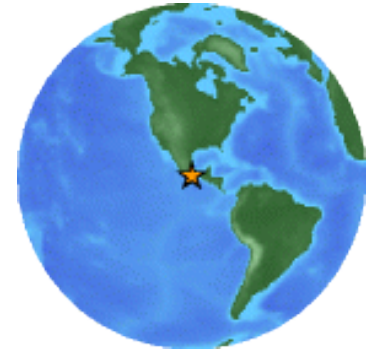


Magnitude 7.4 OAXACA, MEXICO

Tuesday, March 20, 2012 at 18:02:48 UTC

A major earthquake in Oaxaca, Mexico (190 km [120 mi] east of Acapulco) shook buildings in Mexico City, 322 km (200 mi) NNE of the epicenter, sending people flooding into the streets.

The earthquake occurred mid-day (12:02:48 PM) local time. Cell phone lines went down and traffic jammed in the moments after the quake, but the President said there were no immediate reports of major damage. (AP)



Firefighters work to remove a cement beam that fell from a pedestrian bridge onto a public bus after an earthquake was felt in Mexico City. There were no passengers in the mini-bus and the driver suffered minor injuries, according to firefighters.

(AP Photo/Alexandre Meneghini)

Magnitude 7.4 OAXACA, MEXICO

Tuesday, March 20, 2012 at 18:02:48 UTC

The earthquake shook central and southern Mexico, with damage including a fallen bridge and swaying office towers in Mexico City. Some 60 homes are reported damaged near the epicenter of the quake, and there are currently no reported deaths. (AP)

A magnitude 5.1 aftershock was felt in the capital and several other aftershocks have been recorded near the epicenter.

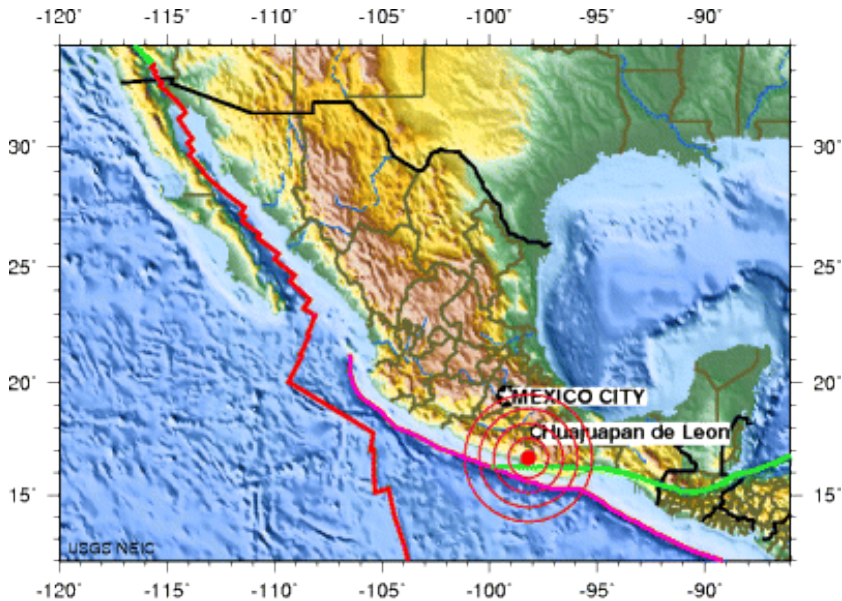


Image courtesy of the US Geological Survey



Aftershocks in the first 8 hours after the earthquake. Red- magnitude 7.4, yellow- aftershocks

