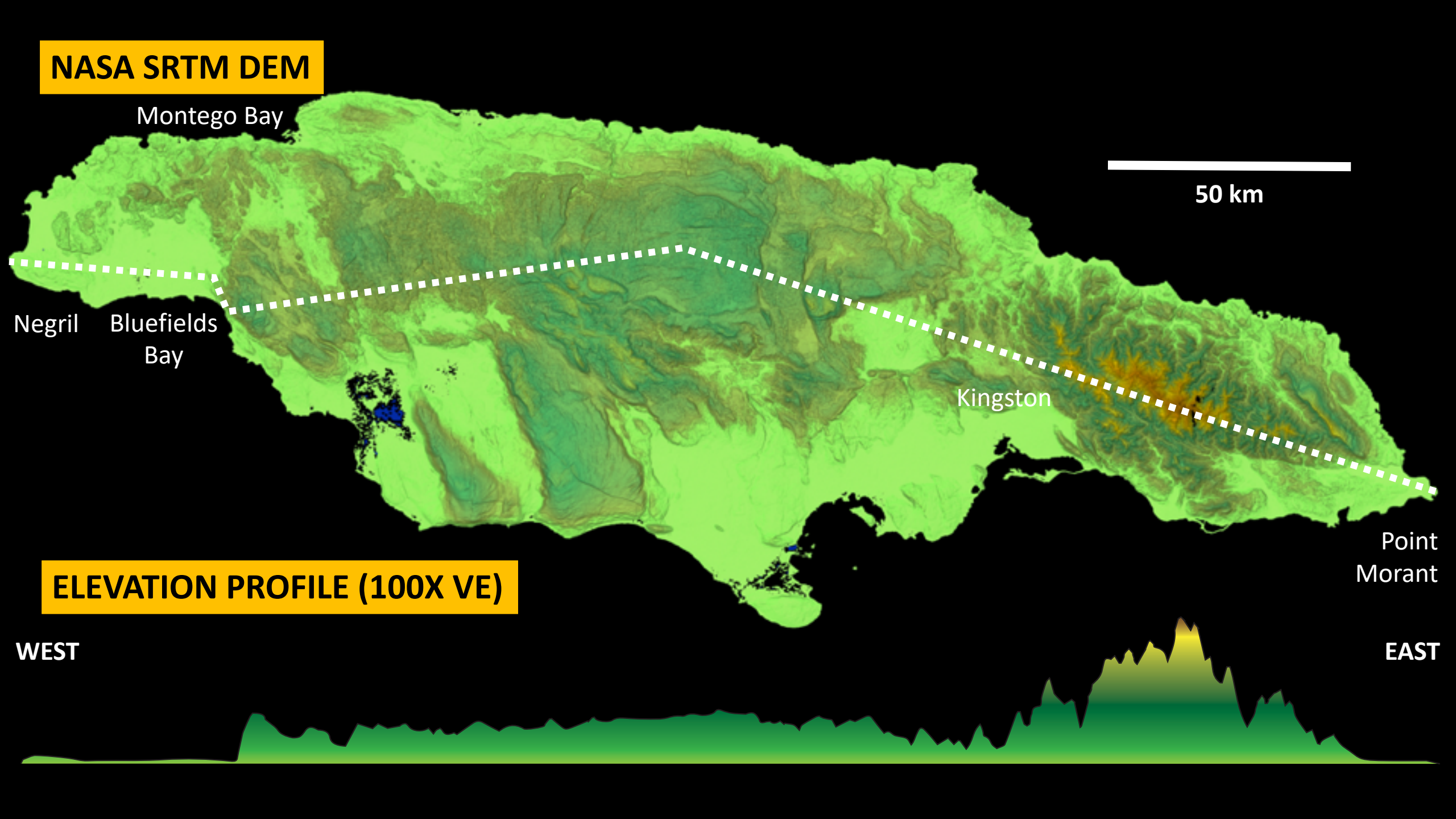
KEY POINTS



- Jamaica tectonically active
- Two mapped geologic units at Bluefields Bay:
  - Quaternary alluvium
  - White Limestone Group (mid-Eocene to mid-Miocene)
- New: Coastal Group — Lithified marine-influenced debris flow deposits Belmont Point and non-marine debris flows and paleokarst from Mearnsville to Cave
- 1979 debris flow near Bluefields River are analog for ancient debris flows

