



# Jamaican Seismology with reference to other islands in the Greater Antilles

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- Historical earthquakes
- Tectonic setting
- Recent significant earthquakes
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# The Earthquake Unit

- operate the Jamaica Seismograph Network (JSN) [12 stations, 8 accelerographs]
- maintain a database of all earthquakes recorded by the JSN
- inform the public about recent earthquakes
- collect information about effects of earthquakes felt in Jamaica
- conduct research on the seismicity, seismic hazard, site response and vibration analyses & related fields
- Exchange data with international and regional networks
- Jamaica's National Data Centre of the Comprehensive (Nuclear) Test-Ban Treaty Organization's (CTBTO) International Data Centre
- Welcome visits from school & community groups





# Global frequency of occurrence of earthquakes

Magnitude	Occurrence on average per year	Descriptor
$\geq 8$	1	Great
7-7.9	17	Major
6-6.9	134	Strong
5-5.9	1,319	Moderate
4-4.9	Est. 13,000	Light
3-3.9	Est. 130,000	Minor
2-2.9	Est. 1,300,000	Very minor





# Historical Earthquakes

## Eastern Jamaica

- 1692 (X)
- 1771 (VII)
- 1812 (VIII)
- 1907 (IX)
- 1914 (VII)
- 1993 (VII)

## Western Jamaica

- 1839 (VII)
- 1943 (VII)
- 1957 (VIII)