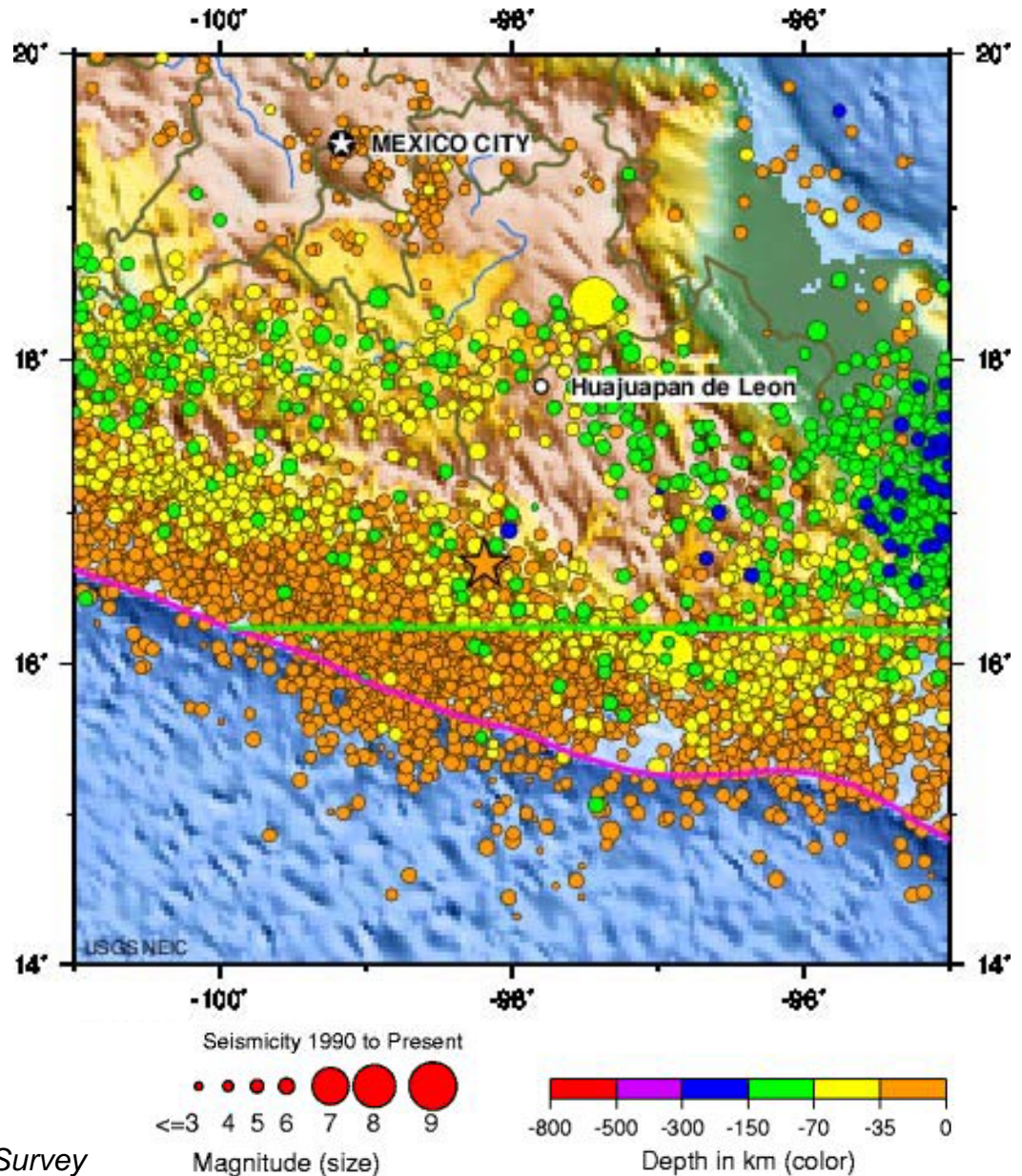
Magnitude 7.4 OAXACA, MEXICO

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

Mexico has a long history of destructive earthquakes and volcanic eruptions. In September 1985, a magnitude 8.1 earthquake centered in the subduction zone off Acapulco killed more than 9,500 people and left more than 100,000 homeless in Mexico City, more than 300 km away.

Since 1973, 15 magnitude 7.0 or larger earthquakes have occurred along the subduction zone of southern Mexico (within 500 km of today's event).