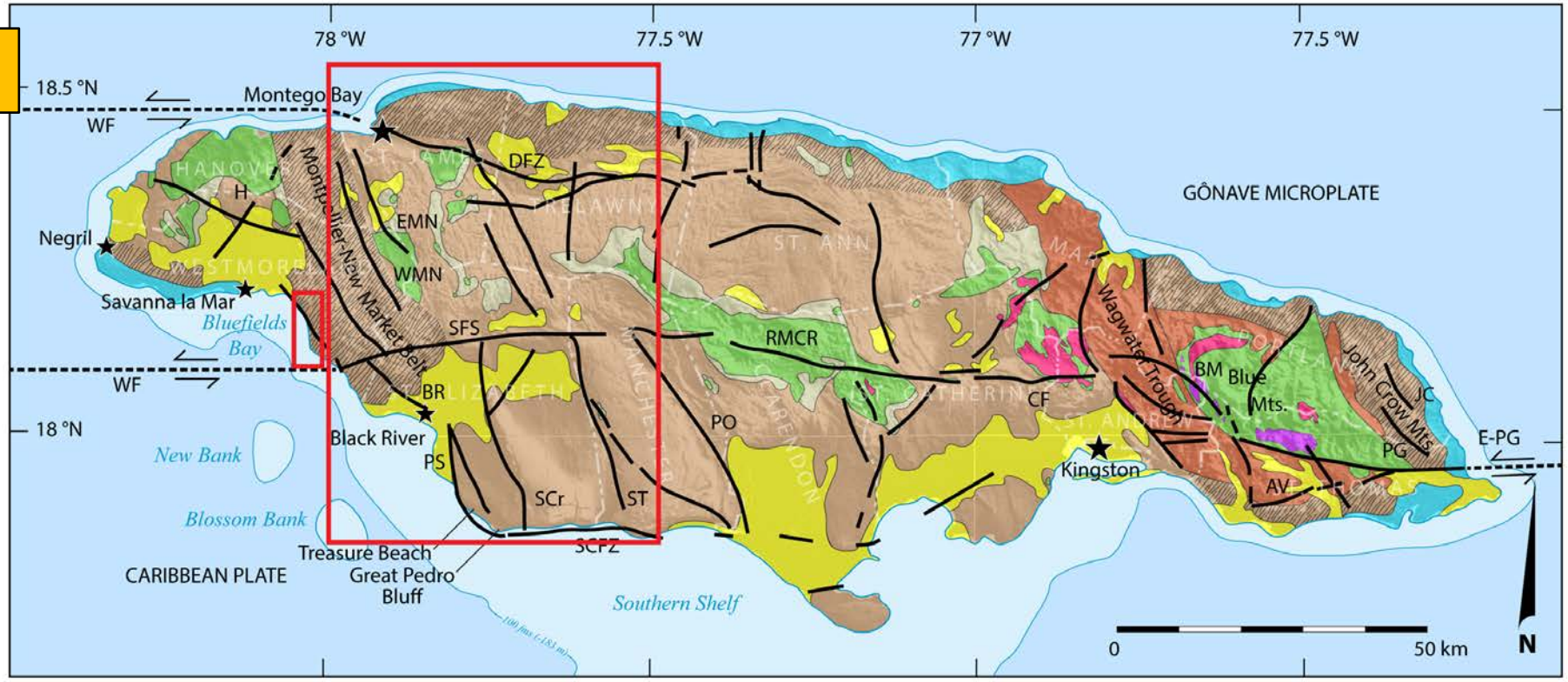

TECTONIC SETTING
Florida
NORTH AMERICAN PLATE
Bahamas
Cuba
Yucatan Peninsula
PUERTO RICO TRENCH
OFZ
SFZ
GONÂVE MICROPLATE
Hispañola
Jamaica
EPGFZ
Puerto Rico
WFZ
NICARAGUAN RISE
CARIBBEAN PLATE
Central America
442 mi
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Google earth


TECTONIC SETTING
DFZ
Jamaica
WFZ
SFS
RMCRFZ
SCr
ST
Po
PS
EPGFZ
SCFZ
SOUTHERN SHELF
PEDRO BANK
59 mi
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Google earth


NASA SRTM DEM
Montego Bay
50 km
Negril
Bluefields Bay
Kingston
Point Morant
ELEVATION PROFILE (100X VE)
WEST
EAST

GEOLOGIC BACKGROUND

- 140 million years in age
- Volcanics (K)
- Rift zones (K-Pg)
- Yellow Ls. Group (mid-Eocene)
- White Ls. Group (mid-Eo. to mid-Mio.), resembled Bahamas
- Compression: Faulted and uplifted
- Coastal Group (mid-Mio. to Pleisto.)
- Seismically active



EXPLANATION

- Alluvium (Quaternary sediments and morass)
- Coastal Group (mid-Miocene to Pleistocene)
- White Limestone, shallow/deep water facies (mid-Eocene to mid-Miocene)
- Yellow Limestone (Paleocene)
- Wagwater and John Crow rift deposits
- Cretaceous sedimentary rocks (with granitoids and volcanics)

