Magnitude 7.6 COSTA RICA
Wednesday, September 5, 2012 at 14:42:10 UTC

A major earthquake shook Costa Rica 10km (6mi) NE of Hojancha and 140km (87mi) W of the capital city San José.

Power was knocked out across Costa Rica's capital and phone lines failed, but damage appears to be limited with some structural damage to homes near the epicenter and landslides blocking several roads. There is a report of 1 death.

Earth partially covers a road after a landslide was triggered by an earthquake in Samara, Costa Rica, Wednesday, September 5, 2012. The powerful, magnitude 7.6 earthquake shook a wide swath of Central America on Wednesday.

(*AP Photo/Danica Coto*)

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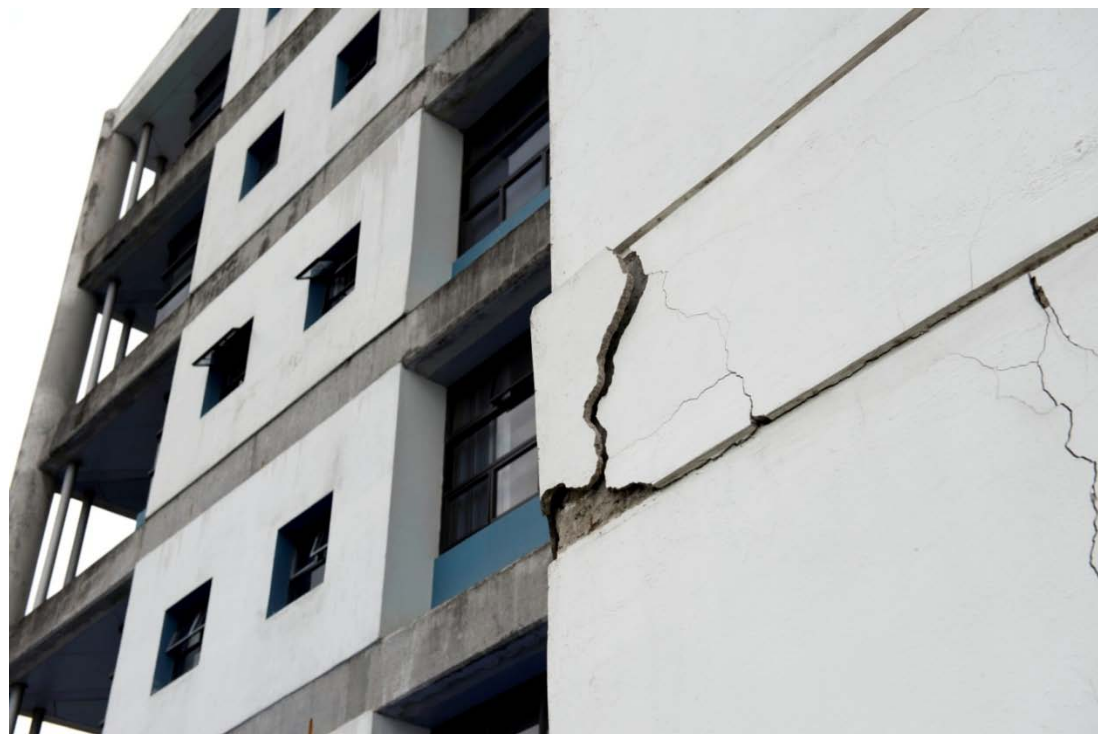
The hypocenter of this earthquake was 40.8 km (25 miles) deep. For an earthquake of a given magnitude, a deeper event will cause less damage but will be more widely felt. As seismic waves radiate away from the hypocenter, their energy is spread over a larger area of wavefront. Lower energy per unit area of wavefront means that the amplitudes of seismic wave oscillations are smaller. With a 40.8 kilometer depth of hypocenter, amplitudes of the ground surface oscillations produced by this Costa Rica event were much less than would have occurred had the hypocenter been closer to the surface. For comparison, the hypocenter of the M7.0 Haiti earthquake in 2010 was only 10 km deep.



A wall at the University of Costa Rica's school of electrical engineering is damaged after the earthquake.

(*AP Photo/Thomas Dooley*)

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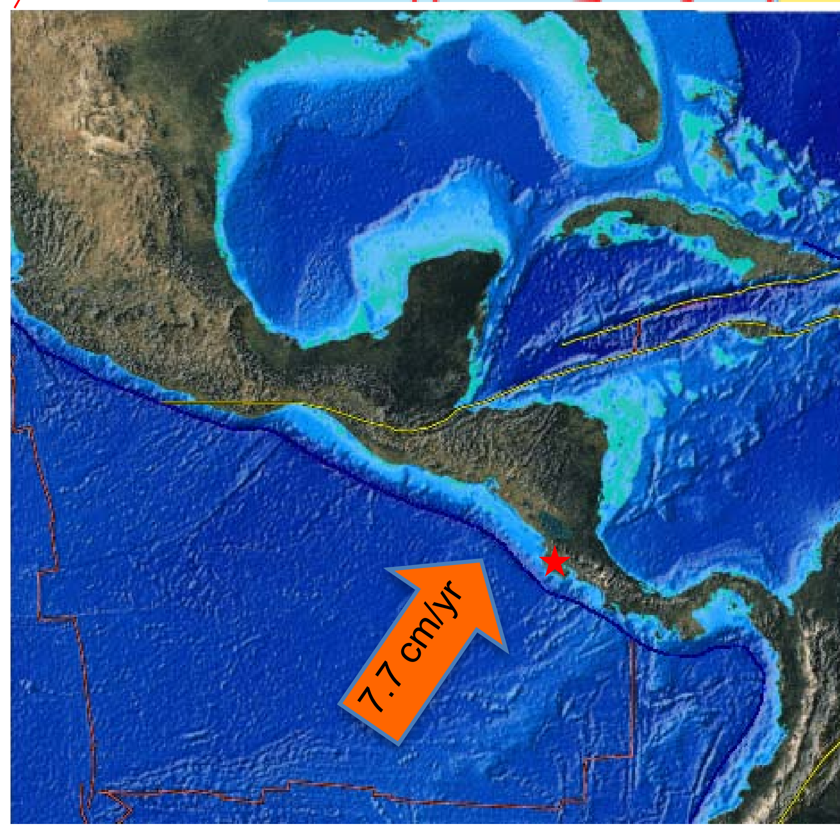
This earthquake occurred beneath the Nicoya Peninsula (beneath star, lower map) as a result of thrust faulting on or near the plate boundary interface between the Cocos and Caribbean plates. (USGS)

At the latitude of this earthquake, the Cocos plate moves north-northeast with respect to the Caribbean plate at a velocity of approximately 77 mm/yr, and subducts beneath Central America at the Middle America Trench.