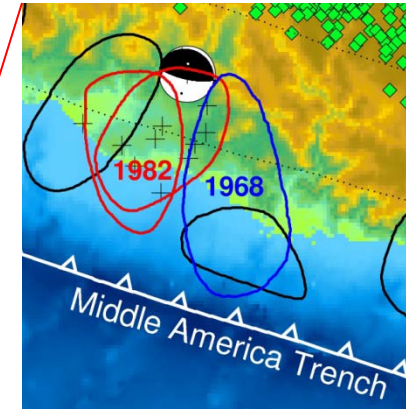


Magnitude 7.4 OAXACA, MEXICO

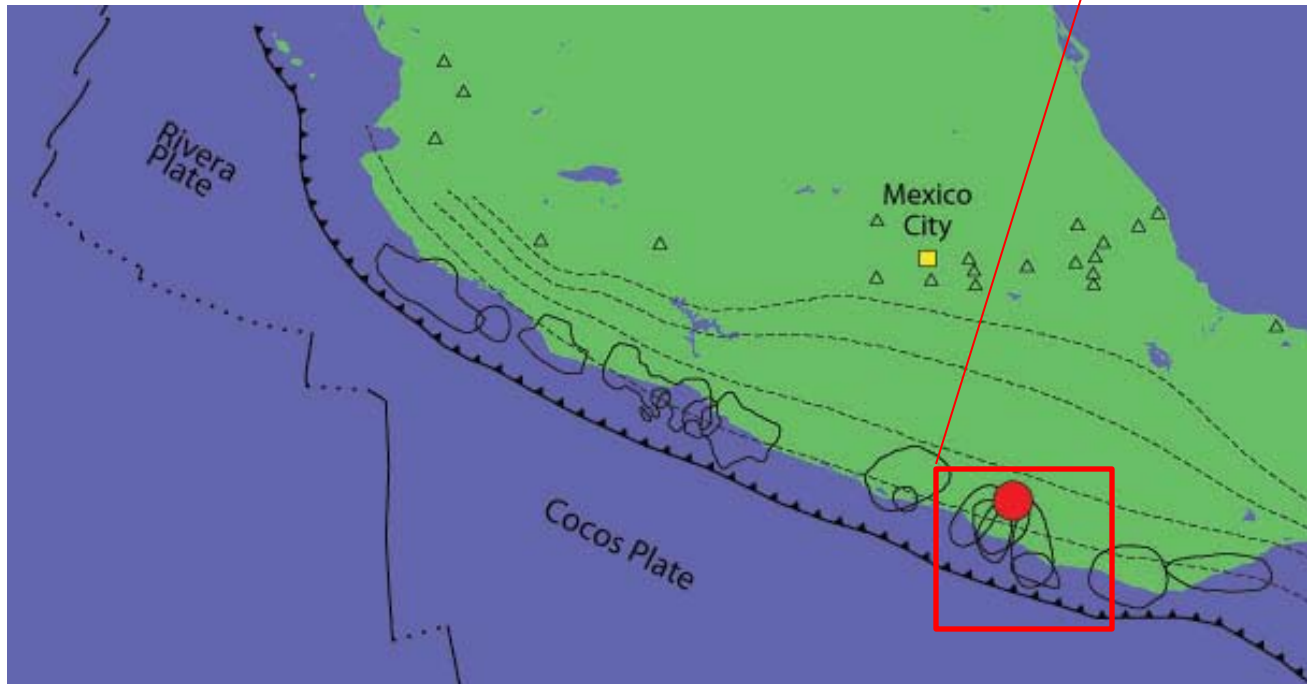
Tuesday, March 20, 2012 at 18:02:48 UTC

Megathrust earthquakes occur at convergent boundaries where one tectonic plate is subducted beneath another. The world's largest earthquakes are all megathrust earthquakes. In the map below, zones that slipped in large megathrust earthquakes over the last ~70 years are outlined along the subduction zone.

These patterns of rupture are analyzed to calculate the probability that a given section will rupture in the future.