MAJOR FAULTS AND FAULT ZONES

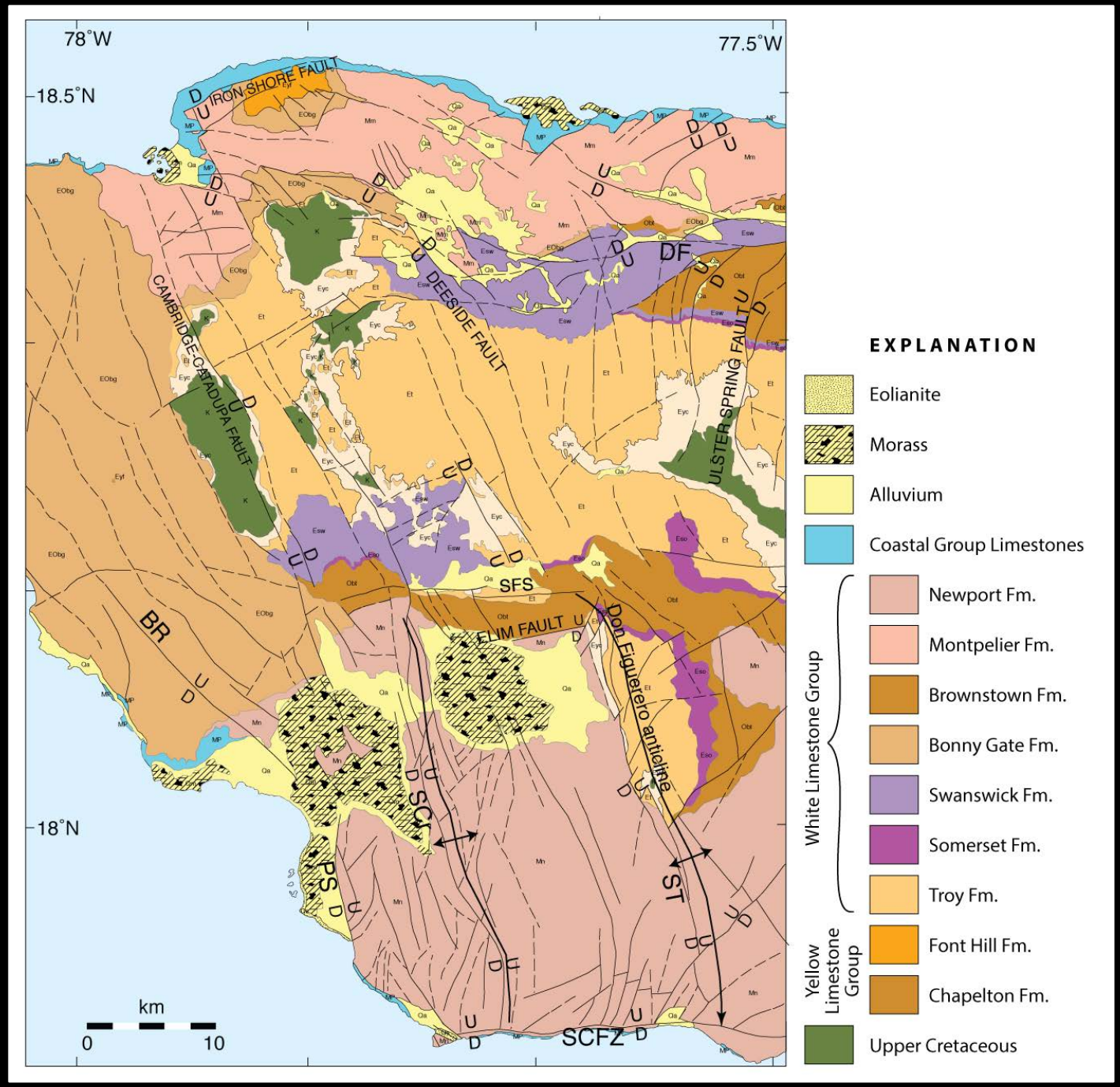
AV	Aeolus Valley	PO	Porus
BM	Blue Mountain	PS	Pondside
BR	Black River	RMCR	Rio Minho-Crawle River
CF	Cavaliers Fault	SCFZ	South Coast Fault Zone
DFZ	Duanvale Fault Zone	SCr	Santa Cruz
EMN	Eastern Montpellier-New Market	SFS	Siloah Fault System
E-PG	Enriquillo-Plantain Garden	ST	Spur Tree
H	Hanover	WF	Walton Fault
JC	John Crow	WMN	Western Montpellier-New Market
PG	Plantain Garden		

★ Key urban areas

Modified from Mitchell <http://www.sfmgeology.com/JamaicaGeology3.html> and Benford et al. (2012)

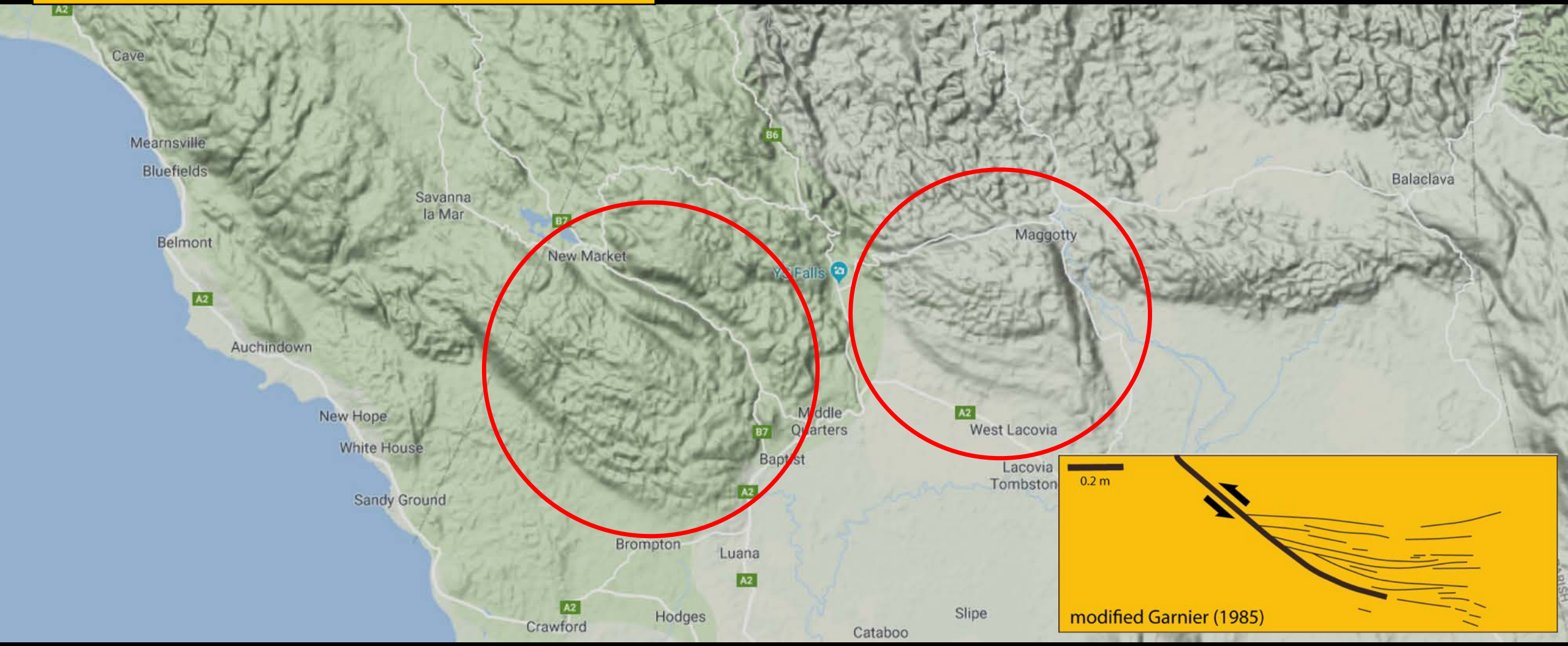
STRUCTURAL SETTING

- Jamaica: one or more active plate boundary faults or fault zones (Benford et al. 2012)
- SW Jamaica: reactivation normal faults as reverse faults in (Benford et al. 2014)
- RMCRFZ has accommodated 8-10 km left-lateral strike-slip movement (Mitchell, 2003); 10-12 km move-ment on PG fault (Mann et al. 1984)
- Several models for restraining bend behavior