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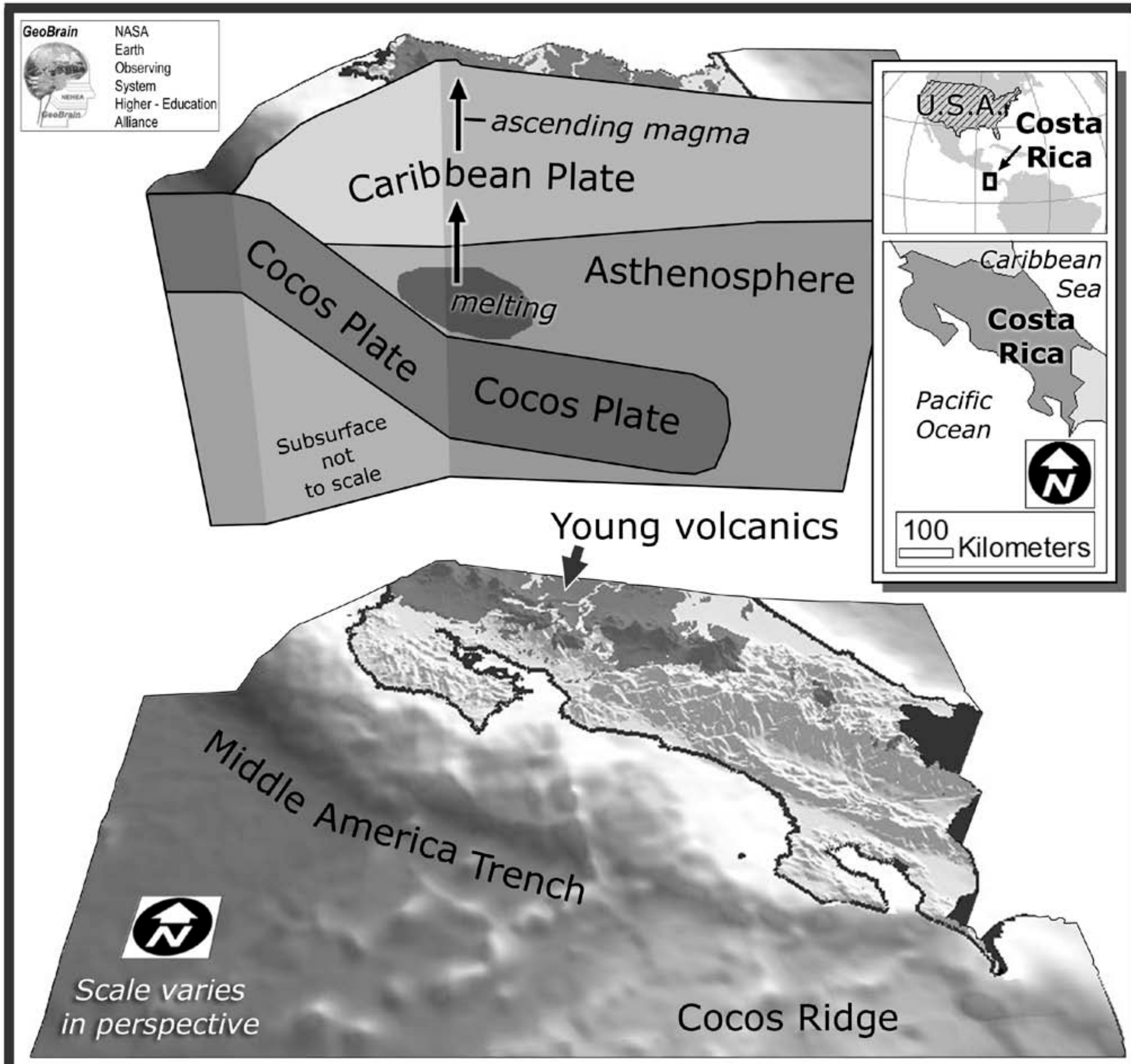
As the Cocos Plate subducts into the asthenosphere beneath the Caribbean Plate, water is driven from the subducting plate into the overlying asthenosphere.

That addition of water to the hot mantle rocks causes partial melting resulting in formation of magma.

In turn magma ascends toward the surface of the Caribbean Plate and some of that magma erupts to form the many volcanoes found in Central America..

(*SERC – Carleton College*)



IRIS Teachable Moments

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The earthquake (yellow star) is plotted with epicenters of earthquakes in the region since 1990.

According to the USGS, over the past 40 years, the region within 250 km of this earthquake has experienced approximately 30 earthquakes with magnitude 6 or greater; two of these were larger than magnitude 7.

The last comparable magnitude in the Nicoya Penninsula was a magnitude 7.7 in 1950. It resulted in dozens dead and heavy damage to buildings.