The zone of rupture defined by this earthquake and its aftershocks overlaps both the zones ruptured in 1982 and 1968.



This regional view integrates plate boundaries, divergent (solid line), transform (dotted line), convergent (line with triangles), volcanoes (triangles), large megathrust earthquakes over the last ~70 years (black outlines), subducting slab contours (dashed), and this earthquake (red circle).

Image courtesy Mike Brudzinski

Magnitude 7.4 OAXACA, MEXICO

Tuesday, March 20, 2012 at 18:02:48 UTC

USGS PAGER

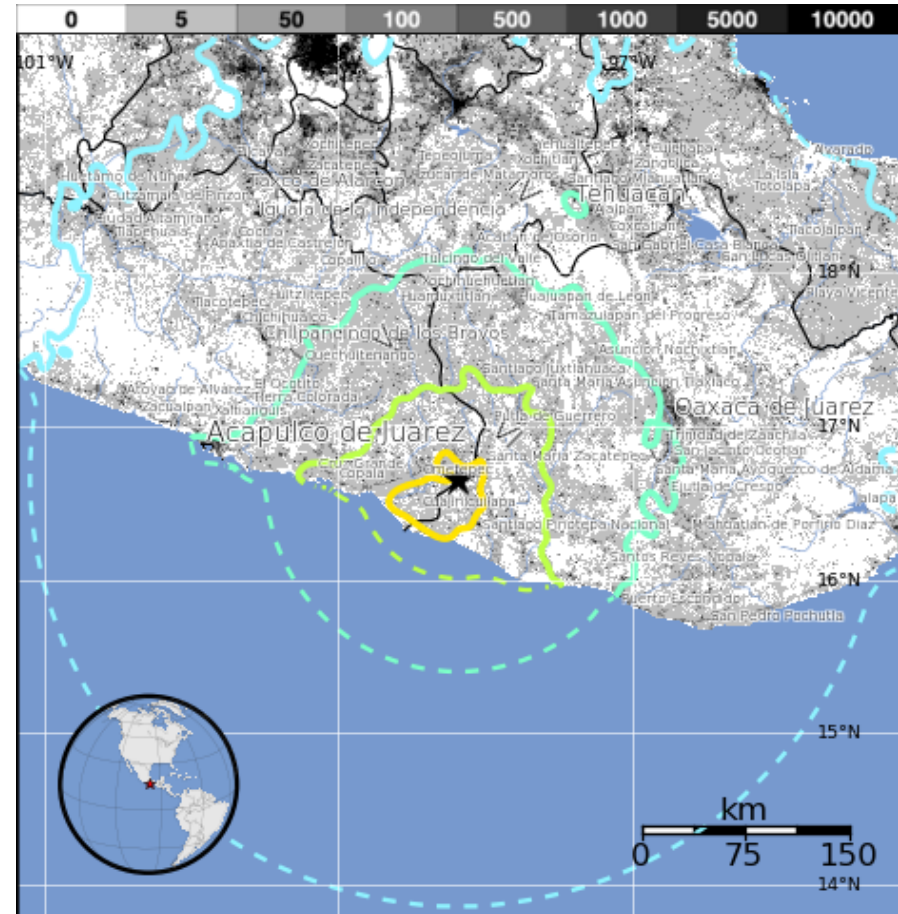
Population Exposed to Earthquake Shaking