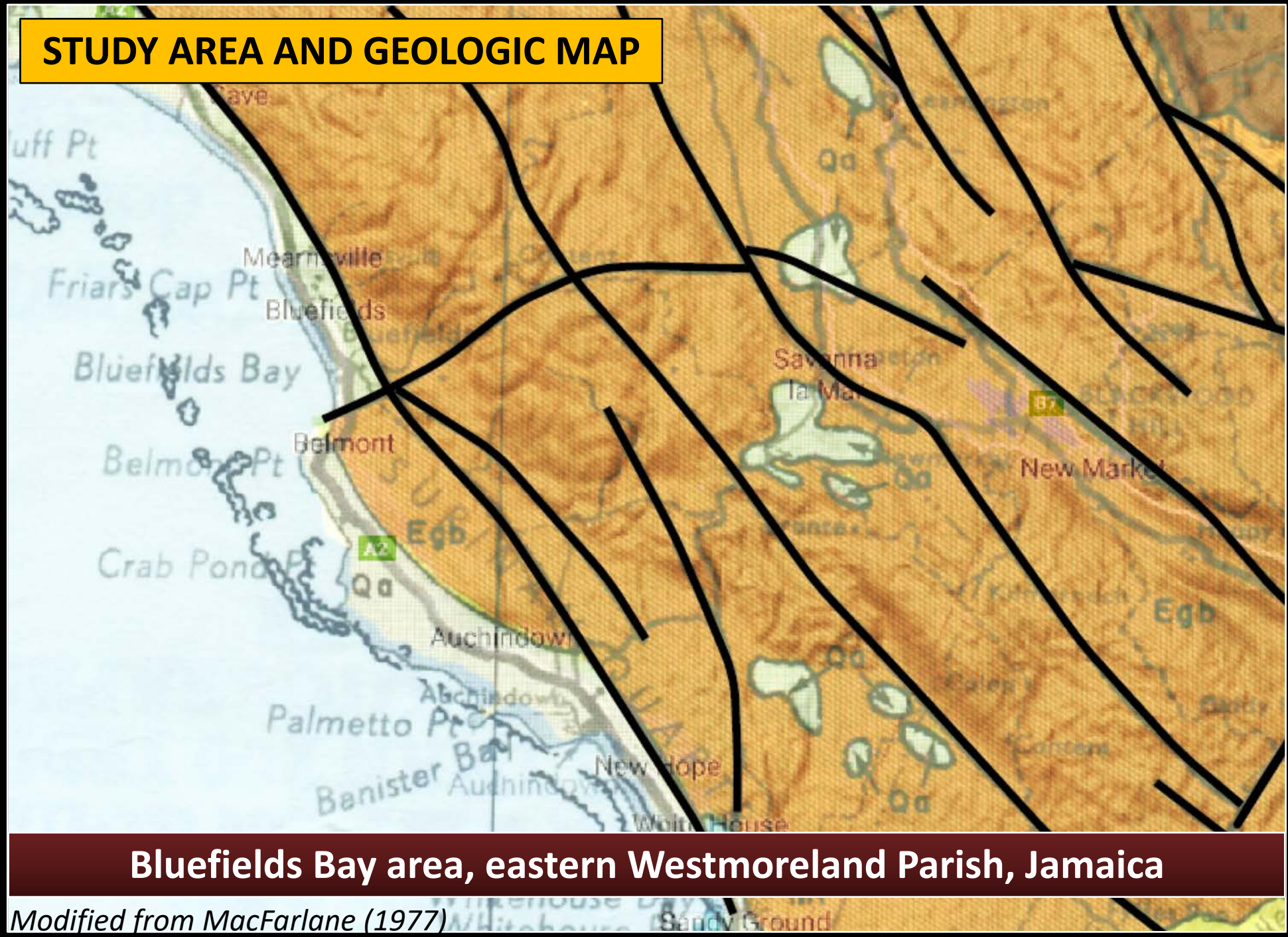
Modified from Benford et al. (2014) after Walker (1975)

CONTRACTIONAL HORSETAIL SPLAYS



Indicate left-lateral strike-slip movements on the Brompton and Cambridge-Catadupa fault zones; likely, another restraining bend?

