Teacher Guide

Welcome to Teachable Moments! Our goal is to provide timely and accurate information to develop knowledge about a newsworthy earthquake for audiences from middle school through college. Please use the slides to get a concise, but thorough overview of the recent earthquake and then use them as is, or customize it for your students and curriculum.

New for the 2024-25 school year:

1. **Color-coding for grade levels.** 

middle school + 

high school + 

college

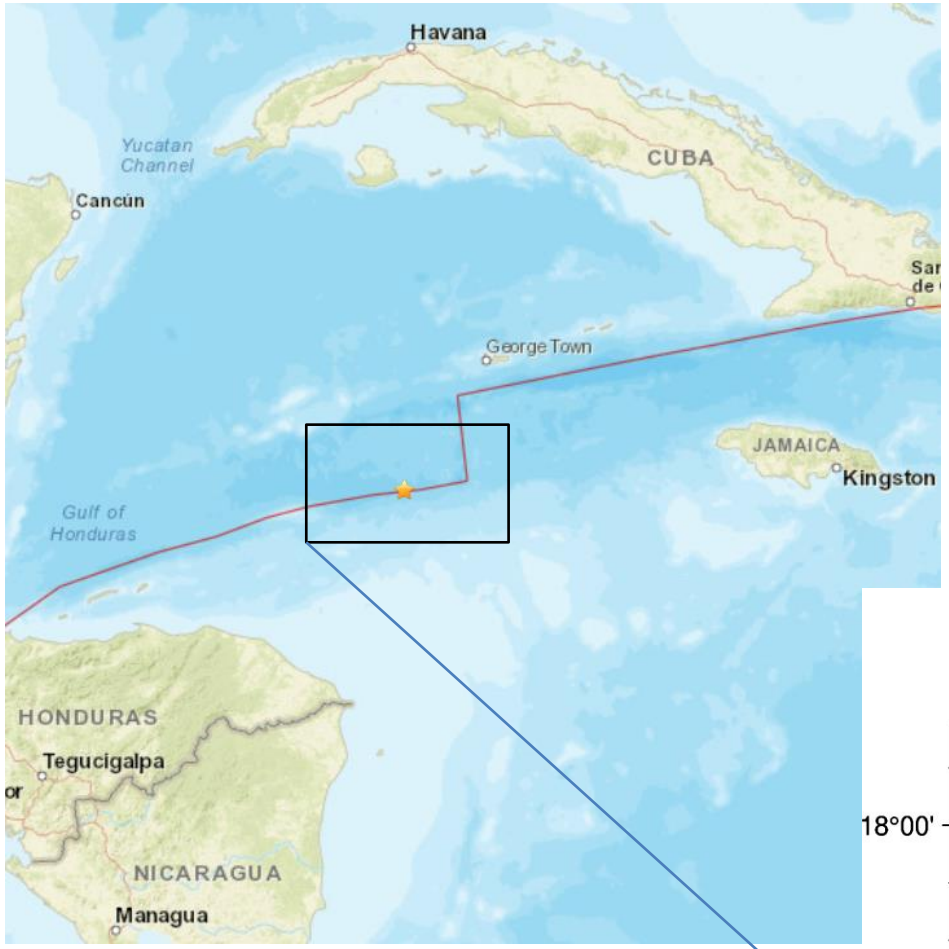
1. **Check out the new Slide Guide: Slides or pdf that will guide your students through the slide deck:** middle school pdf high school pdf college pdf
2. **New Geography slide(s): A quick hit about the city or area that gives you cross-curricular connections:** geography, physics, chemistry, biology, environmental science or even history.
3. **NGSS Connections linked to questions in the Slide Guide are located in the notes sections below each slide guide.**
4. **Fill in the blank sub-plans:** The first two pages can be completed and used all year (hint: sheet protector). The rest are for you to modify or fill-in to customize your sub-plans to fit what you're doing.

Magnitude 7.6 CAYMAN ISLANDS

Saturday, February 8, 2025 at 23:23:14 UTC

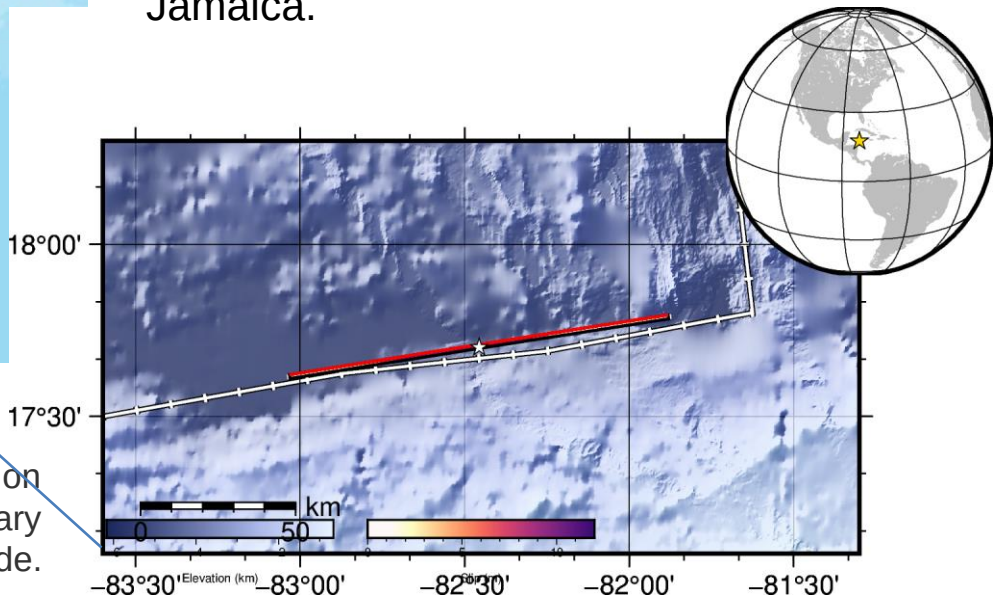
ALL

Latitude 17.702°N
Longitude 82.456°W
Depth 10 km



A magnitude 7.6 earthquake occurred in the Caribbean Saturday night, north of Honduras and southwest of the Cayman Islands, briefly triggered tsunami alerts that were later lifted. There are no reports of injuries or damage.