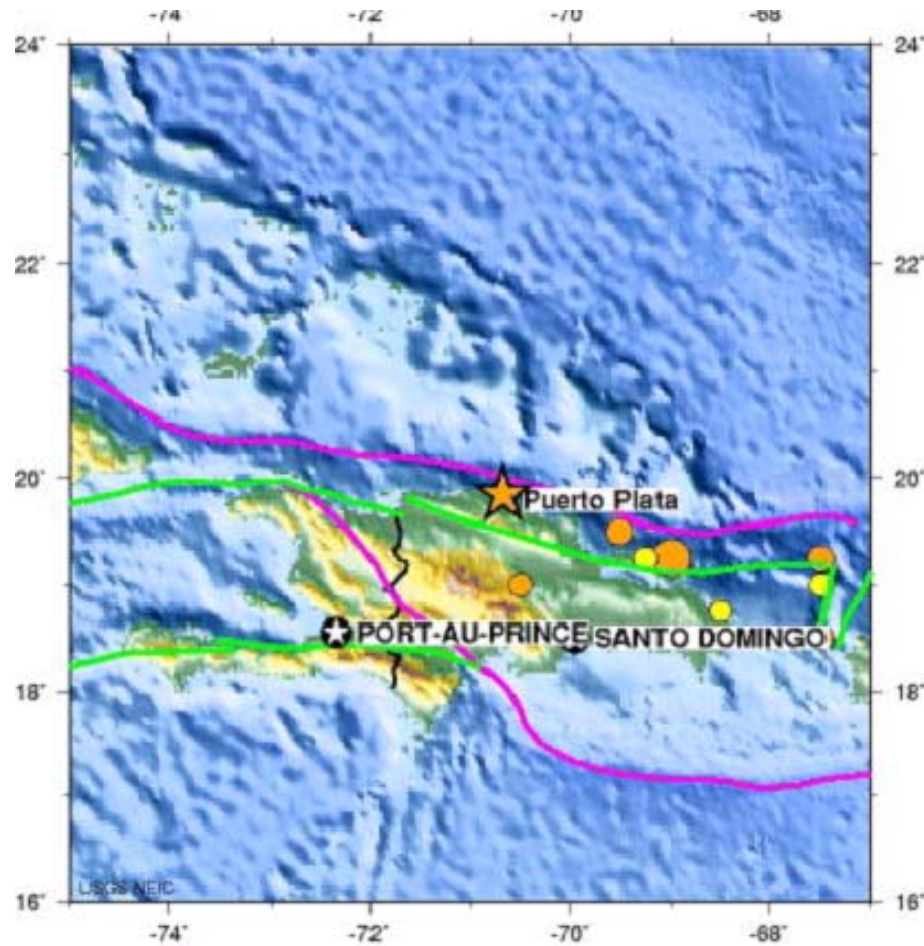


# 1692 Port Royal, Jamaica





# 1946 DR earthquake



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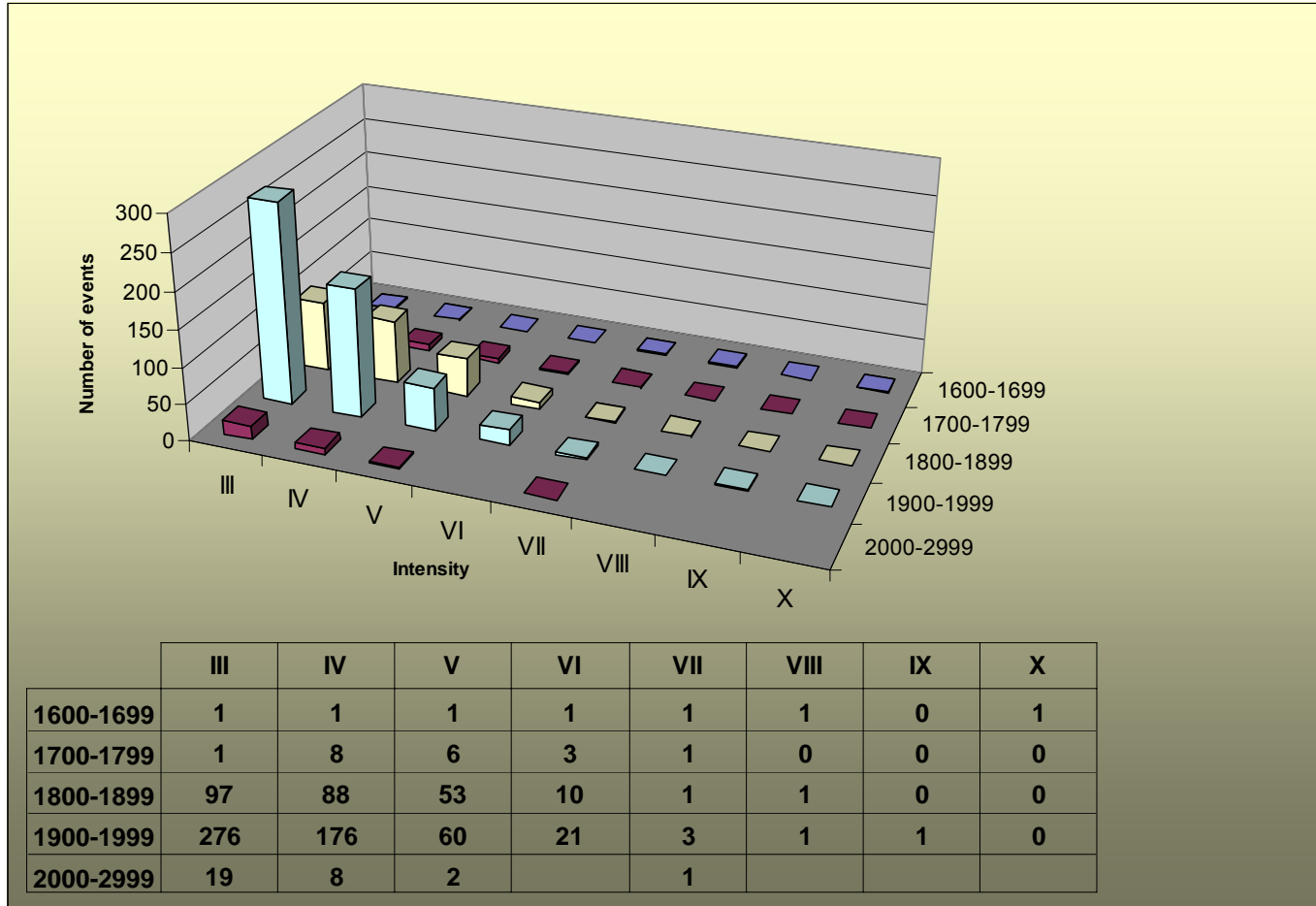
# Average Frequency of earthquakes