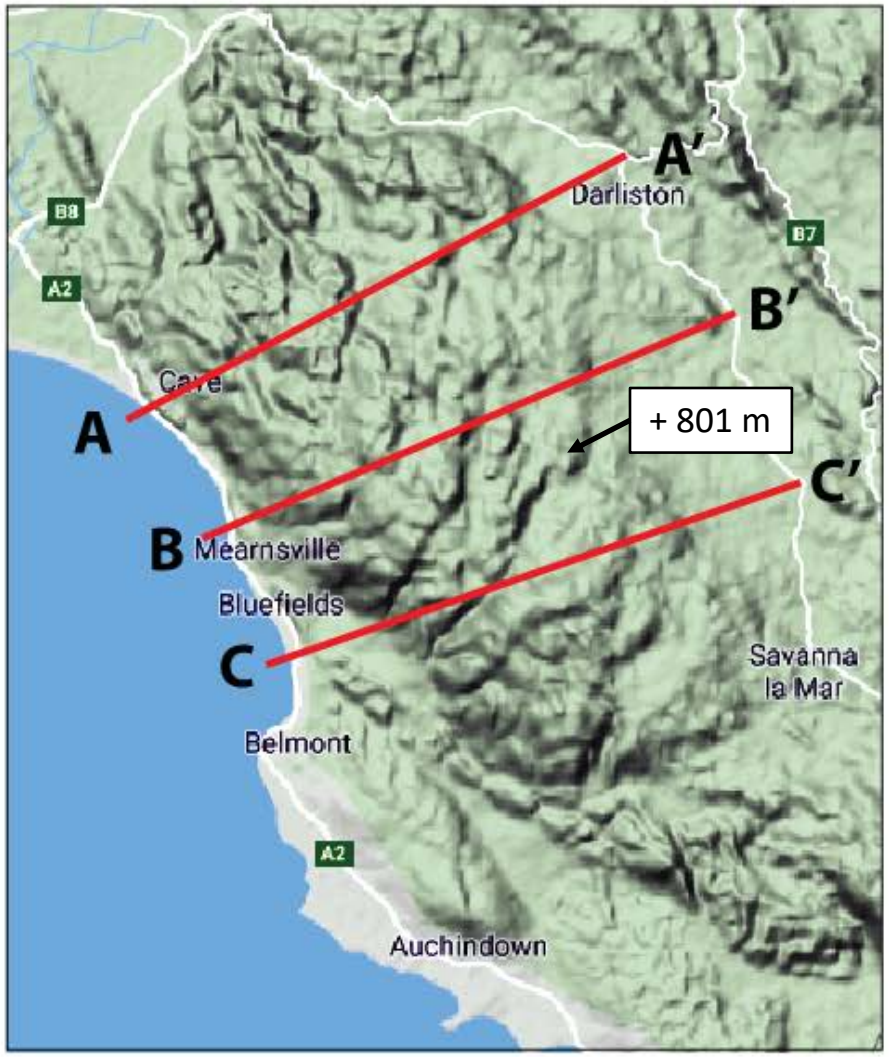
STUDY AREA AND GEOLOGIC MAP



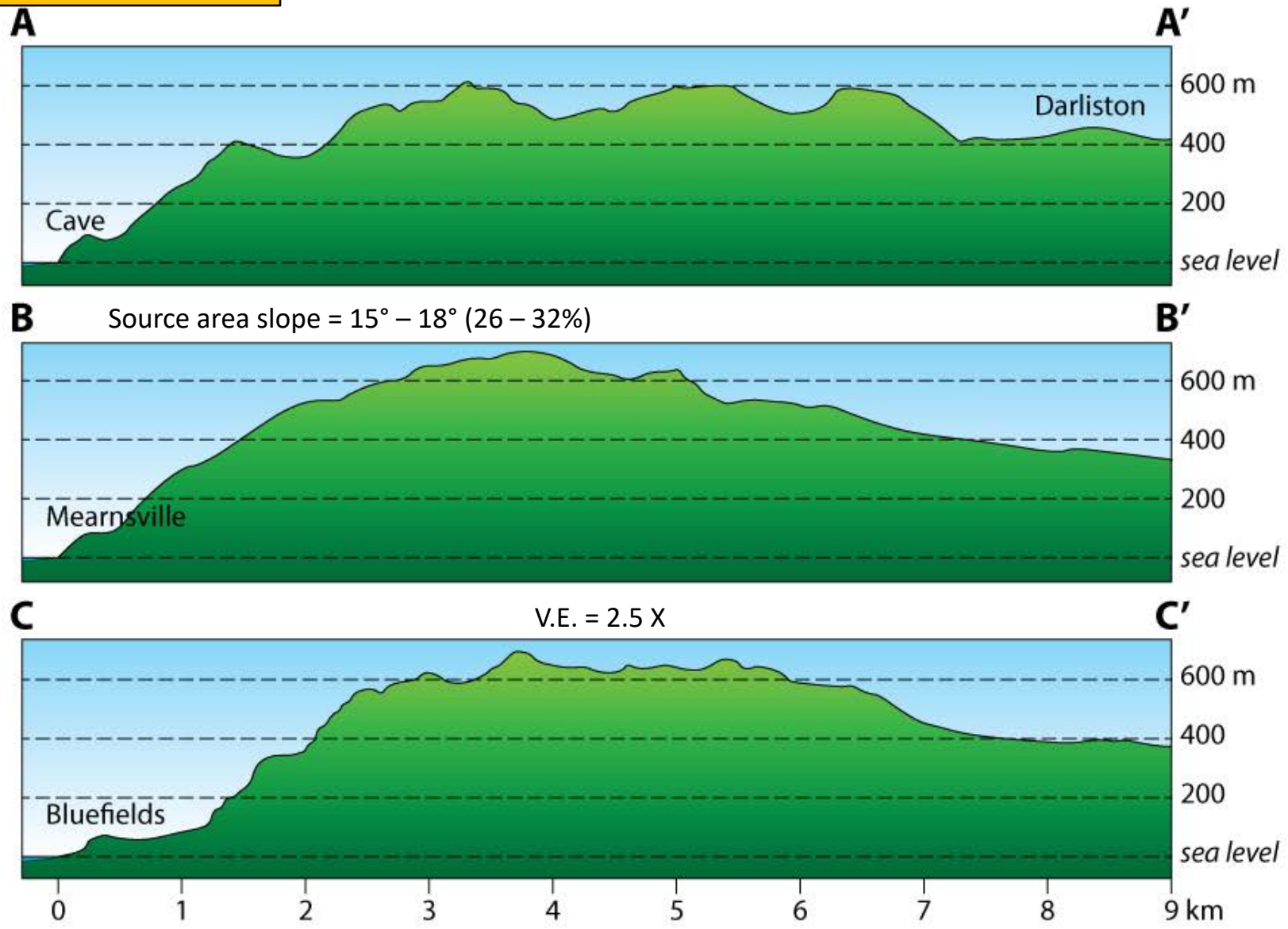
Bluefields Bay area, eastern Westmoreland Parish, Jamaica