The earthquake occurred about 207 km (129 miles) southwest of George Town, the capital of the Cayman Islands, and 598 (372 miles) west of Kingston, Jamaica.



Surface projection of the slip distribution superimposed on GEBCO bathymetry. White line indicate plate boundary [Bird 2003]. Cross section of slip on the next slide.

ALL

Magnitude 7.6 CAYMAN ISLANDS

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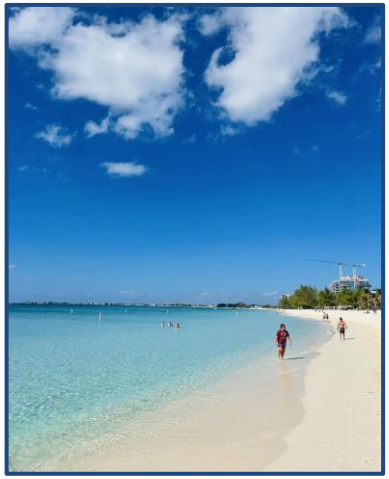
- British Territory consisting of 3 islands.
- Capital is George Town on Grand Cayman.



By User2369 - Own work, CC0, https://commons.wikimedia.org/w/index.php?curid=147213431

- Official language is English -Spanish heard too.
- Economy is mostly driven from financial services and tourism.
- Christopher Columbus (1503) named it “Las Tortugas”.
- Topography is mostly flat.
- Islands from peaks of Cayman Ridge.
- Located in Hurricane Alley - takes direct hits from hurricanes every 2.23 years.

Sgerbic, CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0>, via Wikimedia Commons

Magnitude 7.6 CAYMAN ISLANDS

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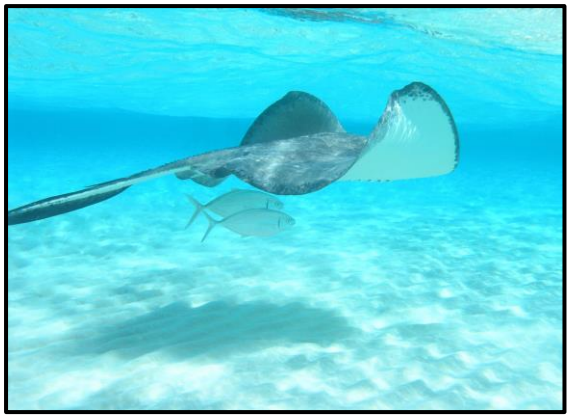
- Tropical climate = High Biodiversity.
- Islands = limestone base with coral reefs surrounding it.



By Jcparsaligan at English Wikipedia, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=101732680

- Blue Iguana (endangered), bats, agouti, butterflies, parrots, etc.
- Marine life: stingrays, tarpon-fish, French angel fish, turtles, goose-beaked whales, etc.
- Mastic Trail - hiking through forest.
- Diving and snorkeling - coral reefs and shipwrecks.
- Geologic Marvels: Hell (image on the right), Crystal Caves, Blowholes, and Devil's Grotto (large underwater cavern).

By Dylanpack - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=7132167

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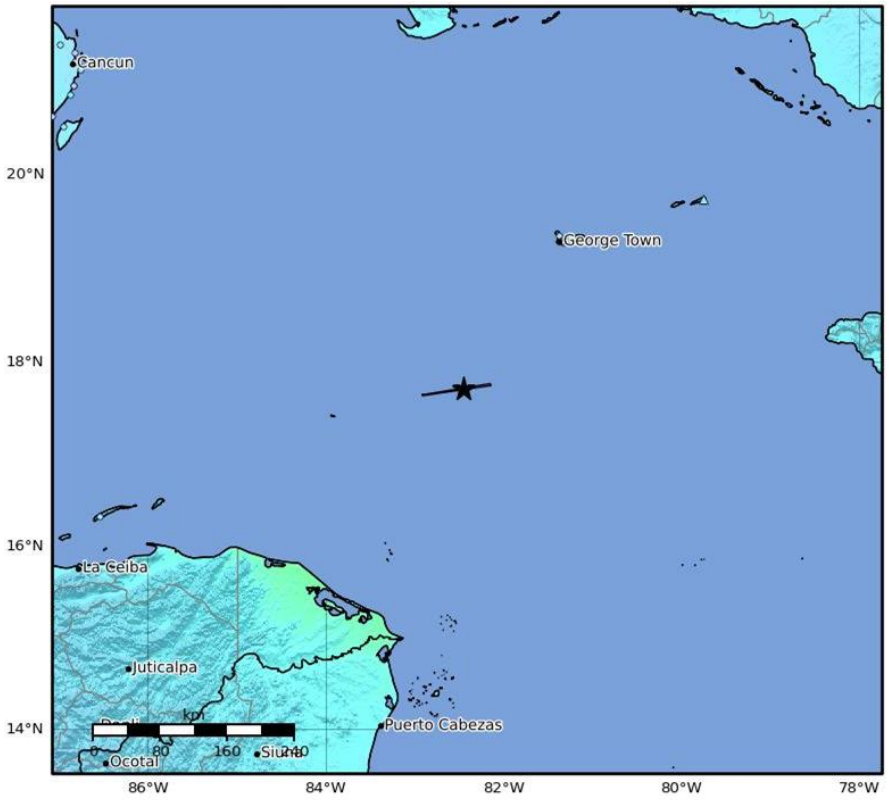
The Modified-Mercalli Intensity (MMI) scale is a ten-stage scale, from I to X, that indicates the severity of ground shaking.

Intensity is based on observed effects and is variable over the area affected by the earthquake and is dependent on earthquake size, depth, distance, and local conditions.