Magnitude	Return Period (Years)
4.0	1.1
5.0	8.7
5.4	20.0
6.0	70.0
7.0	611.0





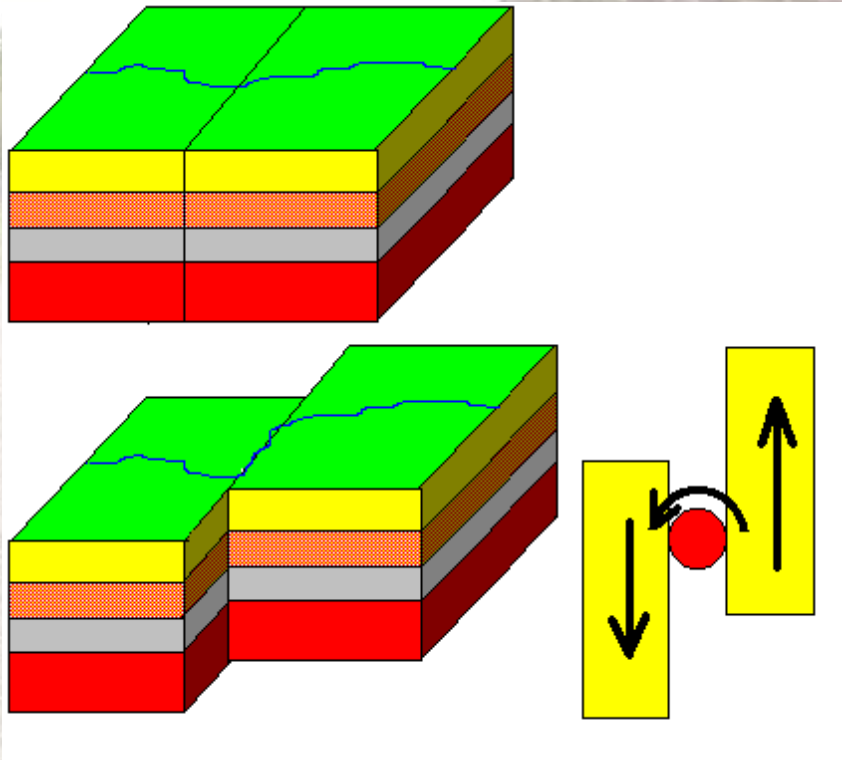
# Jamaican earthquakes per century



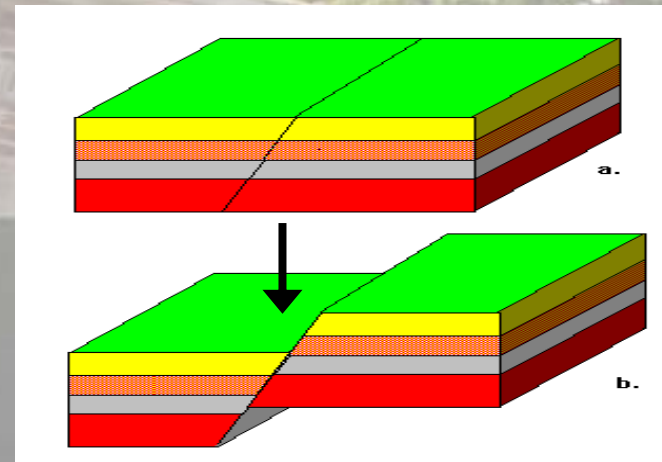


# Fault types

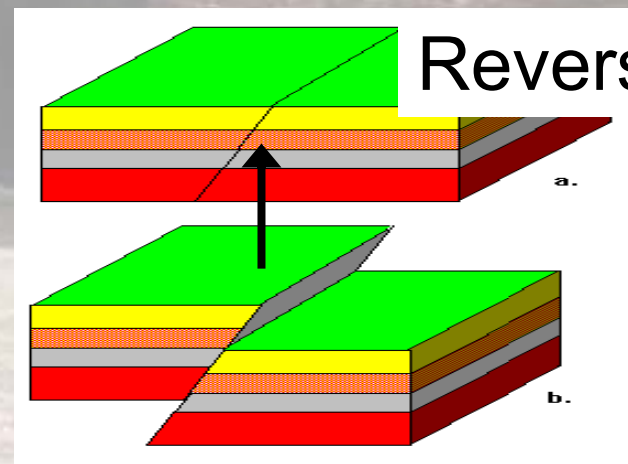