Modified from MacFarlane (1977)

BLUEFIELDS MOUNTAIN ELEVATION PROFILES



(www.heywhatsthat.com)



WHITE LIMESTONE GROUP

- 70% exposures in Jamaica
- Dipping, fractured, and faulted
- Mapped Eocene Bonny Gate Fm. (similar to Newport Limestone)
- Lime mudstone to wackestone to packstone
- Interpreted as bank top sedimentation (west of Montpellier-New Market Trough)

Bluefields Mountain

WHITE LIMESTONE GROUP

Graded Bedding

Case-hardened regolith, colluvium, or debris flow deposit?

FLANK MARGIN CAVE

- Not White Ls. Gp.
- Lithified not alluvium
- Clast-supported breccia
- White Limestone Group clasts
- Crude lobe-like, poorly defined beds

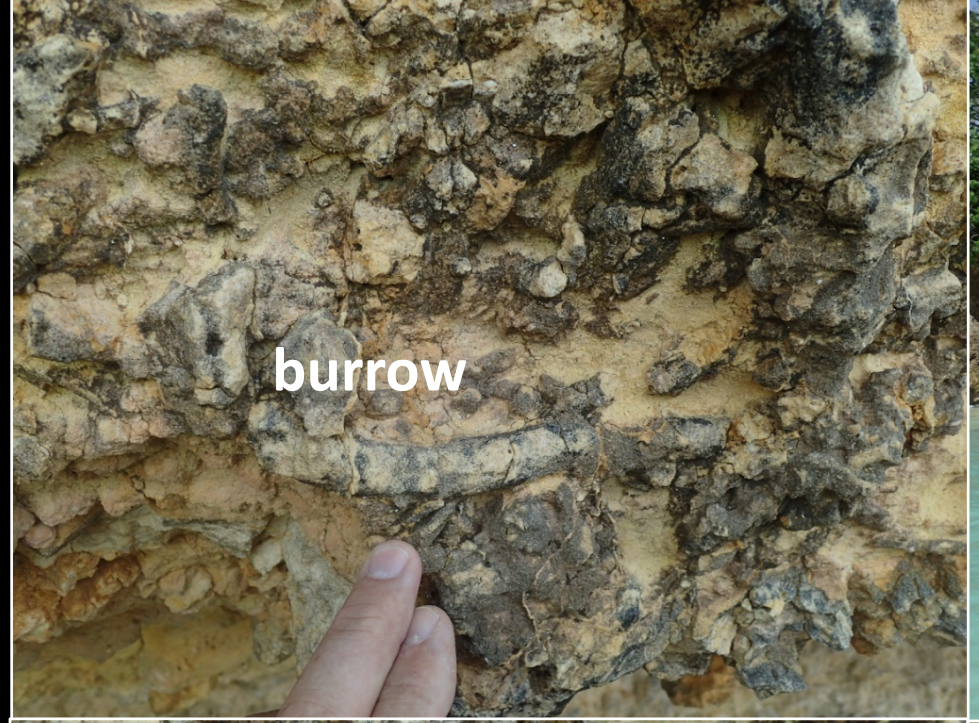
Belmont

FLANK MARGIN CAVE

- Holocene wave-cut notches
- Anthropocene unconformity above cave

COASTAL GROUP

- Breccia with friable, silty, fine sand, carbonate matrix and lime-stone clasts
- Trace fossils
- Marine fossils
- More small caves
- Minor calcite-filled linear fractures
- Upper Miocene to Pleistocene



COASTAL GROUP

Interpretation:
Marine-influenced debris flow

Alternative hypotheses:
Tsunami or storm deposit? No obvious cross-bedding or current indicators