MMI	Perceived Shaking
X	**Extreme**
IX	**Violent**
VIII	**Severe**
VII	**Very Strong**
VI	**Strong**
V	Moderate
IV	Light
II-III	Weak
I	Not Felt



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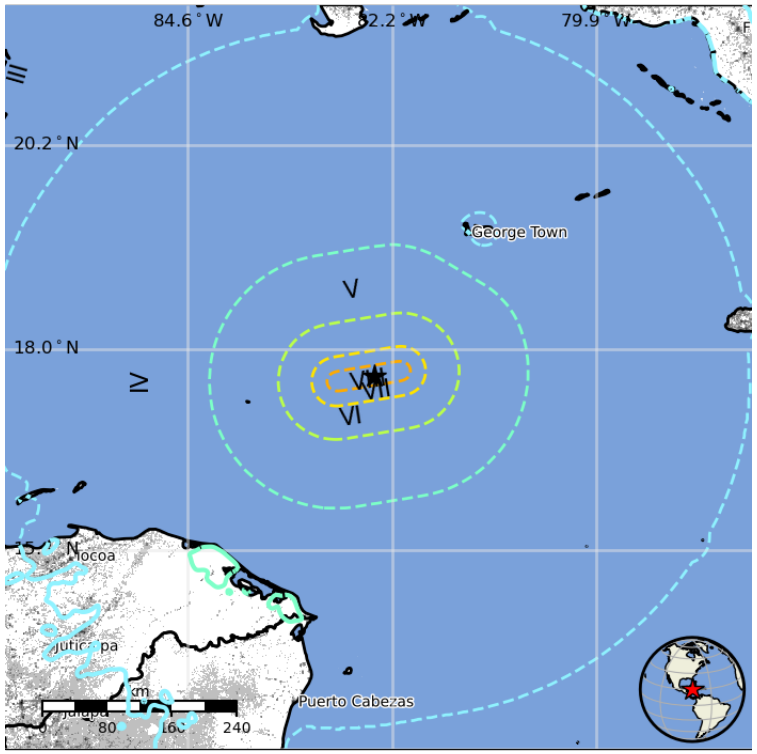
ALL

The USGS PAGER map shows the population exposed to different Modified Mercalli Intensity (MMI) levels. The USGS estimates that approximately 11,000 people felt moderate shaking from this earthquake.

MMI	Shaking	Population
I	Not Felt	0 k*
II-III	Weak	2,942 k*
IV	Light	2,722 k
V	Moderate	11 k
VI	Strong	0 k
VII	Very Strong	0 k
VIII	Severe	0 k
IX	Violent	0 k
X	Extreme	0 k



The color-coded contour lines outline regions of MMI intensity. The total population exposure to a given MMI value is obtained by summing the population between contour lines. The estimated population exposure to each MMI Intensity is shown in the table.

Image courtesy of the US Geological Survey

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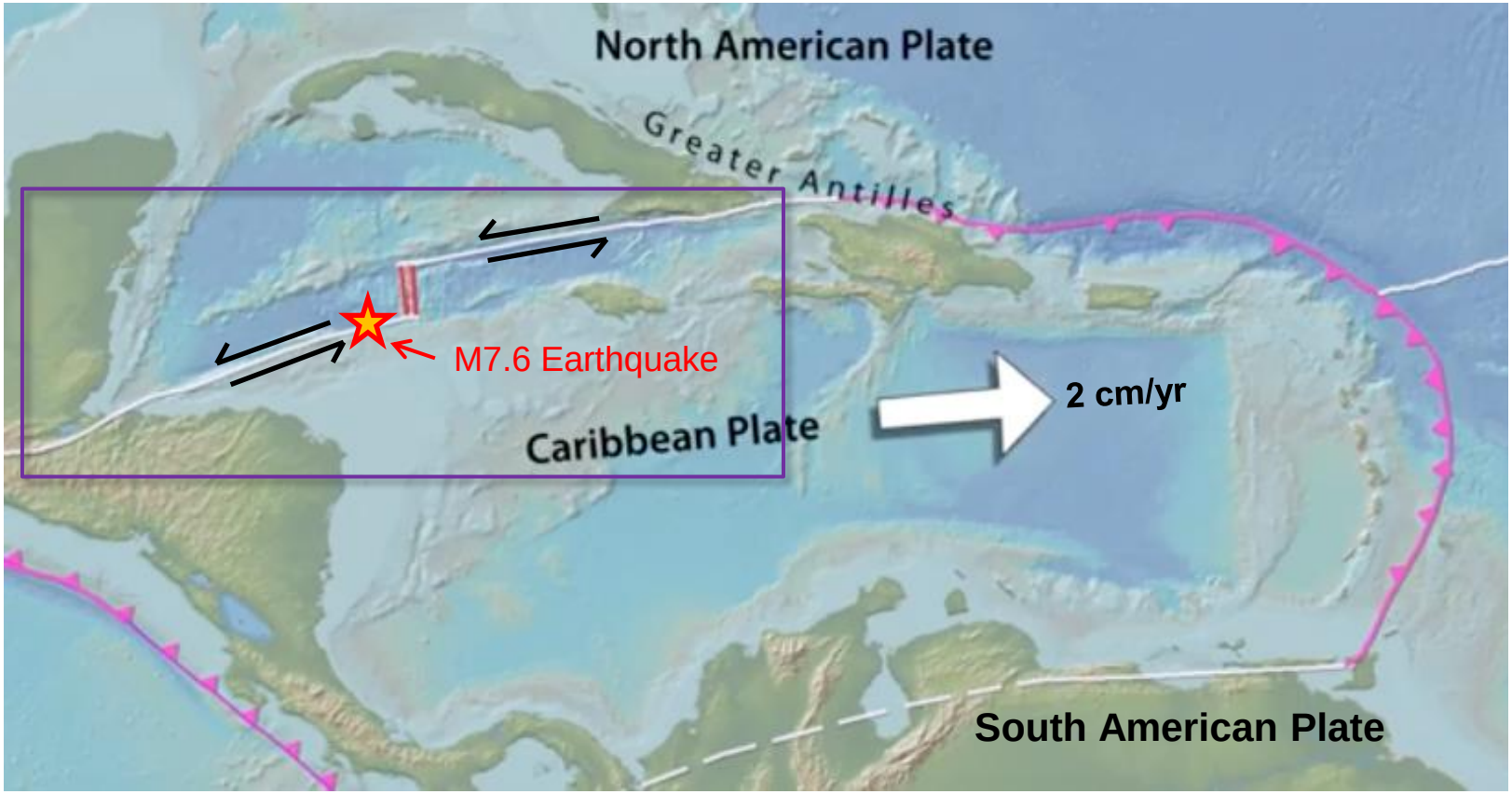
The Caribbean Plate moves east at about 2 cm/yr with respect to the North and South American plates. In the area of the M7.6 February 8, 2025 earthquake, the Caribbean – North American Plate boundary is a left-lateral transform fault. Tectonics of the area within the purple outline are described in the next slide.