## Strike-slip



## Normal



## Reverse





# Tectonic setting

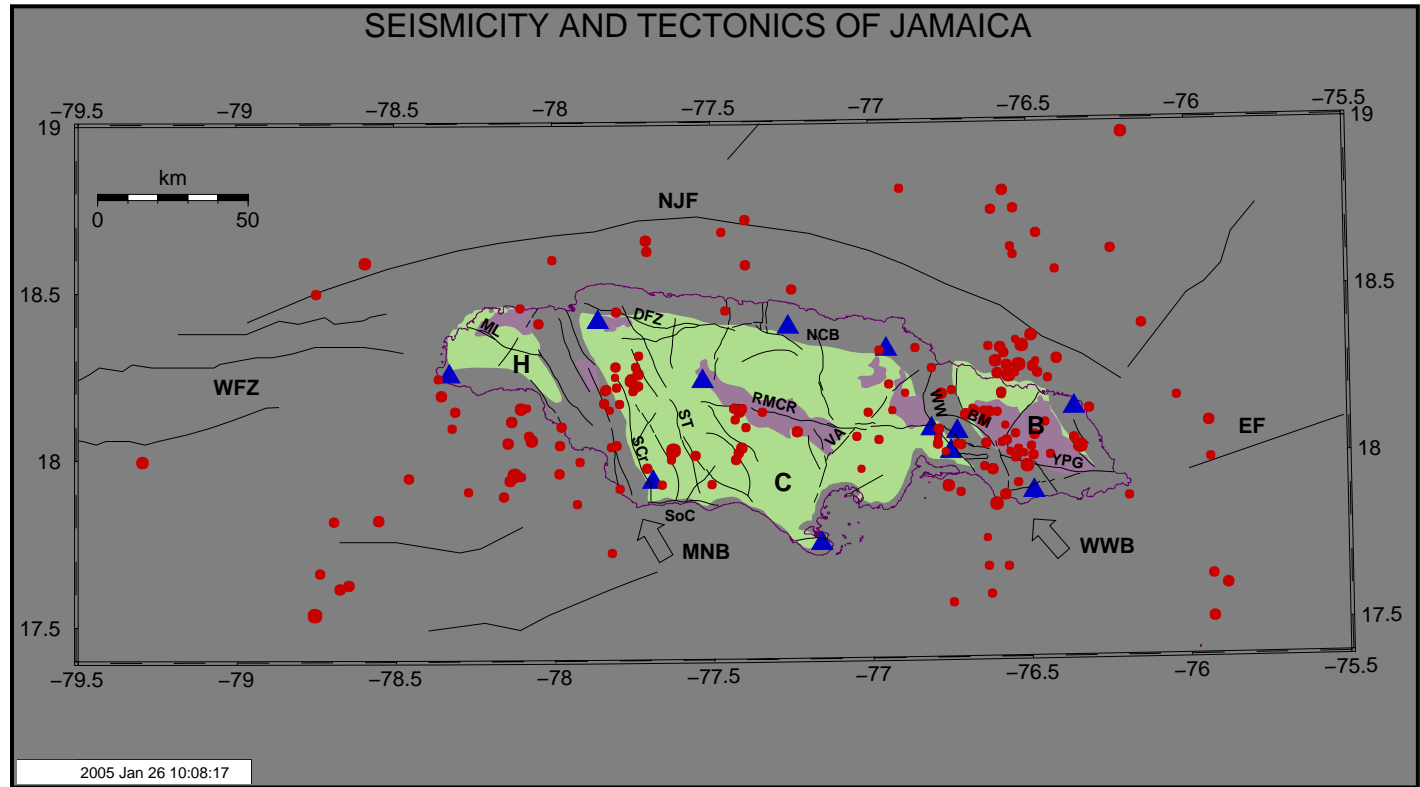
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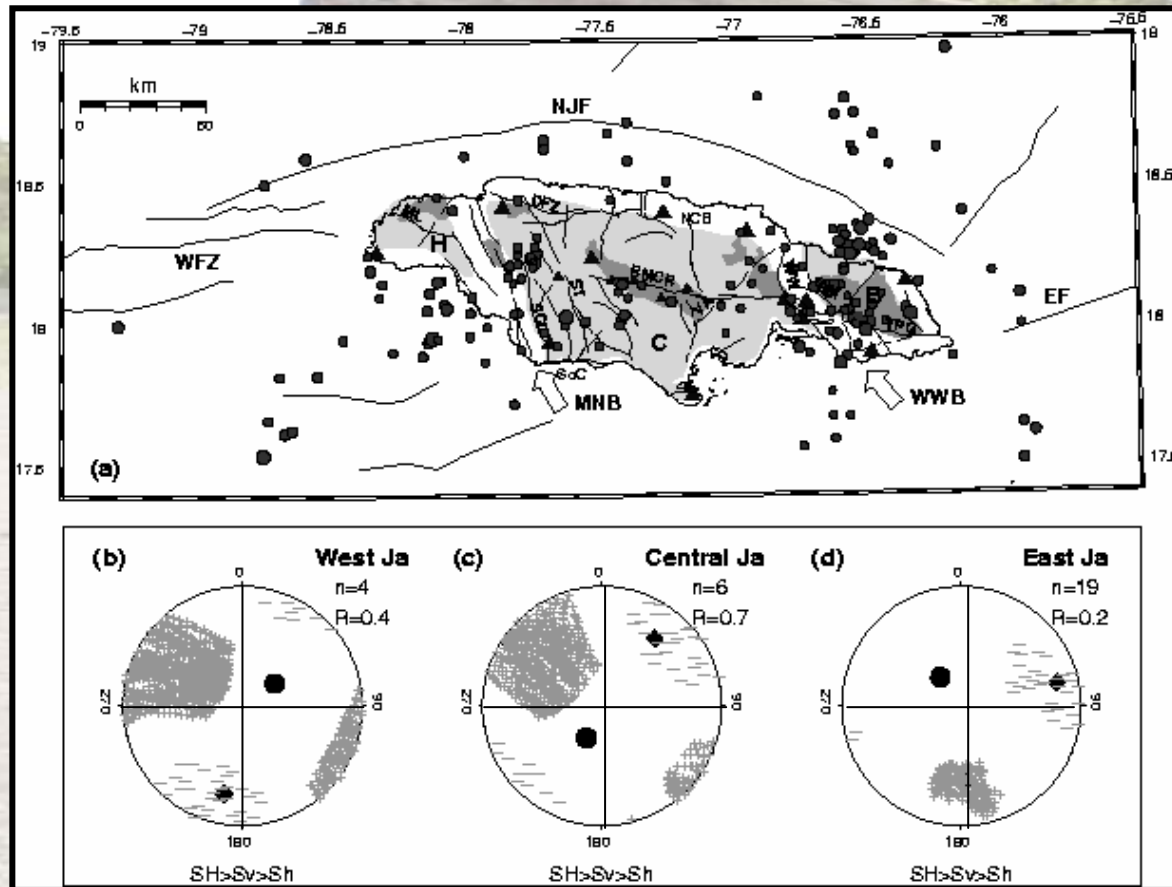