COASTAL GROUP

QUATERNARY ALLUVIUM

- Mangrove swamp and beach
- Mixed siliciclastic and carbonate sand

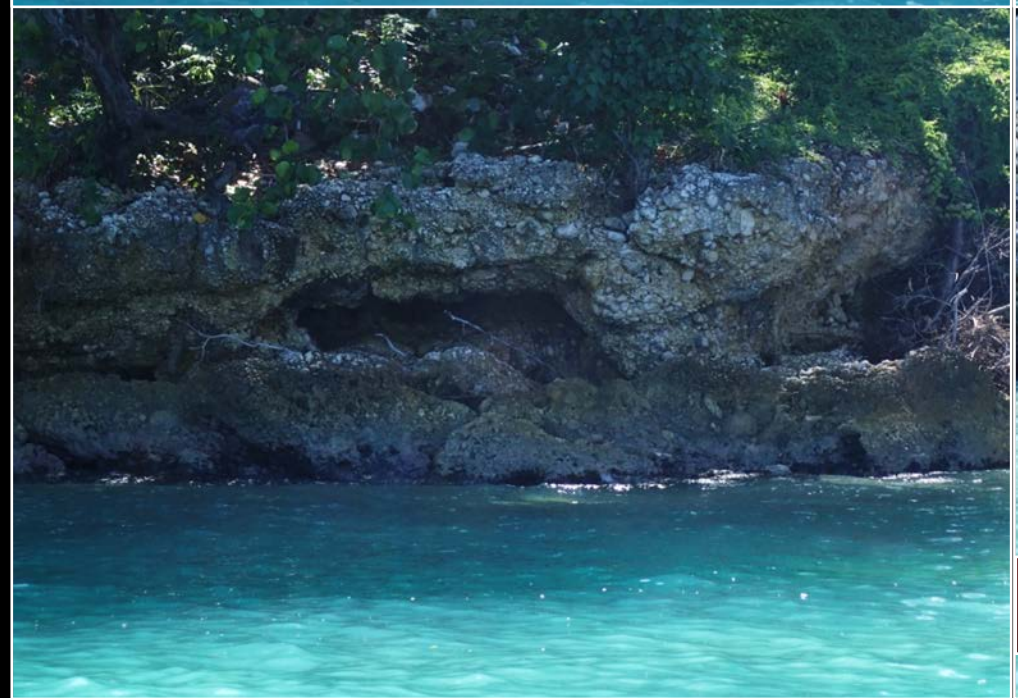
Bluefields Bay Fish Sanctuary

QUATERNARY ALLUVIUM

- Soil development
- Gravel lags and pockets
- Rounded imbricated clasts
- Coated grains, comparable to Late Holocene coated clasts in Bluefields River

Bluefields

CONGLOMERATES AND BRECCIAS — BLUEFIELDS BEACH TO CAVE

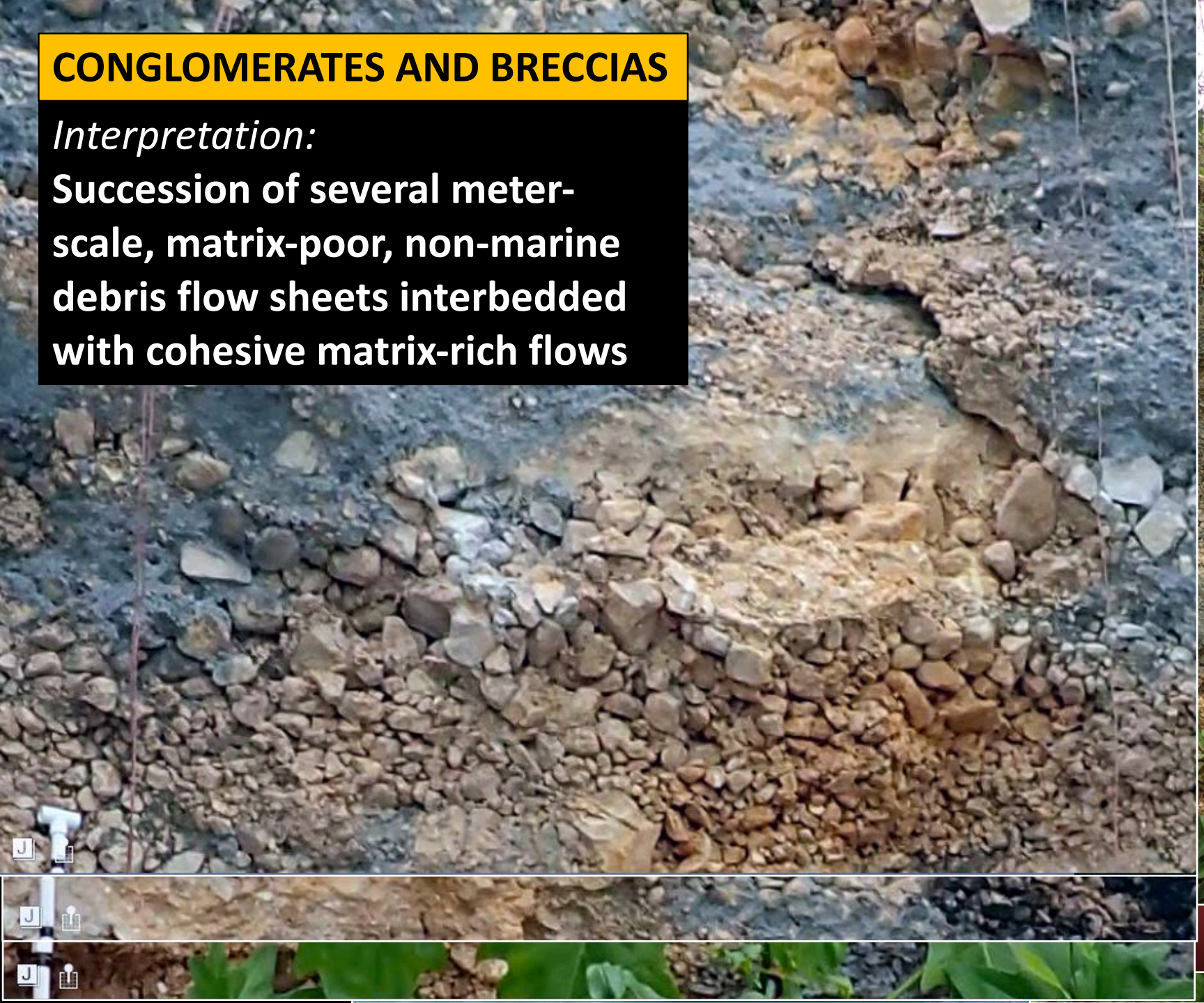


Bluefields Bay Villas

CONGLOMERATES AND BRECCIAS

Interpretation:

Succession of several meter-scale, matrix-poor, non-marine debris flow sheets interbedded with cohesive matrix-rich flows