Magnitude 7.6 CAYMAN ISLANDS

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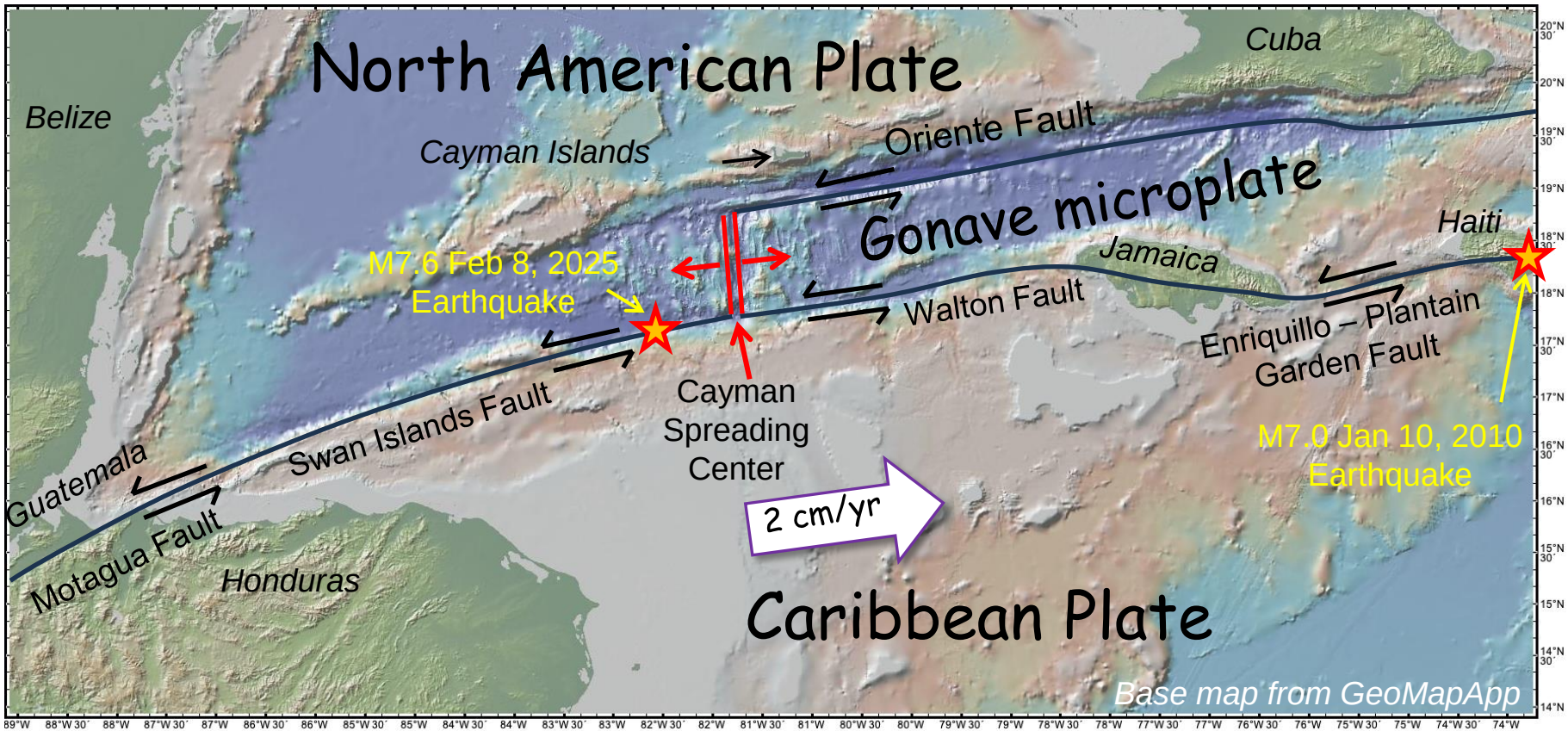
The **Swan Islands Fault** is a **left-lateral transform fault** between the **North American** and **Caribbean plates**, connecting the **Cayman Spreading Center** to the **Motagua Fault** in Guatemala. The **M7.6 earthquake on February 8, 2025**, occurred on this fault, based on its **epicenter location** and **strike-slip focal mechanism**. East of the **Cayman Spreading Center**, the movement of the **Caribbean Plate** is divided between the **Oriente Fault** on the north and the **Walton and Enriquillo–Plantain Garden Faults** on the south, along the **Gonave microplate**. This microplate moves **east-northeast at about 1 cm per year**, which is half the **Caribbean Plate's** overall motion of **2 cm per year**.

A similar fault system was responsible for the **M7.0 Haiti earthquake on January 10, 2010**, which occurred along the **Enriquillo–Plantain Garden Fault** and resulted in approximately **160,000 fatalities**.