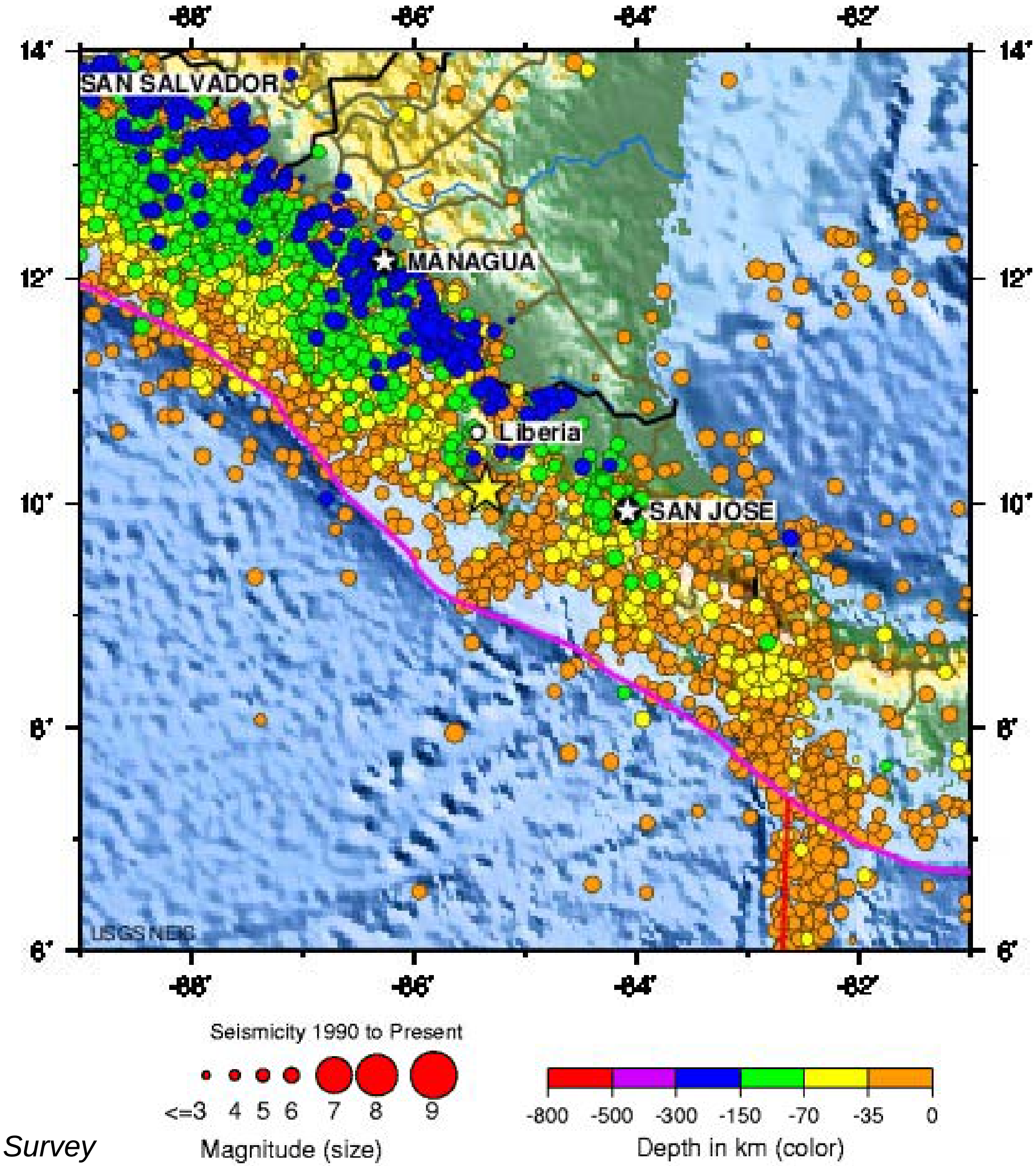

Image courtesy of the US Geological Survey

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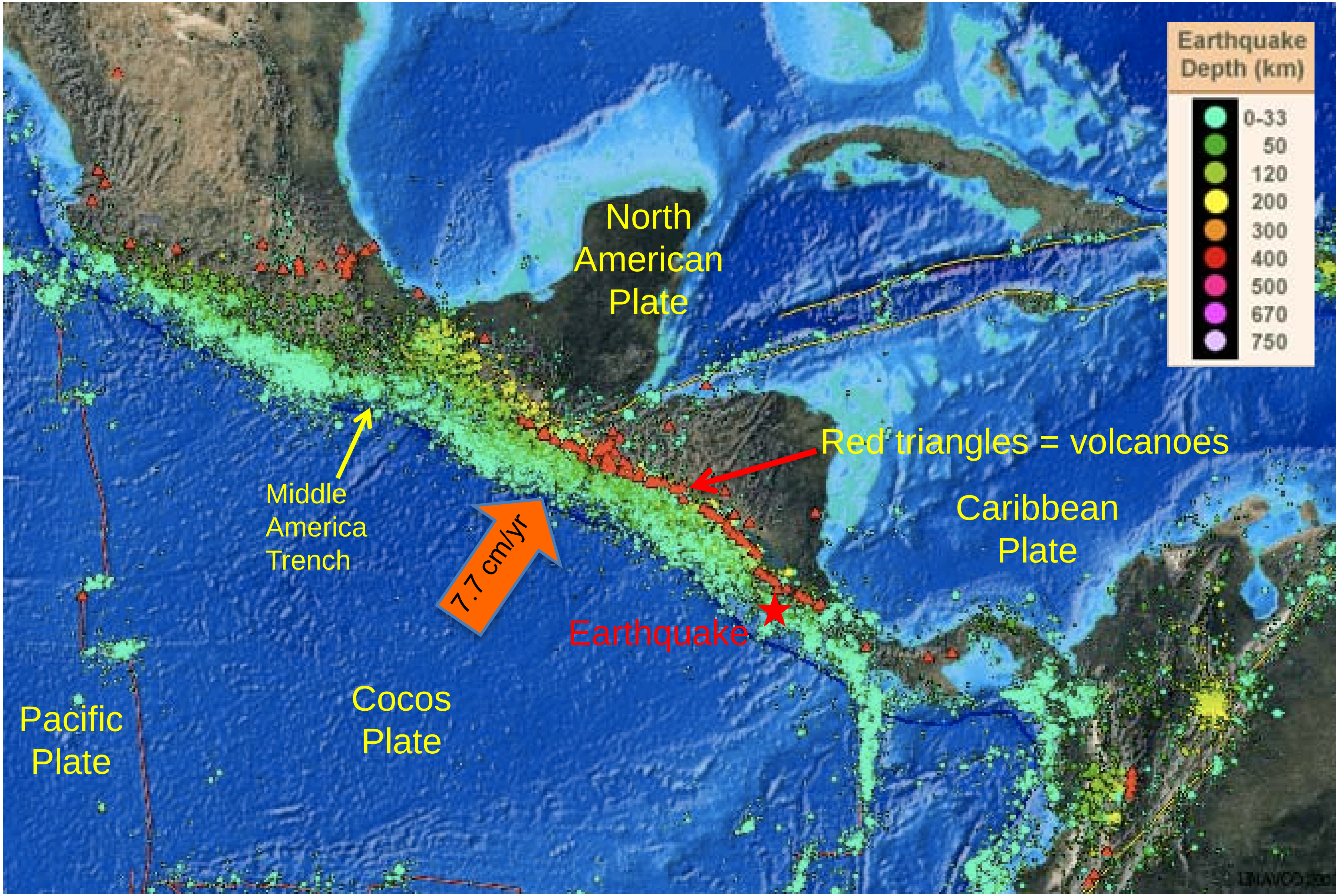

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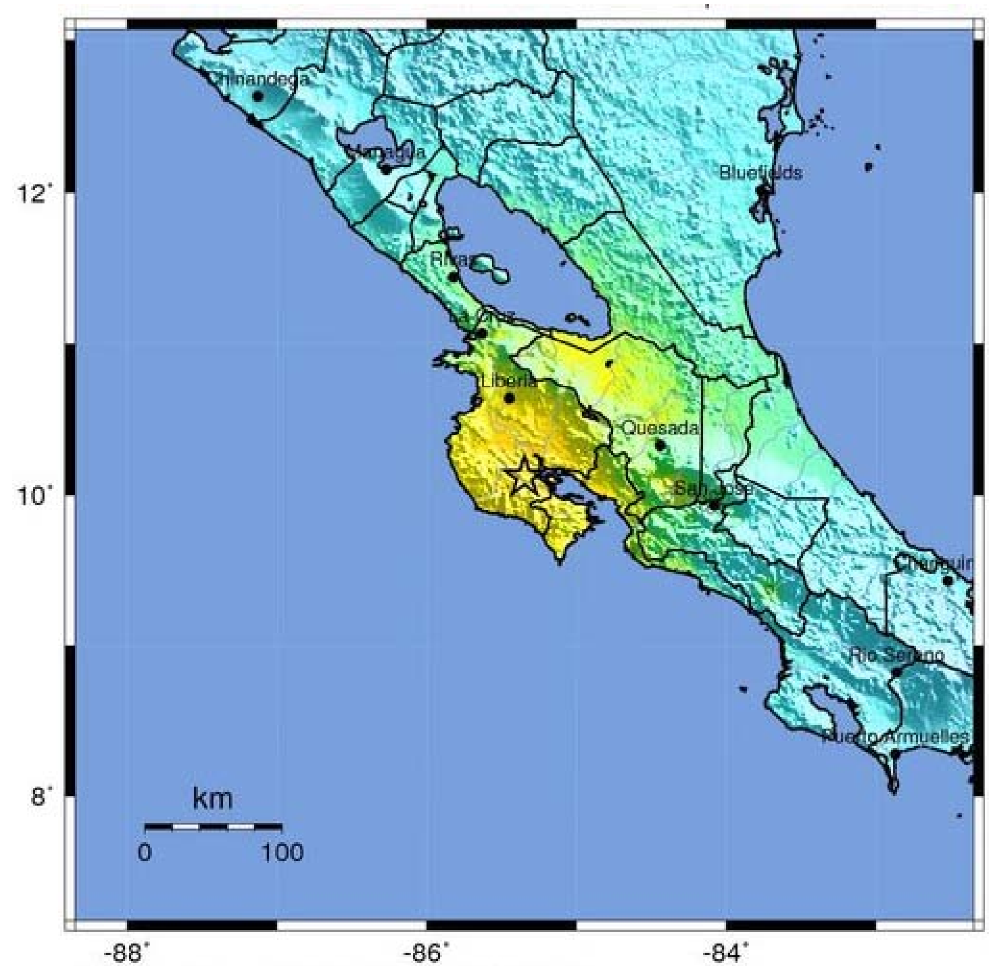
Shaking intensity scales were developed to standardize the measurements and ease comparison of different earthquakes. The Modified-Mercalli Intensity scale is a twelve-stage scale, numbered from I to XII. The lower numbers represent imperceptible shaking levels, XII represents total destruction. A value of IV indicates a level of shaking that is felt by most people. The area nearest the epicenter of the Costa Rica earthquake experienced strong to very strong ground shaking.