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 a mix of vulnerable (mud wall and adobe block with concrete bond beam) and earthquake resistant 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	--*	1,028k*	32,198k*	2,736k	596k	182k	0	0	0
Perceived Shaking	Not Felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme

Magnitude 7.4 OAXACA, MEXICO

Tuesday, March 20, 2012 at 18:02:48 UTC

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.

Modified Mercalli Intensity

X
IX
VIII
VII
VI
V
IV
II-III
I

Perceived Shaking

Extreme

Violent

Severe

Very Strong

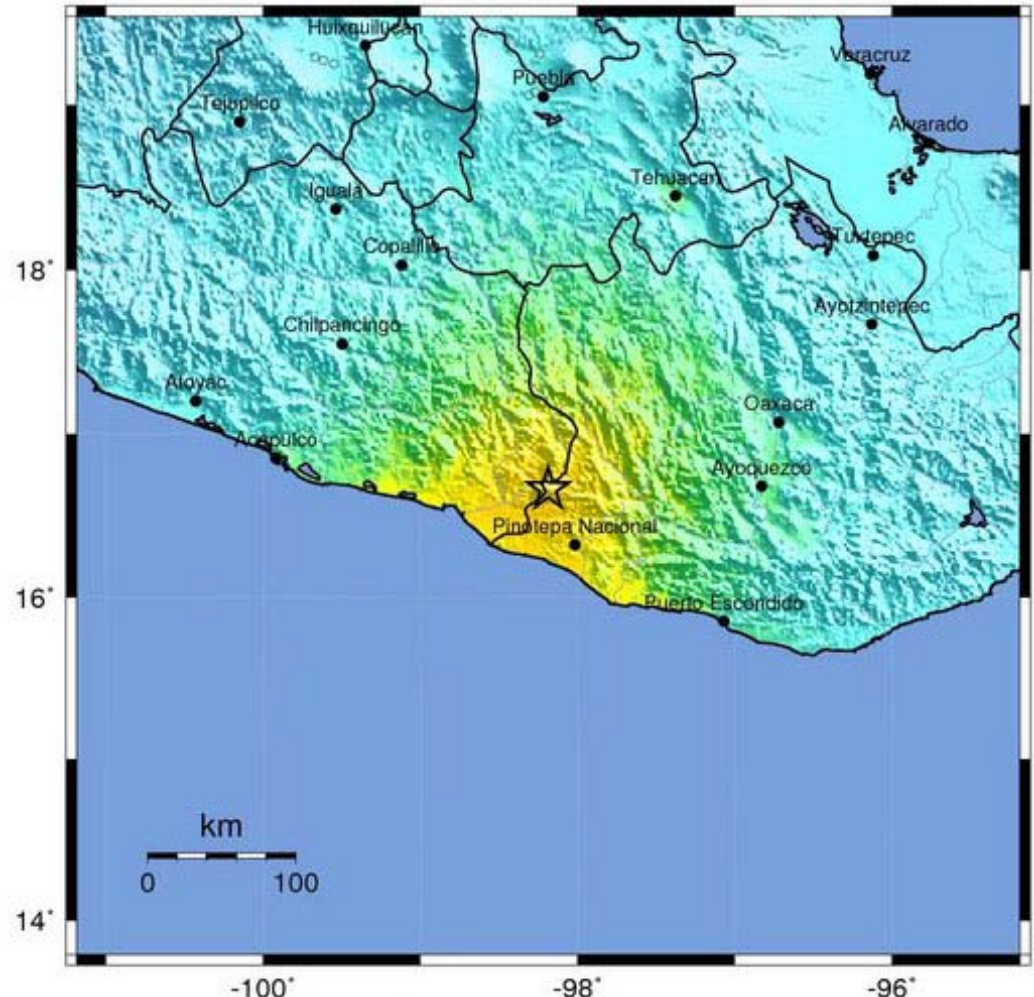
Strong

Moderate

Light

Weak

Not Felt



Magnitude 7.4 OAXACA, MEXICO

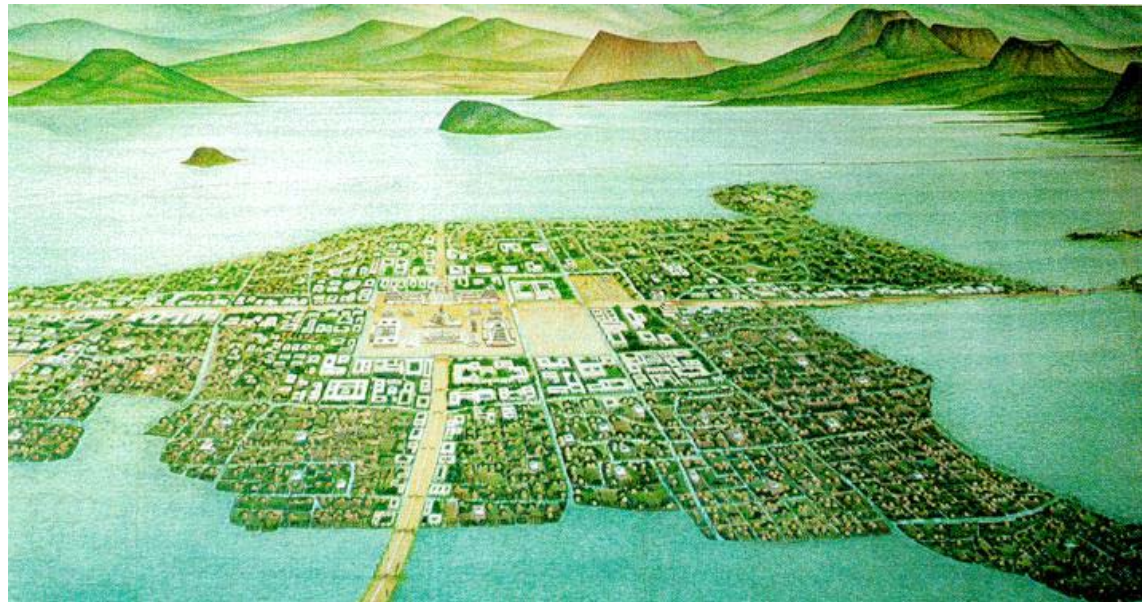
Tuesday, March 20, 2012 at 18:02:48 UTC

“Unusually long and strong” are words that dominate the news reports of this earthquake from Mexico City. The shaking was widely felt in Mexico City and the duration of shaking was many seconds, despite the 322 km distance. This was fairly strong shaking for a magnitude 7.4 earthquake at that distance, almost certainly due to the fact that portions of Mexico City are built on young unconsolidated sediments where seismic waves are amplified.

The capital of the Aztec empire was Tenochtitlan, built on an island in Lake Texcoco. Mexico City was built by the Spanish on the ruins of Tenochtitlan. Both the Aztecs and the Spaniards extended the island; the Aztecs first to create fertile land for planting, and the Spaniards eventually draining the lake to allow the city to grow.