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Swan Island Fault Zone Earthquakes > M4 between 2005-2025

From Interactive Earthquake Browser (www.iris.edu/ieb)

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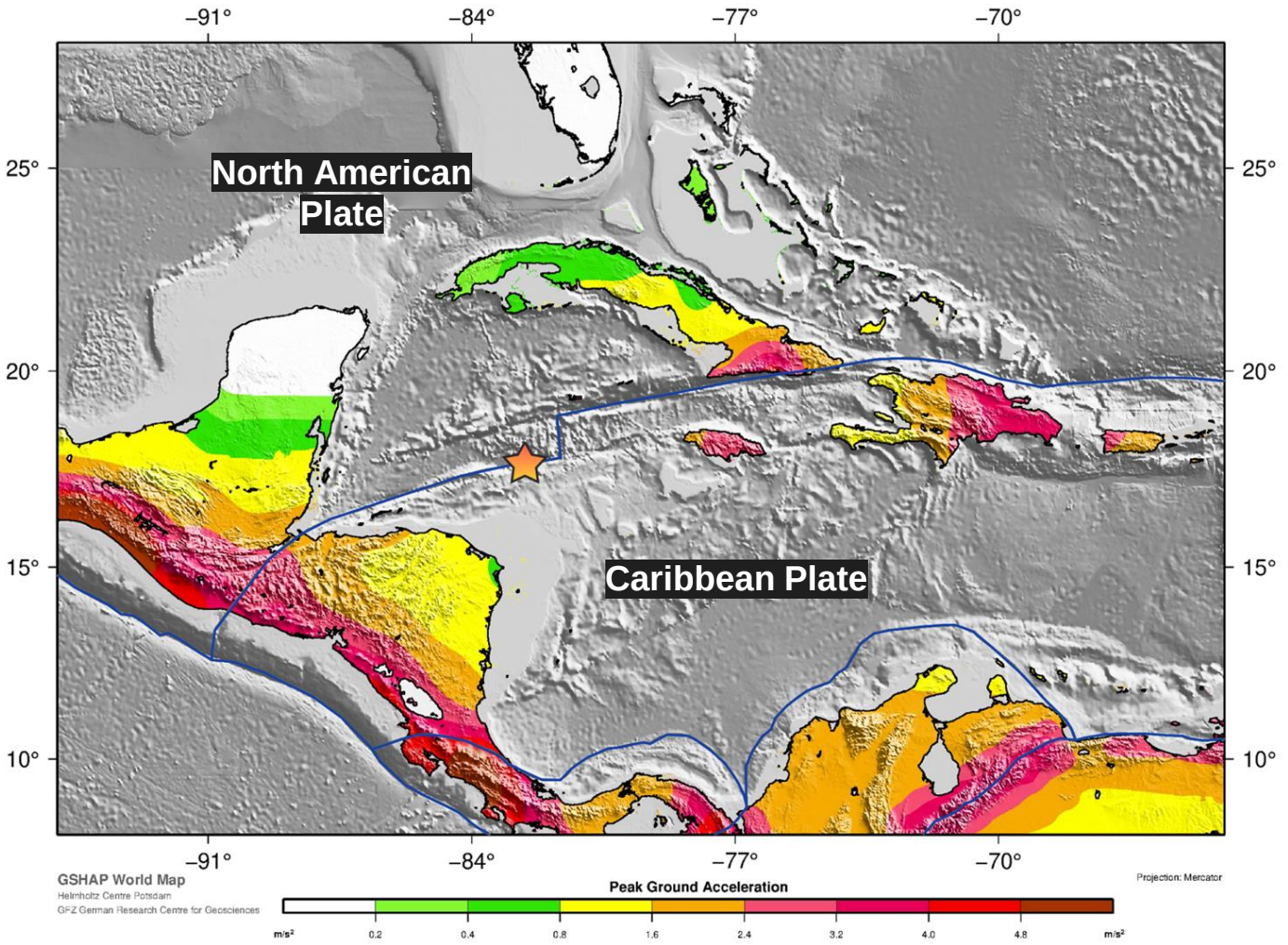
ALL

Seismic hazard in the western Caribbean is significant along the boundary between the North American and Caribbean plates, where shallow earthquakes are common. Additionally, the subduction zone off Central America's west coast creates another zone of high hazard. Fortunately, the February 8 earthquake struck a remote area, far from population centers.

Seismic Hazard Map of Western Caribbean



Low hazard **High hazard**

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ALL

A tsunami advisory was initially issued for Puerto Rico and the Virgin Islands, with a tsunami threat also issued for coastlines along the Caribbean Sea. These warnings were later canceled.

Tsunamis are typically triggered by vertical displacement of the seafloor during earthquakes. Although this earthquake was large and occurred beneath the seafloor, its horizontal motion did not generate such displacement. However, horizontal-motion earthquakes can still cause underwater landslides, which may lead to tsunamis.

Tsunami evacuation route sign, old San Juan, Puerto Rico
Image from NOAA

Video: [Why do some earthquakes produce tsunamis while others don't?]

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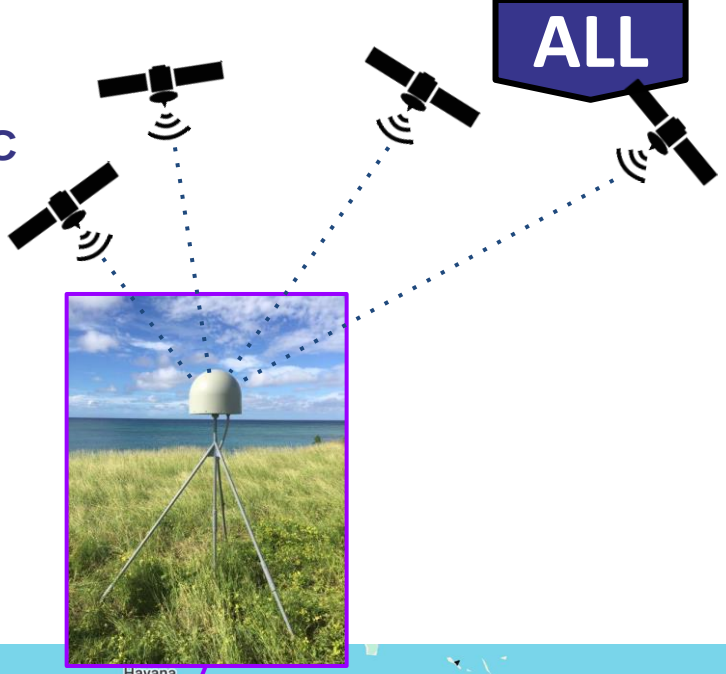
One of the ways we know the rates of plate motion is from GPS stations.

GPS stations receive signals from satellites and use the time offset between when the signal leaves the satellite and when it arrives at the station to determine distance. If a station receives signals from 4 or more stations, it is able to determine its location (6 or more satellites is much better).

This is the same way GPS works in phones and other devices but the high-precision stations can determine location within millimeters (<¼ inch) rather than 5-10 meters (15-30 feet).