# Jamaican seismicity





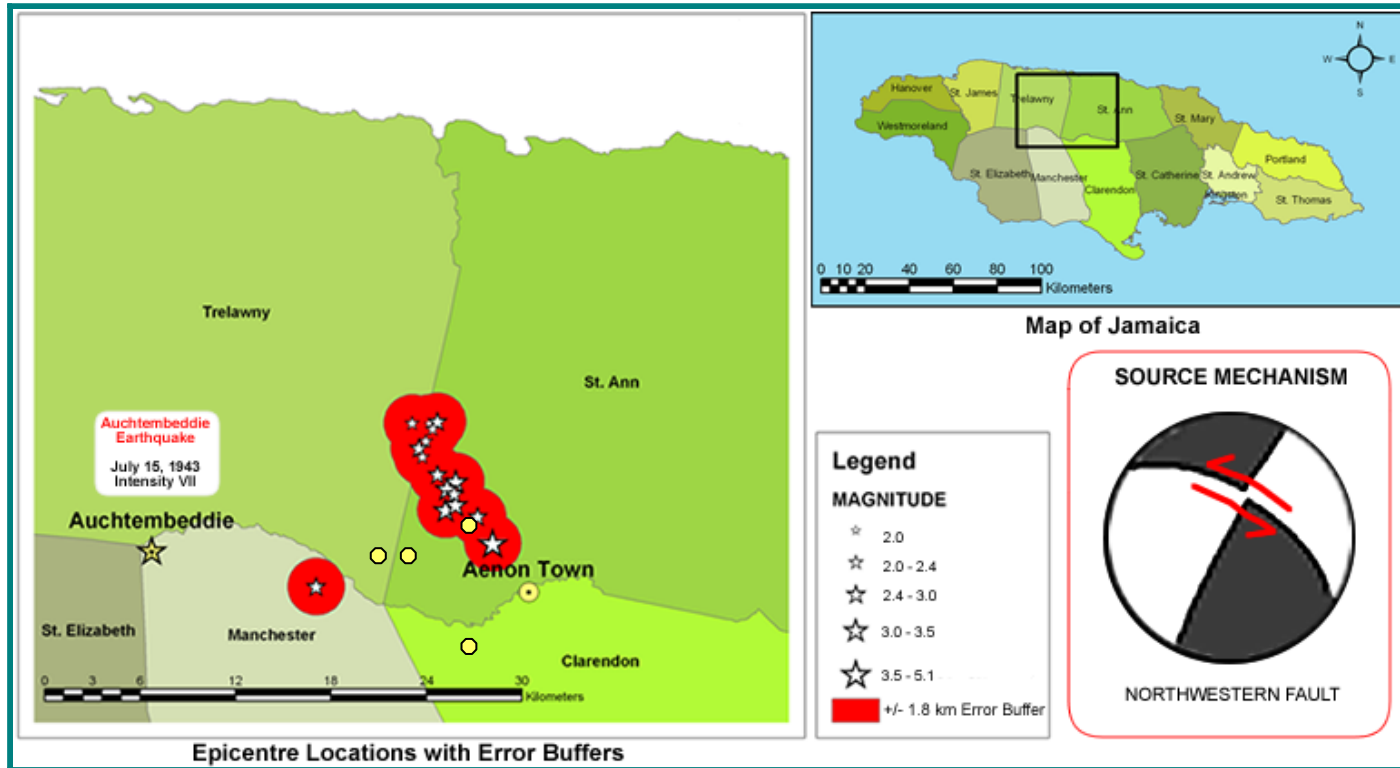
# Stress orientations in the Jamaican crust





# Aenon Town, Central Jamaica

## June 12, 2005, M 5.1





# June 12 Damage - Toppled Cockpit summit - Frazier, SW St. Ann



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# House Damage – June 12 - Lemon Walk, Trelawny ; Top Alston, Clarendon ; Grant's Bailey, St. Ann



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# Cayman EQ, Dec 14, 2004, M 6.8