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

Image courtesy of the US Geological Survey



USGS Estimated shaking Intensity from M 7.6 Earthquake

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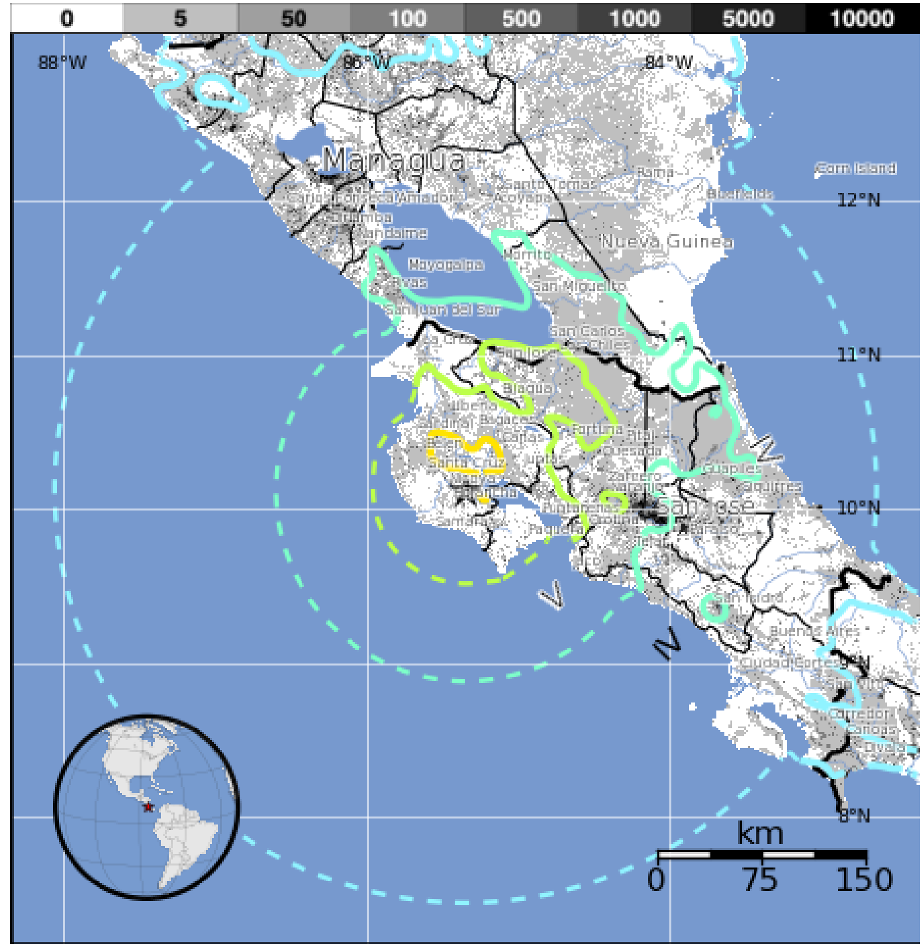
USGS PAGER
Population Exposed to Earthquake Shaking

The USGS PAGER map shows the population exposed to different Modified-Mercalli Intensity (MMI) levels. MMI describes the severity of an earthquake in terms of its effect on humans and structures and is a rough measure of the amount of shaking at a given location. Overall, the population in this region resides in structures that are vulnerable to earthquake shaking, though some resistant structures exist. The predominant vulnerable building types are adobe block and mud wall construction.



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 the contour lines. The estimated population exposure to each MMI Intensity is shown in the table below.

Image courtesy of the US Geological Survey

Estimated Modified Mercalli Intensity	I	II-III	IV	V	VI	VII	VIII	IX	X
Est. Population Exposure	--*	430k*	5,513k	2,945k	805k	55k	0	0	0
Perceived Shaking	Not Felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme

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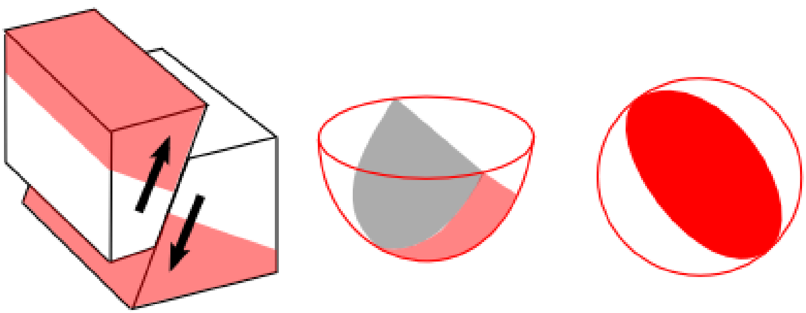
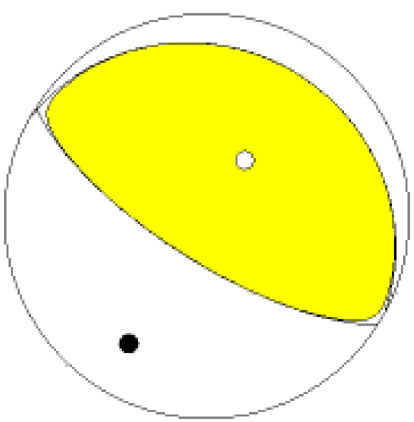
The colored beach ball, called a focal mechanism, is how seismologists plot the 3-D stress orientations of an earthquake. Since an earthquake occurs as slip on a portion of the fault, it generates quadrants of compression (shaded) and extension (white) as the two sides of the fault move.

Seismologists identify the orientation of these quadrants from recorded seismic waves, and use them to characterize the type of faulting that generated the earthquake.

Reverse/Thrust/Compression





USGS WPhase Centroid Moment Tensor Solution

Shaded areas show quadrants of the focal sphere in which the P-wave first-motions are away from the source, and unshaded areas show quadrants in which the P-wave first motions are toward the source. The dots represent the axis of maximum compressional strain (in black, called the "P-axis") and the axis of maximum extensional strain (in white, called the "T-axis") resulting from the earthquake.