Over time, changing locations allow scientists to determine station movement from plate tectonics, which are shown as vectors (arrows).



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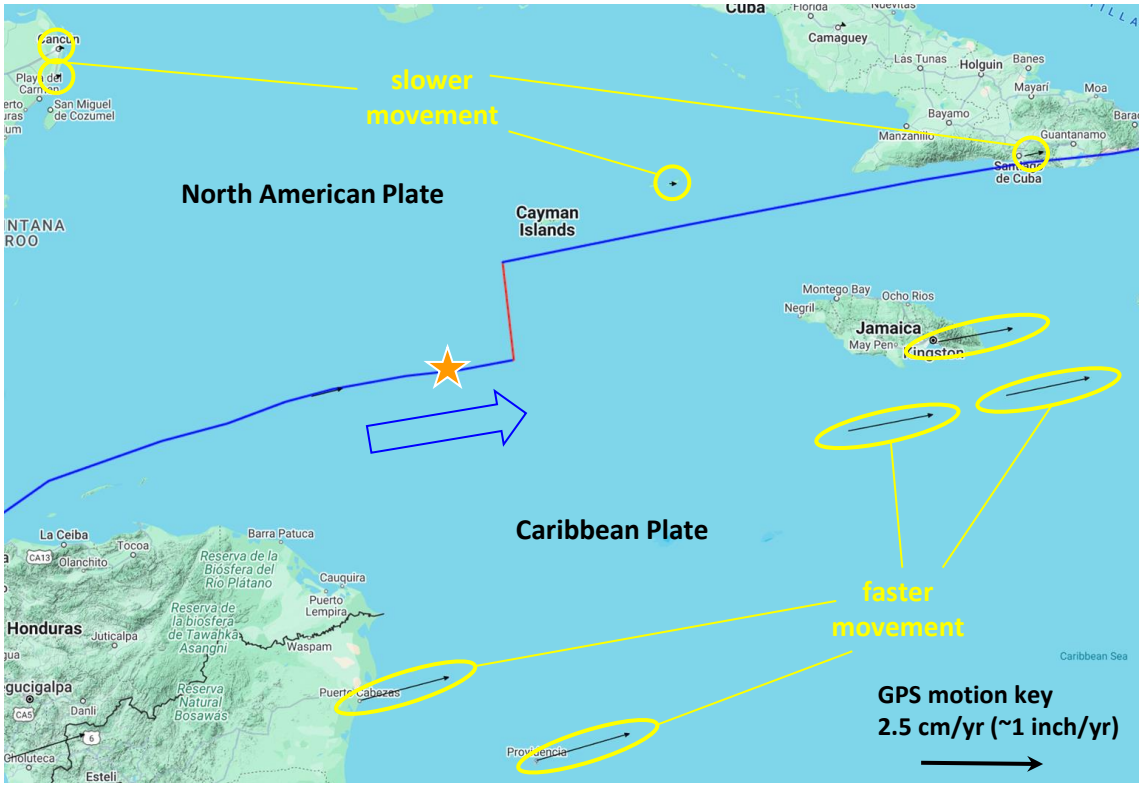
ALL

Caribbean countries have GPS stations that record the long-term motion from plate tectonics. Overall these show clear evidence of strike-slip movement across this region.

Compared to stable eastern North America, some stations are moving as much as 2 cm/yr (0.8 inch/yr) towards the east as the Caribbean Plate slides past the North American Plate.

But areas along the plate boundary (shown in blue) stick together for periods of time. Over decades and centuries the stress accumulates and is occasionally released in earthquakes such as the magnitude 7.6 quake on February 8, 2025.



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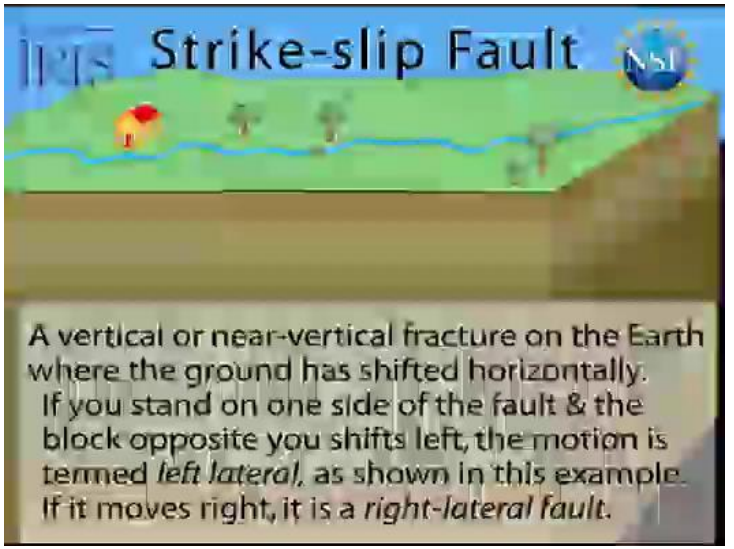
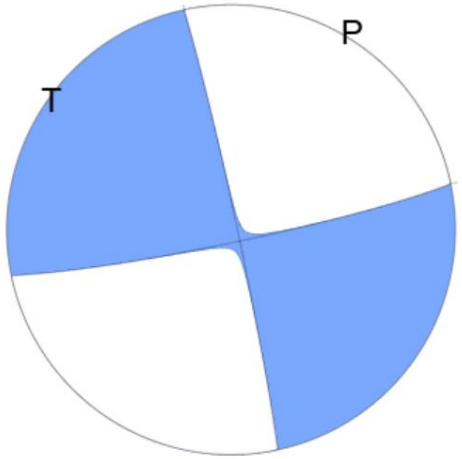
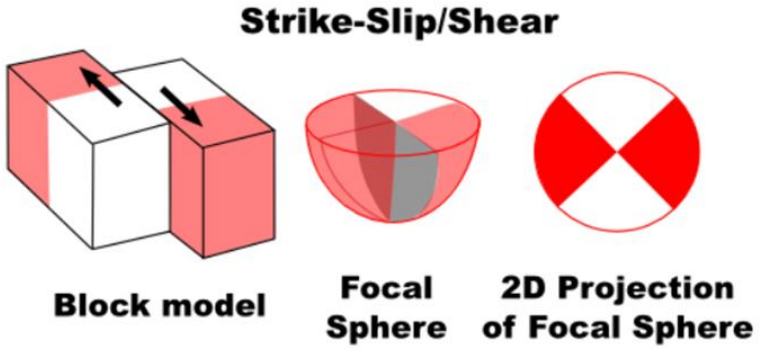
The focal mechanism is how seismologists plot the 3-D stress orientations of an earthquake. Because an earthquake occurs as slip on a fault, it generates primary (P) waves in quadrants where the first pulse is compressional (shaded) and quadrants where the first pulse is extensional (white). The orientation of these quadrants determined from recorded seismic waves determines the type of fault that produced the earthquake.