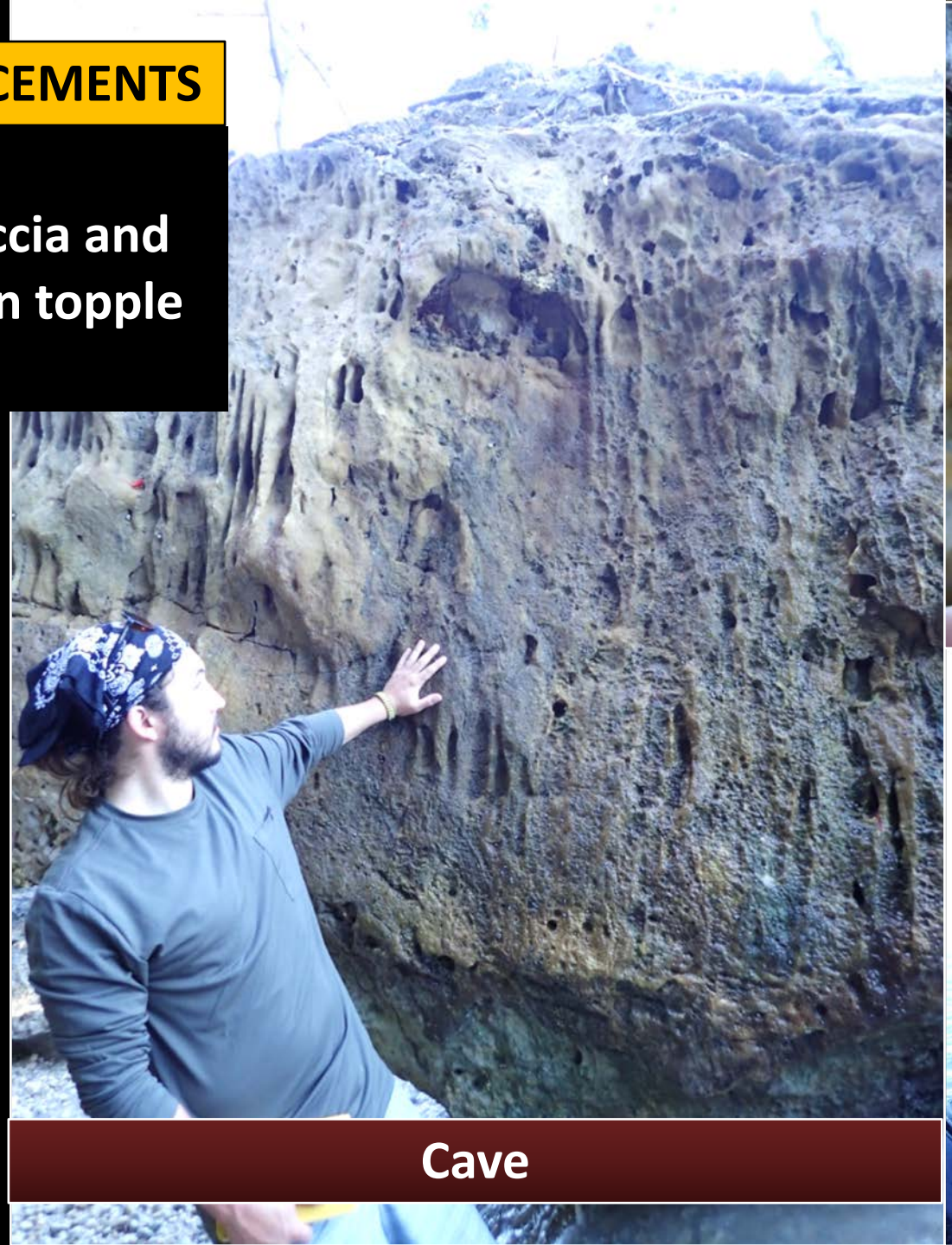


Mearnsville

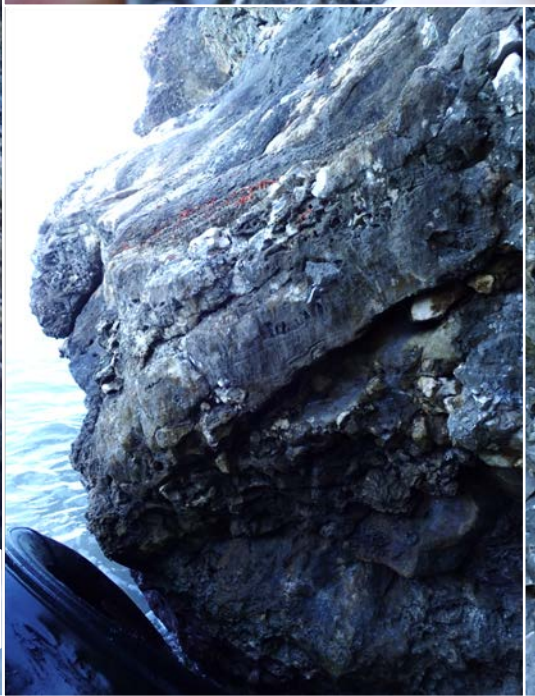
BRECCIA AND CEMENTS

Interpretation:

Paleokarst breccia and speleothems on topple block



Cave



MODERN DEBRIS FLOW ANALOG

- William Patrick Dryer (2010)
- June 12, 1979 — 32 cm rain in 10 hours in Bluefields area
- Sinkholes and impoundment in upland area overflowed
- Up to 9 m downcutting of Goat Gulley and Bluefields River and 150 m debris flow in Bluefields Bay

RHETORICAL QUESTION

Where are the 7-m-thick MIS 5e reef successions present in St. Elizabeth Parish?

Fort Charles Bay to Treasure Beach

CONCLUSIONS

- Coastal Group present at Bluefields Bay as a series of marine and non-marine debris flows
- Landslide hazards persist in mountainous, tropical, seismically active Jamaica

QUESTIONS?

THANKS

- Wolde Kristos and staff of Reliable Adventures Jamaica (RAJ Tours)
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