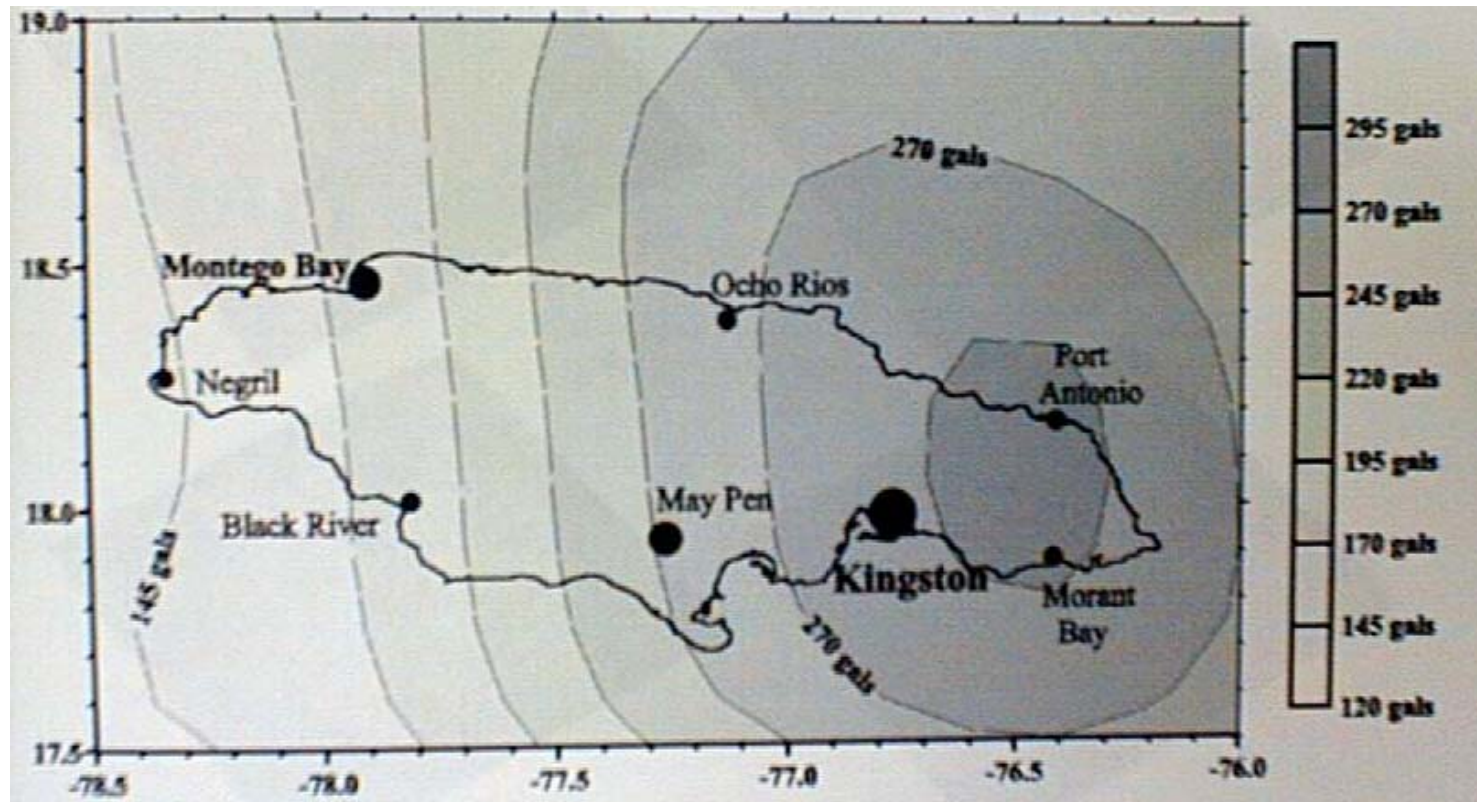
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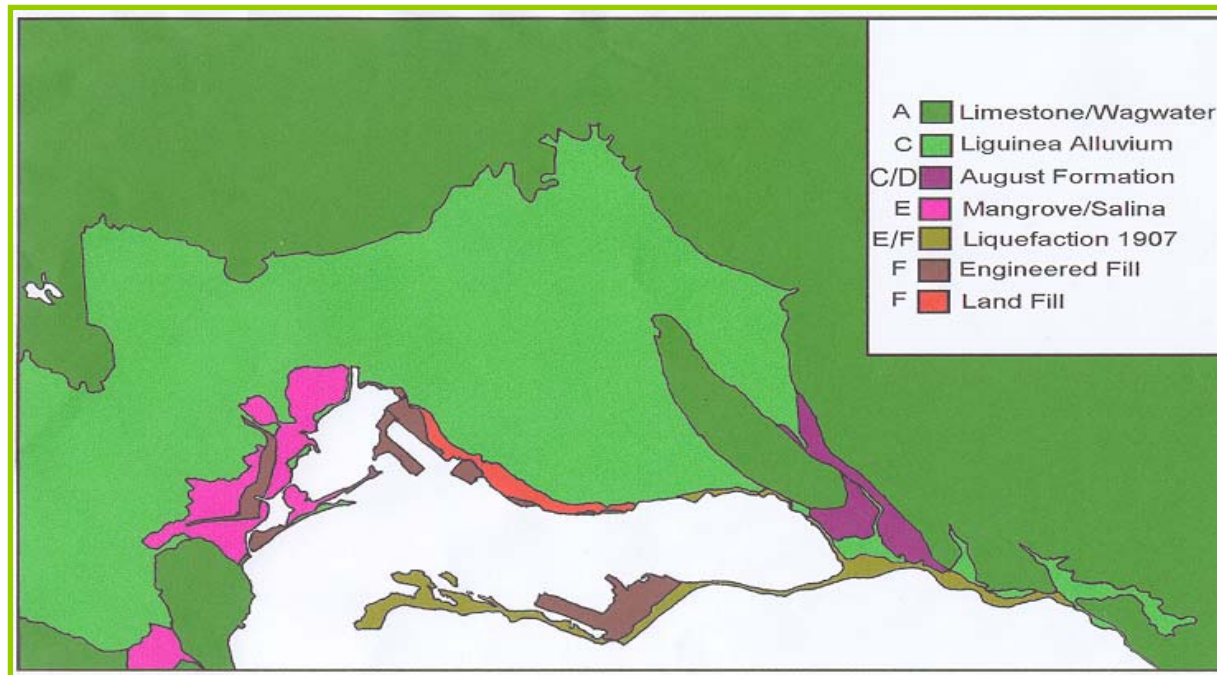


# PGA – PAIGH (Shepherd et al., 1999)





# Site classes - Kingston



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# Alluvial Plain dynamics

Amplification is variable across the plain depending on the location of the source and the position within the plain

Large amplifications over wide range of frequencies expected at the margins of the plain from nearby earthquake sources

Shift to lower frequency response as basin deepens to the south.