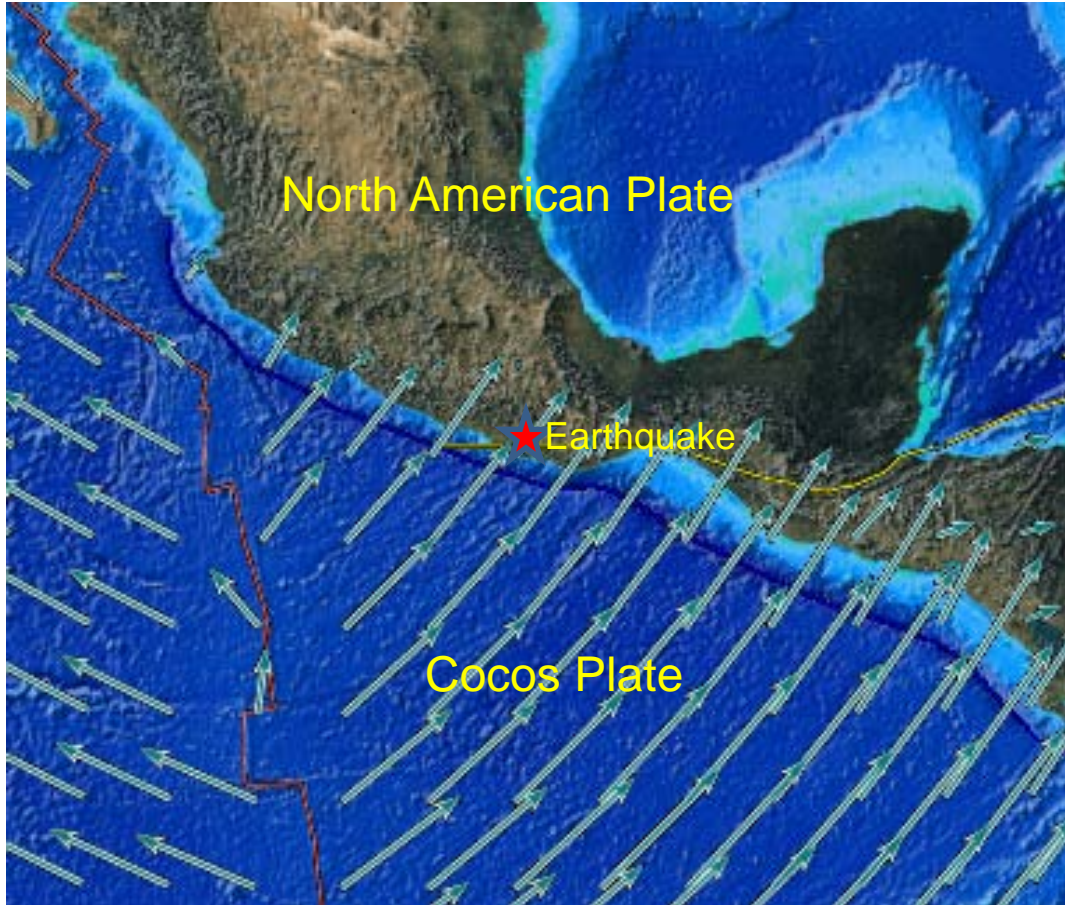
Mexico City



Tenochtitlan- from *The Broken Spears*, Miguel León-Portilla

Magnitude 7.4 OAXACA, MEXICO

Tuesday, March 20, 2012 at 18:02:48 UTC



Arrows show plate motion relative to the North American Plate.



Mexico is one of the most seismologically and volcanically active regions on Earth. It is part of the circum-Pacific “Ring of Fire”.

Most of Mexico rests on the North American plate. The Pacific Ocean floor off southern Mexico, however, is on the Cocos plate. In the region of the March 20 earthquake, the Cocos plate moves northeastward at a rate of 60 mm/yr toward the North American plate.

Magnitude 7.4 OAXACA, MEXICO

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According to the US Geological Survey National Earthquake Information Center: "This earthquake occurred as a result of thrust-faulting on or near the plate boundary interface between the Cocos and North American plates."

The interface between the subducting Cocos plate and the North American upper plate is shown below. The focal mechanism marks this earthquake location, the black crosses mark the approximate aftershock locations, the blue circles are small historical seismicity, and estimated temperatures on the plate interface are shown.