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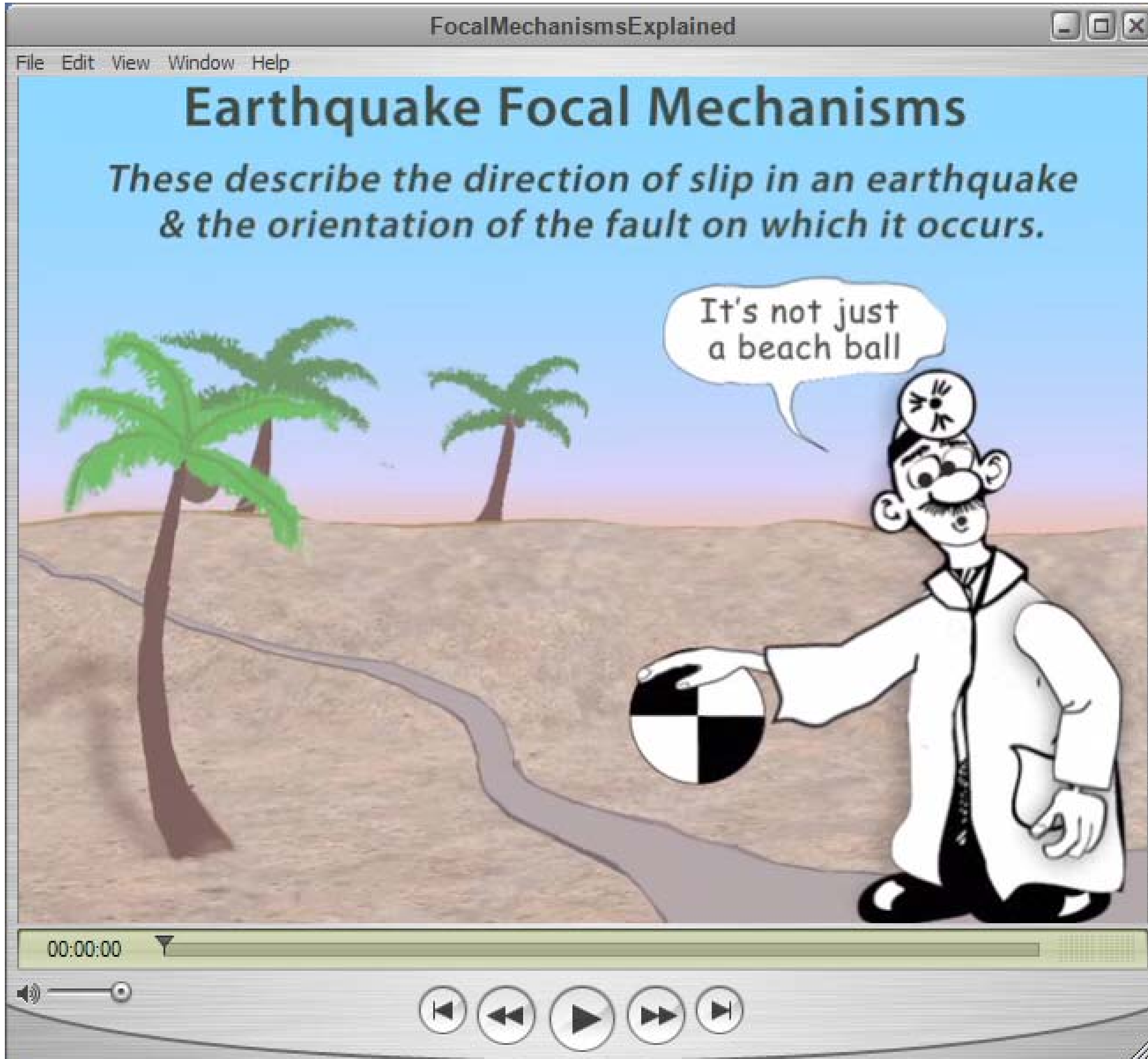

Understanding Focal Mechanisms

Quicktime Required

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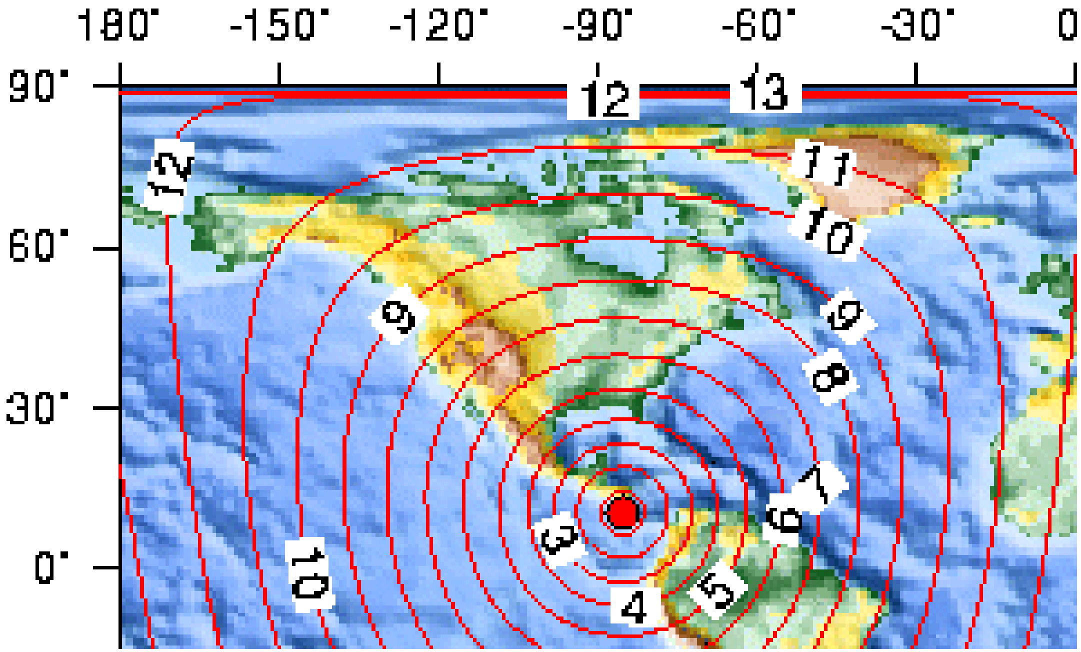
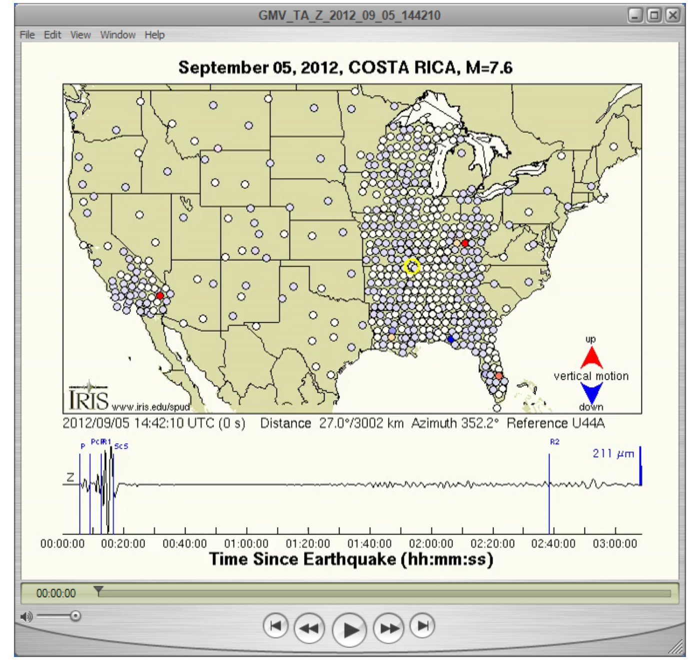


The above map shows the predicted (theoretical) travel times, in minutes, of the first compressional (P) wave from the earthquake across the United States.