# Amplitude attenuation observed in coda waves

Near-surface attenuation

$$A(f, t) = t^{-\beta} A_0 e^{-\pi f \kappa} e^{-\frac{\pi f t}{Q(f)}}$$

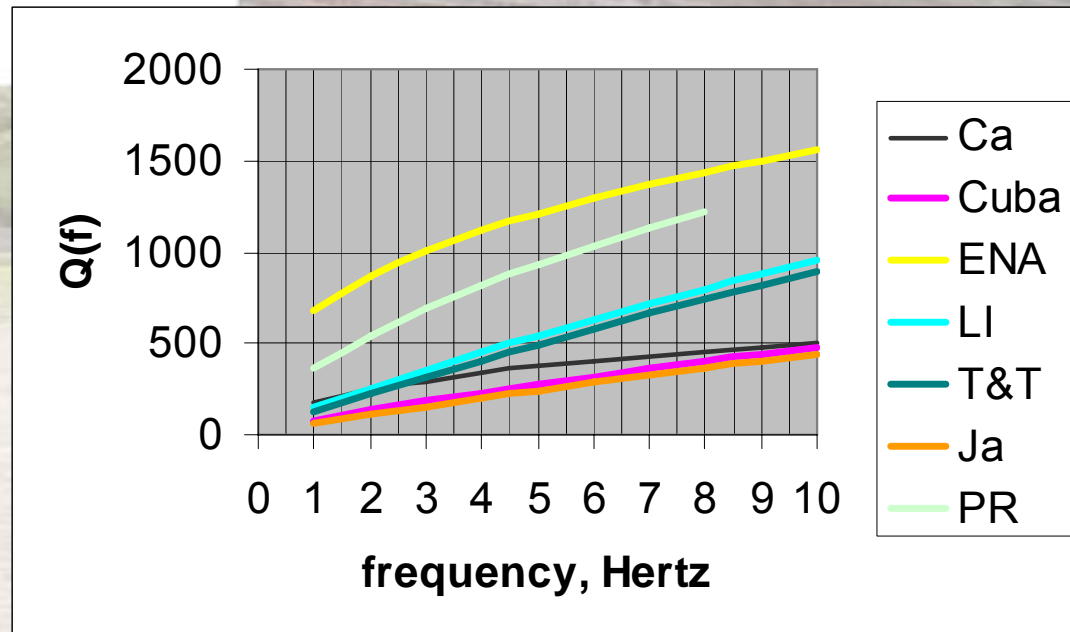
Geometrical spreading

Whole-path intrinsic attenuation



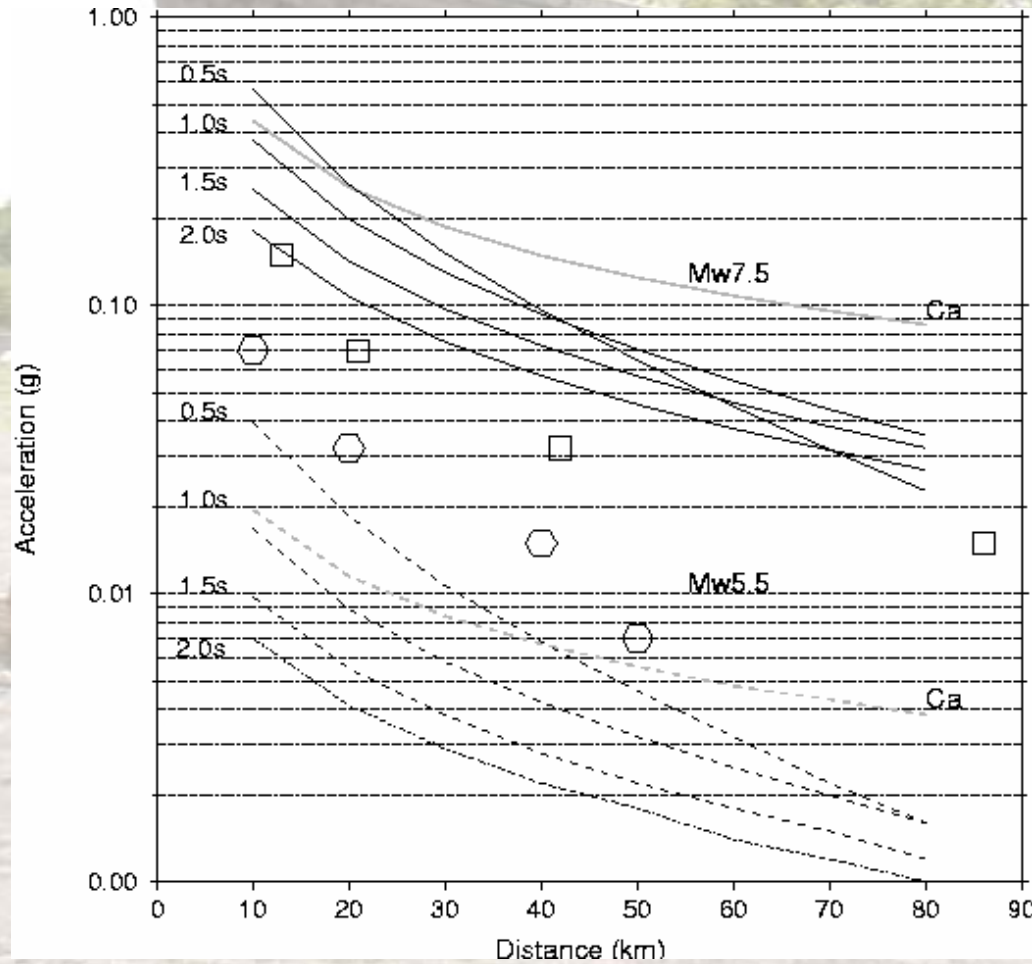


# Q(f) for Jamaica compared with other places





# Attenuation – Ca vs Ja





# Summary

- The northern Caribbean plate boundary deforms by left-lateral strike-slip
- The slip rates are relatively slow 18-20 mm/yr implying long return periods of potentially devastating earthquakes
- Microplates are forming in response to blocking of the westward drift of the Caribbean plate in the north-eastern corner by the Bahamas Platform
- Constructing local spectral attenuation relation is a necessary prelude to constructing proper spectral hazard maps.





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# **TSUNAMIS IN JAMAICA** (*Lander et al., 2002*)

## **1 in 160 years**

1688	Mar-01	Earthquakes felt	a ship at sea damaged by hurricane	not hurricane season; No report of tsunami reaching the shore
1692	Jun-07	<b>Earthquake MMI X estimated magnitude 7.5</b>	<b>Port Royal sank - 2000 killed</b>	<b>in the harbour sea withdrew 274m, 1.8m wave, sea withdrew 1.6 km at Yallahs?</b>
1812	Nov-11	Earthquake	Sea agitated, sea floor subsided at Annotto Bay causing a ship to loose it anchor	no report of tsunami reaching the shore
1852	Jul-17	no earthquake reported	ship 113 km from Jamaica affected by turbulent sea simultaneous with agitation in harbour at Santiago de Cuba	no report of tsunami reaching the shore