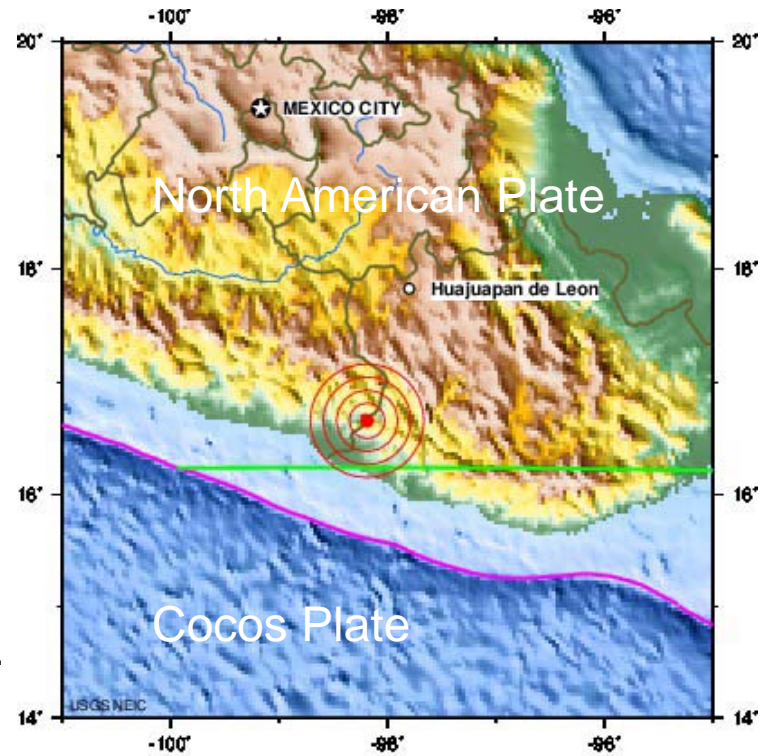


Image courtesy of the US Geological Survey

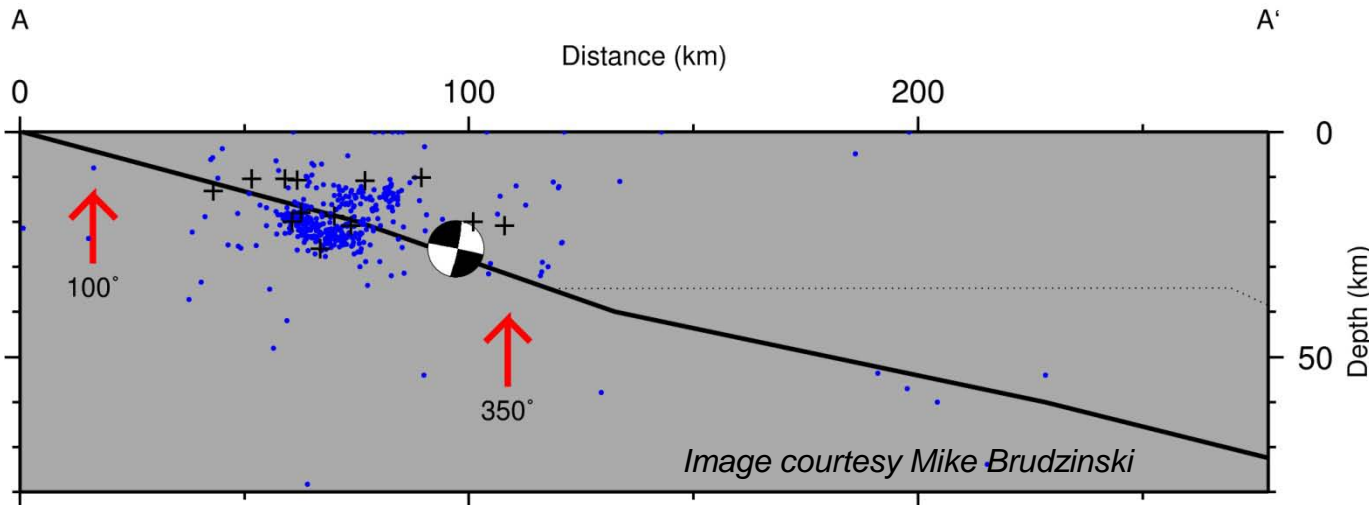
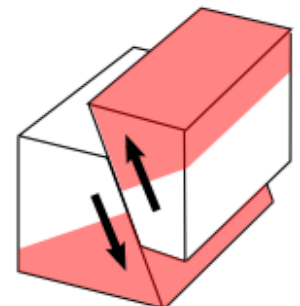