USGS W-phase Moment Tensor Solution

The tension axis (T) reflects the minimum compressive stress direction. The Pressure axis (P) reflects the maximum compressive stress direction.



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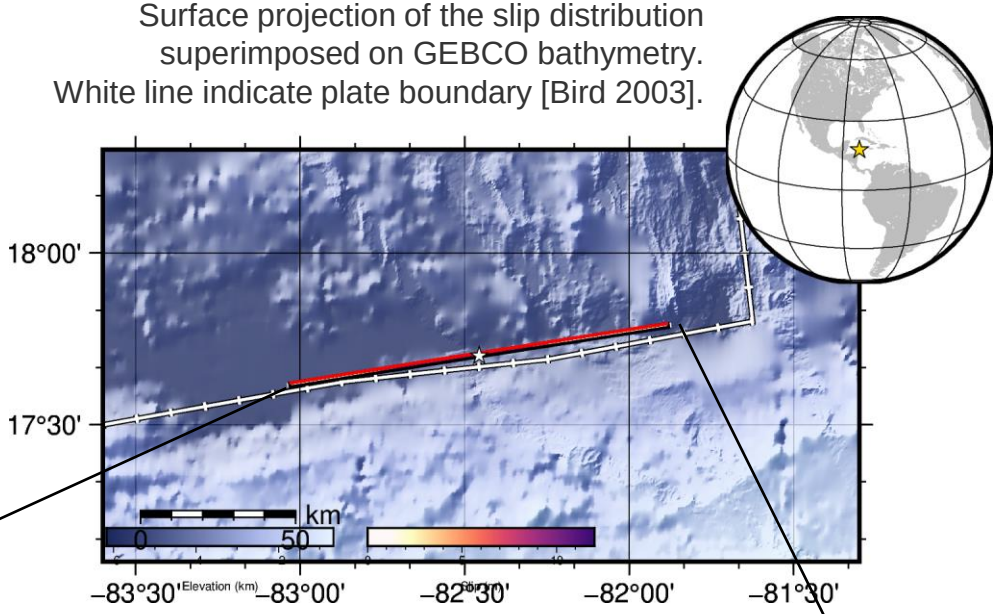
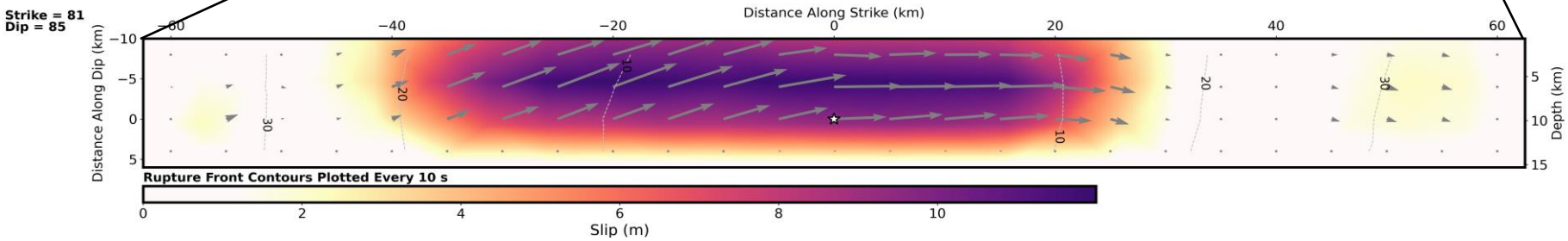
Below is the cross-section of slip distribution

- The strike direction is indicated above the fault plane and the hypocenter location is denoted by a star.
- Slip amplitude is shown in color and the motion direction of the hanging wall relative to the footwall (rake angle) is indicated with arrows.
- Contours show the rupture initiation time in seconds.

Surface projection of the slip distribution superimposed on GEBCO bathymetry. White line indicate plate boundary [Bird 2003].