1907	Jan-14	<b>Earthquake MMI IX estimated M 6.5</b>	<b>Kingston earthquake - 1000 killed,</b>	<b>seiches of 2.5m in Kingston harbour, waves up to 2.5 m affected the north coast from Buff Bay to St. Anns Bay, sea receded up to 93 m at Annotto Bay, 69m at Ocho Rios</b>

# ***Tsunamis in Hispaniola (Lander et al., 2002); 1 in 25 years***

<b>1751</b>	Sep-Nov?	Earthquake Ms 8.0	destroyed Port au Prince and caused subsidence off the coast	no tsunami reported
<b>1770</b>	Jun-03	Earthquake Ms 8.0	200 fatalities at Port-au-Prince	waves noted at the Gulf of Gonave and Arcahaie, 7.2 km inland inundated
<b>1775</b>	Feb/Mar	Earthquake Ms 8.0	Leveled storehouses	much damage by waves also in Cuba
<b>1842</b>	May-07	Earthquake Ms 8.0	4,000 - 5,000 killed	destructive tsunami on the north coast, sea receded 60 m, waves 5m killed 300 of 3,000, at St. John wave height 3.1m, at Santo Domingo 2m
<b>1860</b>	Mar-08	Earthquake Ms 8.0	felt at Port-au-Prince and Anse-a-Veau	waves noted at the Gulf of Gonave and other places
<b>1887</b>	Sep-23	Earthquake Ms 8.0	felt at Port-de-Paix, Inagua & Jamaica	at Jeremie, sea withdrew 20m and returned with a rush
<b>1916</b>	Aug	no earthquake		powerful waves in Santo Domingo harbour wrecked an 18,000-lb. ship, waves >15 m high
<b>1918</b>	Oct-11	Earthquake M7.5 in Mona Passage	sub-marine cables cut	at Santa Domingo water in Rio Ozama fall and rose 70 cm every 40 minutes - 140 killed in tsunami
<b>1946</b>	Aug-04	Earthquake M 8.1	devastated the Dominican Republic and Haiti	Matancitas destroyed by 2.5m tsunami, at Julia Molina 4-5m, killed 100? waves at San Juan 36 mins later, damage on west coast PR, reached Bermuda 2hrs 7 mins later, also reached Daytona Beach and Atlantic City

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