As earthquake waves travel along the surface of the Earth, they cause the ground to move. With the 400 earthquake recording stations in EarthScope's Transportable Array, the ground motions can be captured and displayed as a movie, using the actual data recorded from the earthquake.



Movie showing seismic waves crossing the US recorded by the USArray. The circles in the movie represent earthquake recording stations and the color of each circle represents the amplitude, or height, of the earthquake wave detected by the station's seismometer. The color of the circle changes as waves of differing amplitude travel past the seismometer. Blue represents downward ground motion, red represents upward ground motion, and darker colors indicate larger amplitudes.

A random representative trace (yellow circle is station location) is displayed on the lower part of the animation with its horizontal axis representing the time (in seconds) after the event.

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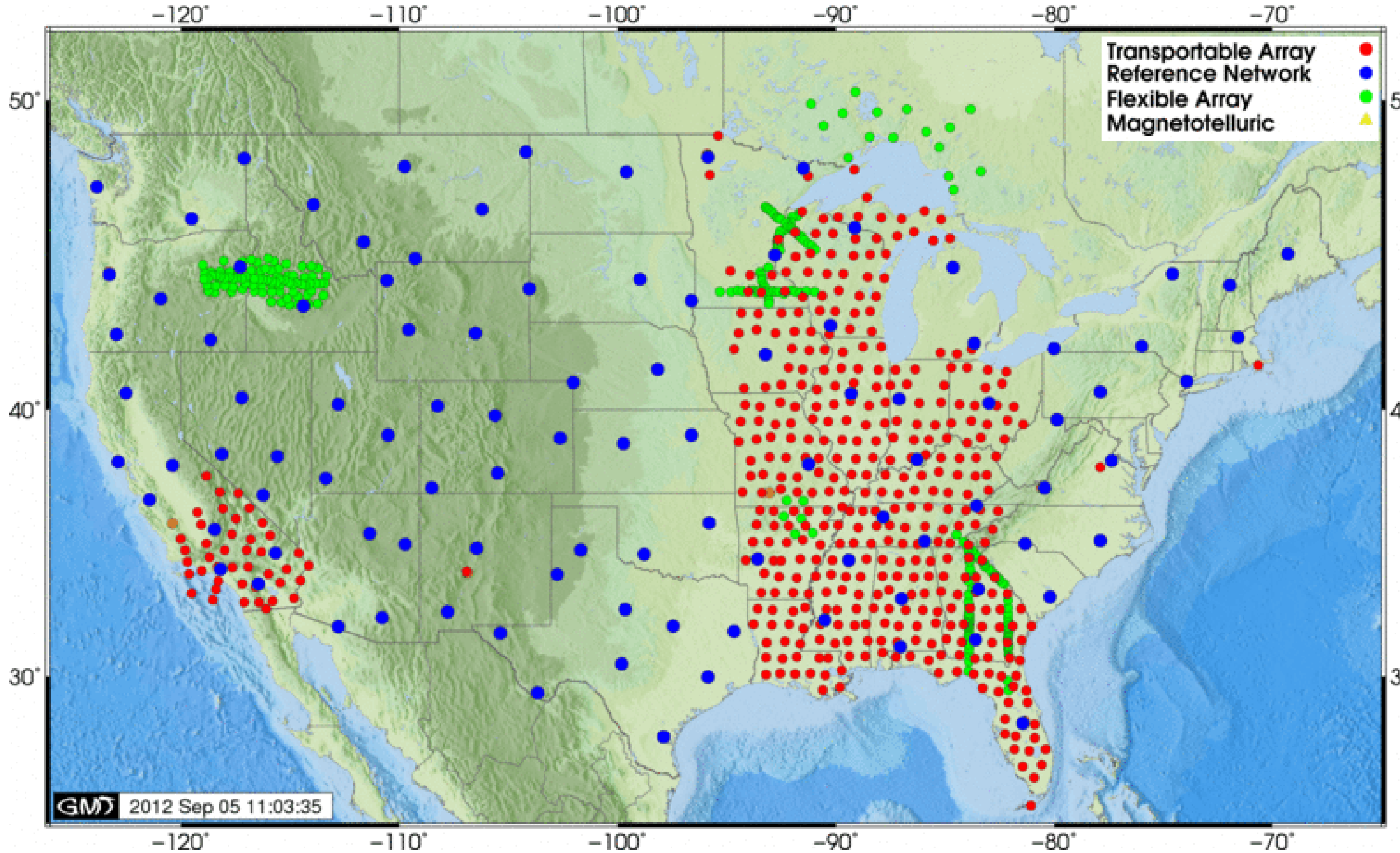
USArray: A Continental-Scale Seismic Observatory

USArray's transportable array is a network of 400 high-quality broadband seismographs that are moving (every two years) across the United States from west to east, and Alaska, in a regular grid pattern. These data are being used to answer questions about the North American continent and underlying mantle..



Operating USArray Stations. The 400 active transportable array stations are plotted in red. Permanent stations are plotted in blue.

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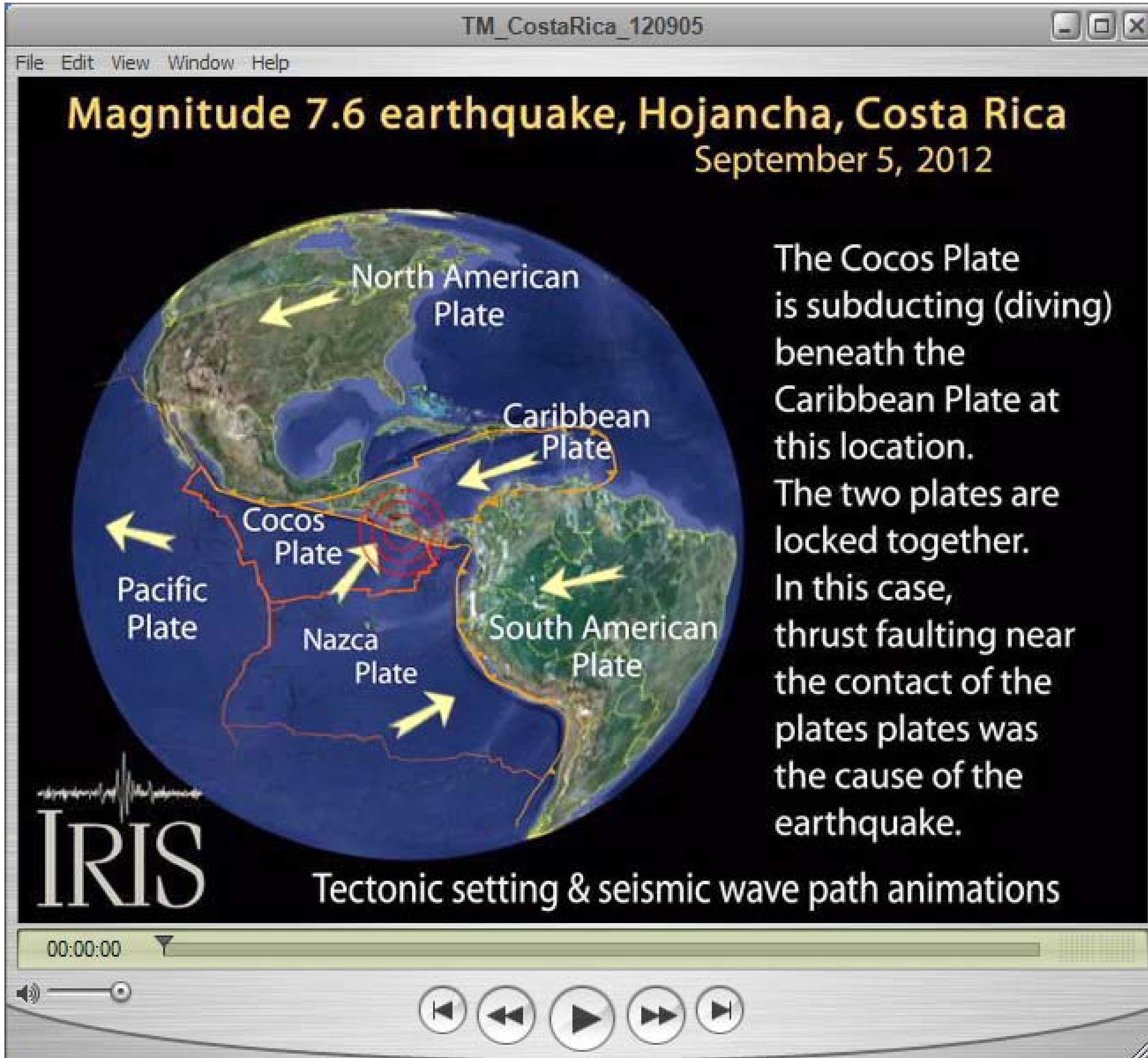