Image courtesy Mike Brudzinski

Thrust Faulting

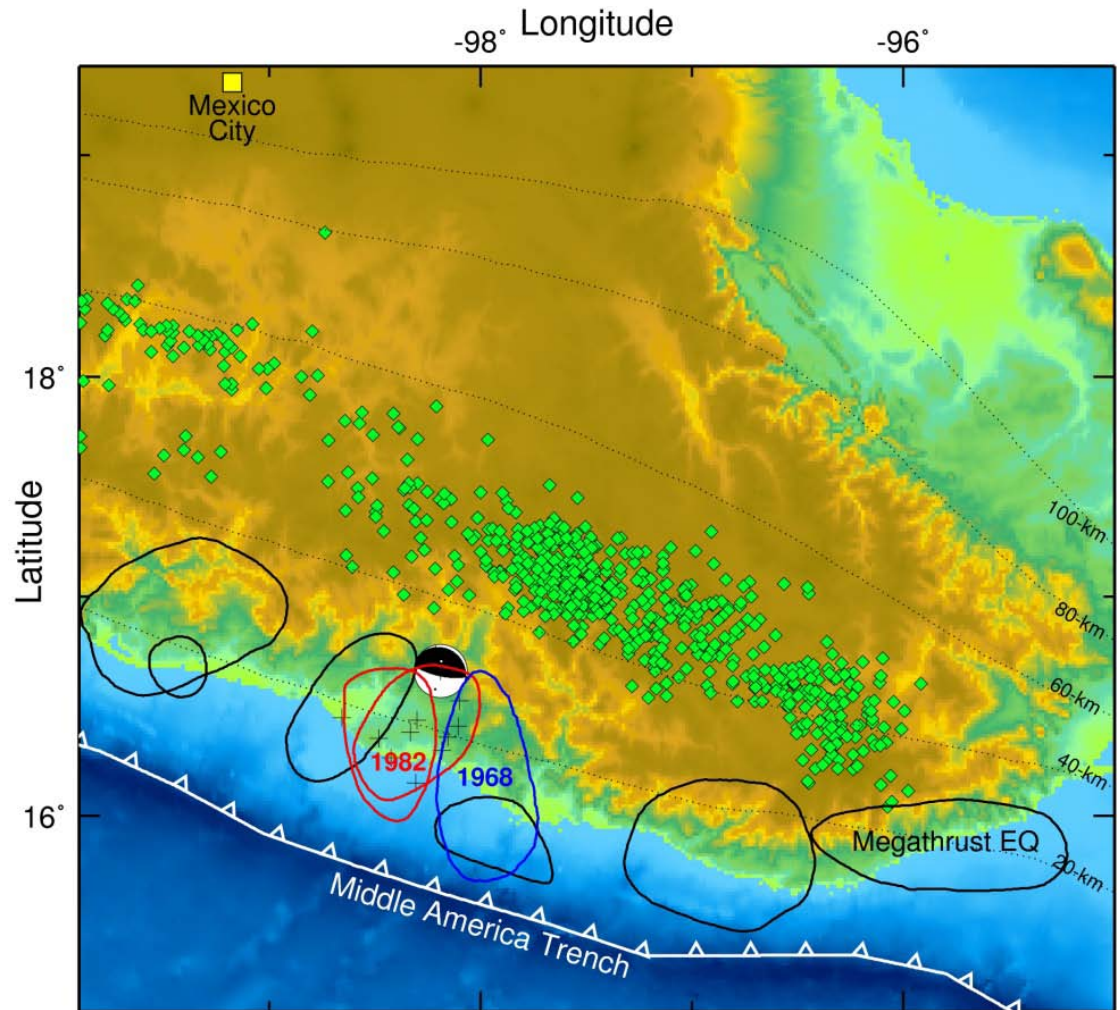


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The focal mechanism and depth of the earthquake are consistent with its occurrence on the subduction zone interface between these plates, approximately 100 km northeast of the Middle America Trench, where the Cocos plate begins its descent into the mantle beneath Mexico.

This is a scientifically important earthquake because there is some preliminary evidence that an episodic tremor and slip (ETS) event (green dots) was occurring when this earthquake happened. If true this will be the first case where the link between ETS and a potentially triggered earthquake can be evaluated.



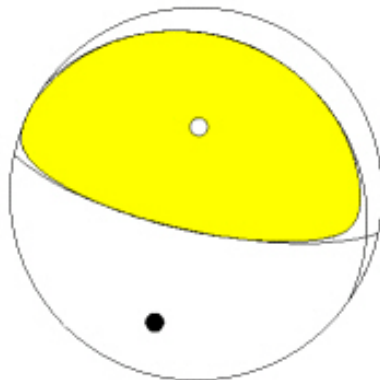
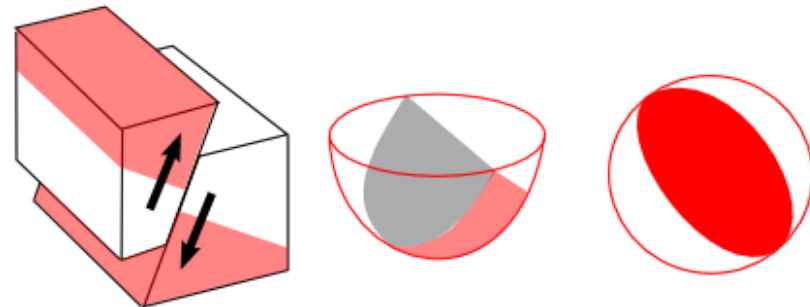
This regional view integrates tremor (green), a focal mechanism for this earthquake, preliminary large aftershocks of today's event (crosses), large megathrust earthquakes over the last ~70 years (black outlines)

Image courtesy Mike Brudzinski

The colored beach ball 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 fault the earthquake occurred on. In this case the waves indicate a thrust fault dipping slightly to the north consistent with the subduction interface.

Reverse/Thrust/Compression



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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- **Volcán de Colima**, south of Guadalajara, erupted in 1994
- **El Chichón**, in southern Mexico, underwent a violent eruption in 1983
- **Paricutín** in northwest Mexico began as puffs of smoke in a cornfield in 1943; a decade later the volcano was 2,700 meters high.



View of Popocatépetl seen from Mexico City



- Popocatépetl is one of Mexico's most active volcanoes.
- North America's 2nd-highest volcano
- In the past centuries large eruptions produced giant mud flows that buried Aztec settlements

Although dormant for decades, Popocatépetl occasionally sends out a puff of ash clearly visible in Mexico City, a reminder to the capital's inhabitants that volcanic activity is near. Popocatépetl showed renewed activity in 1995 and 1996, forcing the evacuation of several nearby villages and causing concern by seismologists and government officials about the effect that a large-scale eruption might have on the heavily populated region nearby.