Magnitude 7.6 CAYMAN ISLANDS

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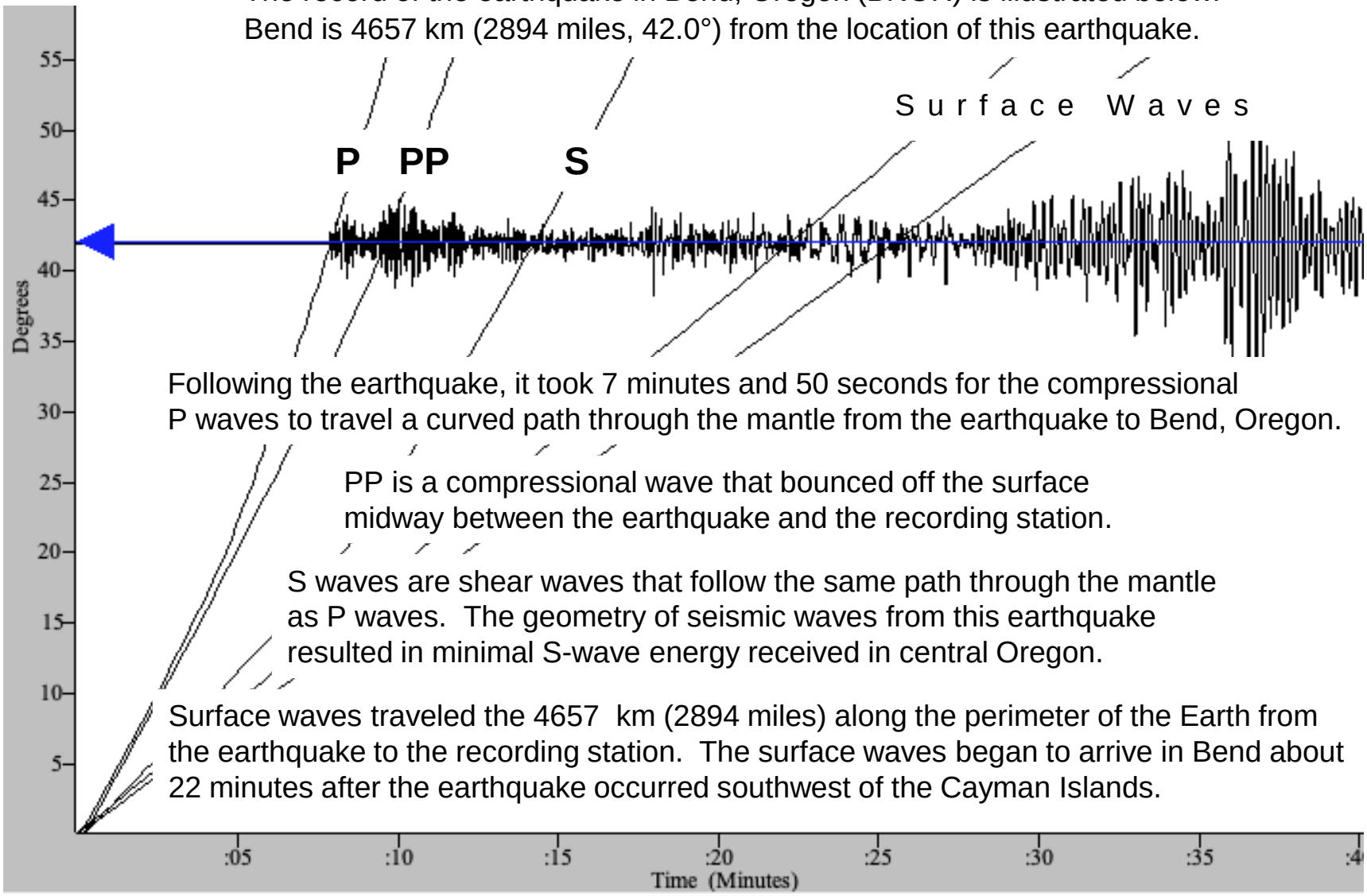
C

The record of the earthquake in Bend, Oregon (BNOR) is illustrated below. Bend is 4657 km (2894 miles, 42.0°) from the location of this earthquake.



Following the earthquake, it took 7 minutes and 50 seconds for the compressional P waves to travel a curved path through the mantle from the earthquake to Bend, Oregon.

PP is a compressional wave that bounced off the surface midway between the earthquake and the recording station.

S waves are shear waves that follow the same path through the mantle as P waves. The geometry of seismic waves from this earthquake resulted in minimal S-wave energy received in central Oregon.

Surface waves traveled the 4657 km (2894 miles) along the perimeter of the Earth from the earthquake to the recording station. The surface waves began to arrive in Bend about 22 minutes after the earthquake occurred southwest of the Cayman Islands.

ALL

Slide Guide

1. Where was the epicenter of this earthquake? (What city/region was it closest to?) When did the earthquake happen? What was its magnitude?
2. How many people are estimated to have felt the earthquake?
3. Which type of boundary is this earthquake related to?
4. What impact did the earthquake have on the location in which it was felt the strongest? (buildings, streets, animals, people…)
5. What additional hazards occurred in addition to the ground shaking? (tsunamis, floods, sinkholes, landslides, fires, volcanoes…)
6. How long did it take the first P-wave to travel to the seismic station in this slide stack?
7. What are 2 more questions you have about earthquakes that can NOT be answered with this slide stack?

Extension Questions

1. Seismic waves travel through the earth. Why did you or did you not feel the earthquake?
2. If you were going to write a news story on this earthquake, what would the headline be? *HINT: Think about where this earthquake occurred, the impact it had on the people living in the area, any effects the earthquake had on the area itself.*

HS

Slide Guide

1. Where was the epicenter of this earthquake? (What city/region was it closest to?) When did the earthquake happen? What was its magnitude?
2. How many people are estimated to have felt the earthquake?
3. What relationship is shown between the seismic hazard map and population density?
4. Which plates are involved and what type of boundary are they creating?
5. What impact did the earthquake have on the location in which it was felt the strongest? (buildings, streets, animals, people…)
6. What additional hazards occurred in addition to the ground shaking? (tsunamis, floods, sinkholes, landslides, fires, volcanoes…)
7. How long did it take the first P-wave to travel to the seismic station in this slide stack?
8. What are 2 more questions you have about earthquakes that can NOT be answered with this slide stack?

Extension Questions

1. Seismic waves travel through the earth. Why did you or did you not feel the earthquake?
2. If you were going to write a news story on this earthquake, what would the headline be? *HINT: Think about where this earthquake occurred, the impact it had on the people living in the area, any effects the earthquake had on the area itself.*

C

Slide Guide

1. Where was the epicenter and hypocenter of this earthquake? (What city/region was it closest to? Longitude/latitude/depth?) When did the earthquake happen? What was its magnitude?
2. What impact did the earthquake have on the location in which it was felt the strongest? *(buildings, streets, animals, people…)*
3. Draw the block model of the fault for this earthquake. Overlay a drawing of the focal mechanism to show how the 2D projection was created. Label it with the type of fault.
4. How are the related tectonic plates involved in creating the nearby boundary? *(Include the type of boundary, and the velocity and name of the plates.)*
5. What additional hazards occurred in addition to the ground shaking? *(tsunamis, floods, sinkholes, landslides, fires, volcanoes…)*
6. Relate the area's population density to its seismic hazard level and earthquake history

Extension Question

1. What efforts have there been to mitigate impacts from earthquakes? What additional mitigation efforts should be implemented?

Teachable Moments are a service of

The EarthScope Consortium

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