Tectonic setting and seismic wave path animation.

Quicktime required

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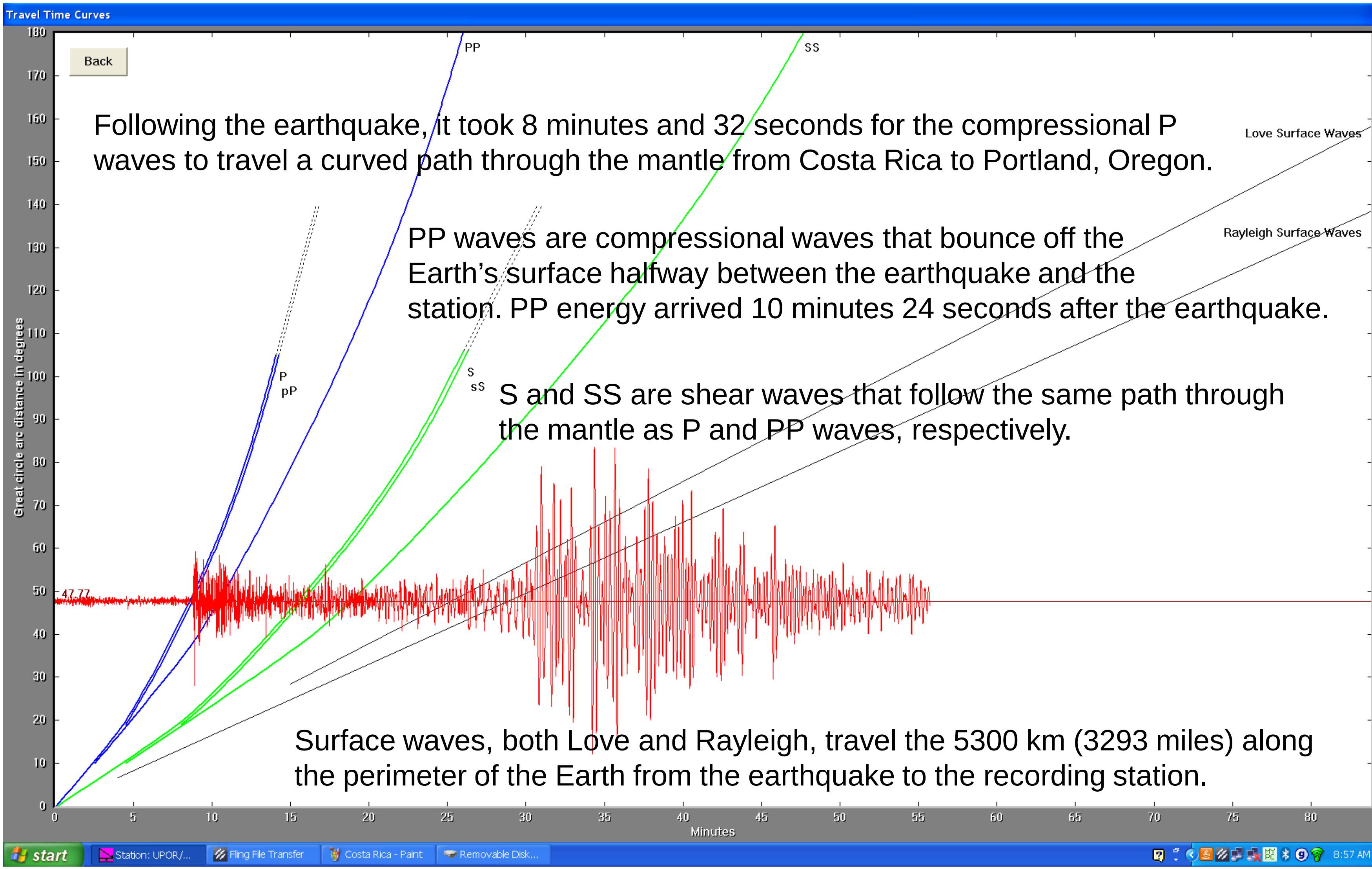
The record of the earthquake on the University of Portland seismometer (UPOR) is illustrated below. Portland is about 5300 km (3293 miles, 47.74°) from the location of this earthquake.



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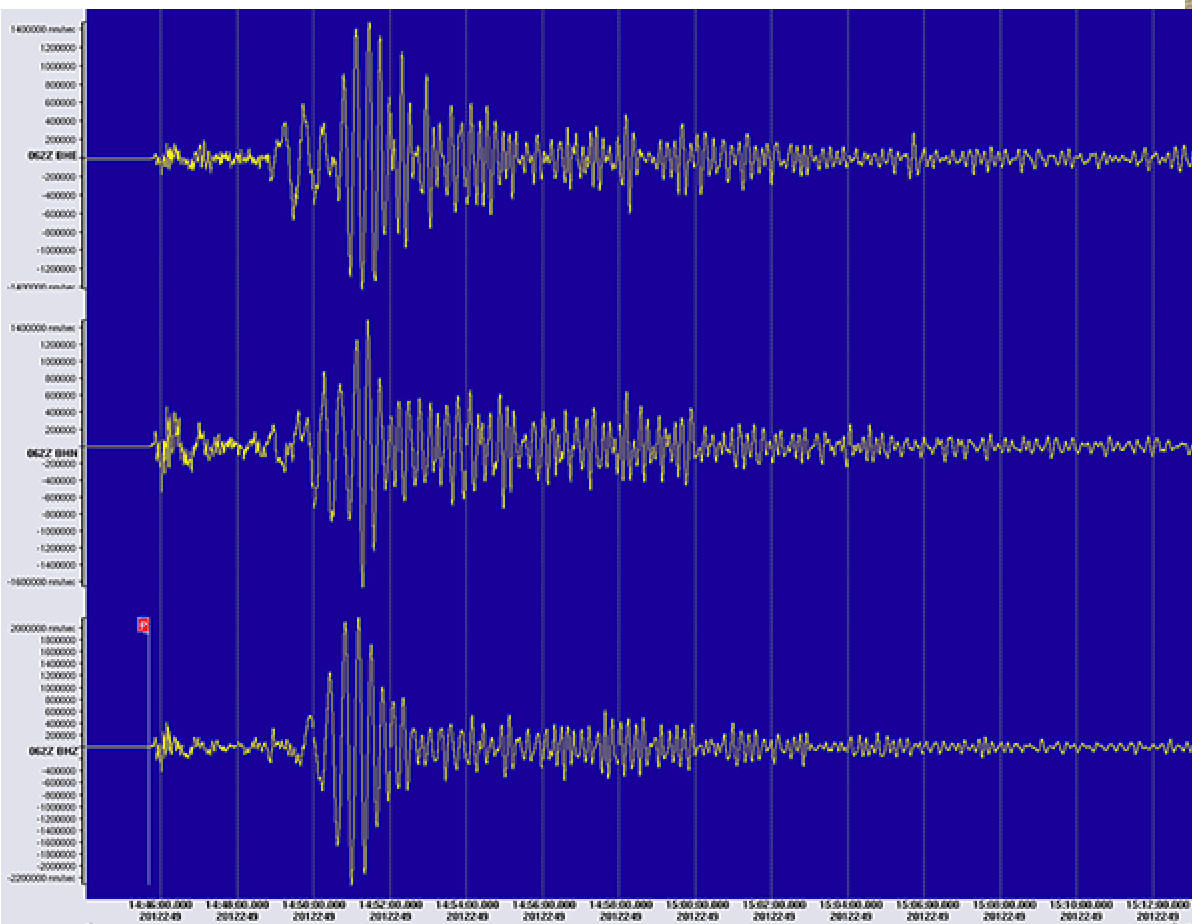
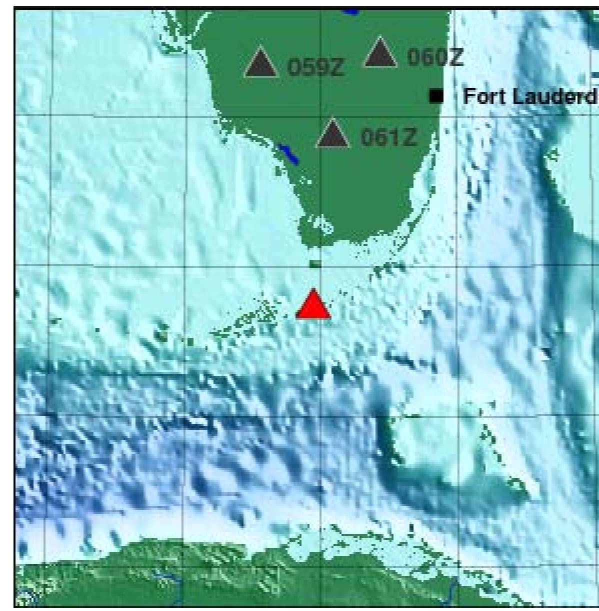
3 components recorded by 062Z (0.01–0.07 Band Pass (BP) filtered), the closest USArray station to the event.



062Z



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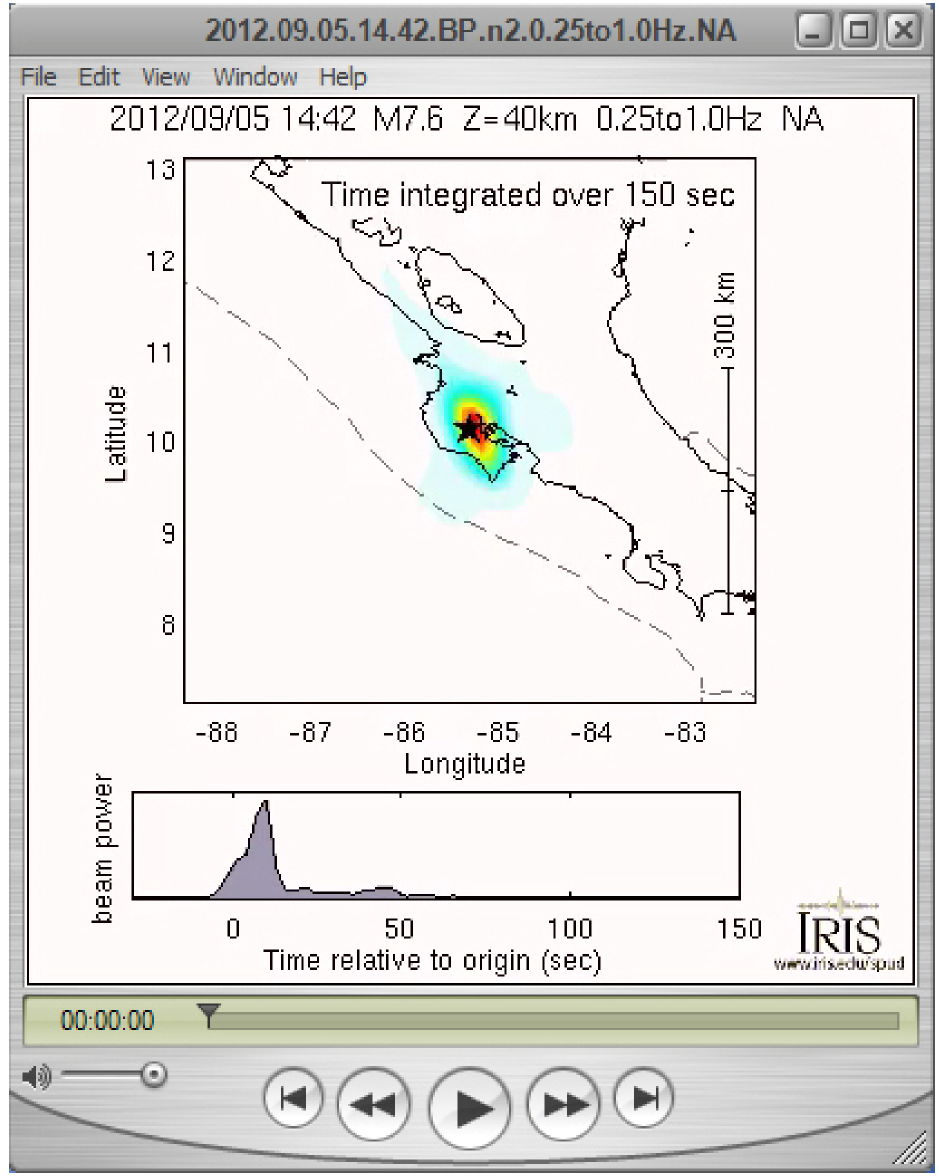
Back Projections are movies created from an automated data processing sequence that stacks up P wave energy recorded on many seismometers on a flat grid around the source region. This grid approximates the fault surface and creates a time and space history of the earthquake.

Warmer colors indicate greater beam power. In the movies, a red circle shows the location of the peak beam power when absolute beam powers are low.

Duration of rupture along the fault can be seen in the graph.



More info: http://www.iris.edu/spud/backprojection