Magnitude 5.8 BAJA CALIFORNIA, MEXICO
Wednesday, December 30, 2009 at 18:48:57 UTC

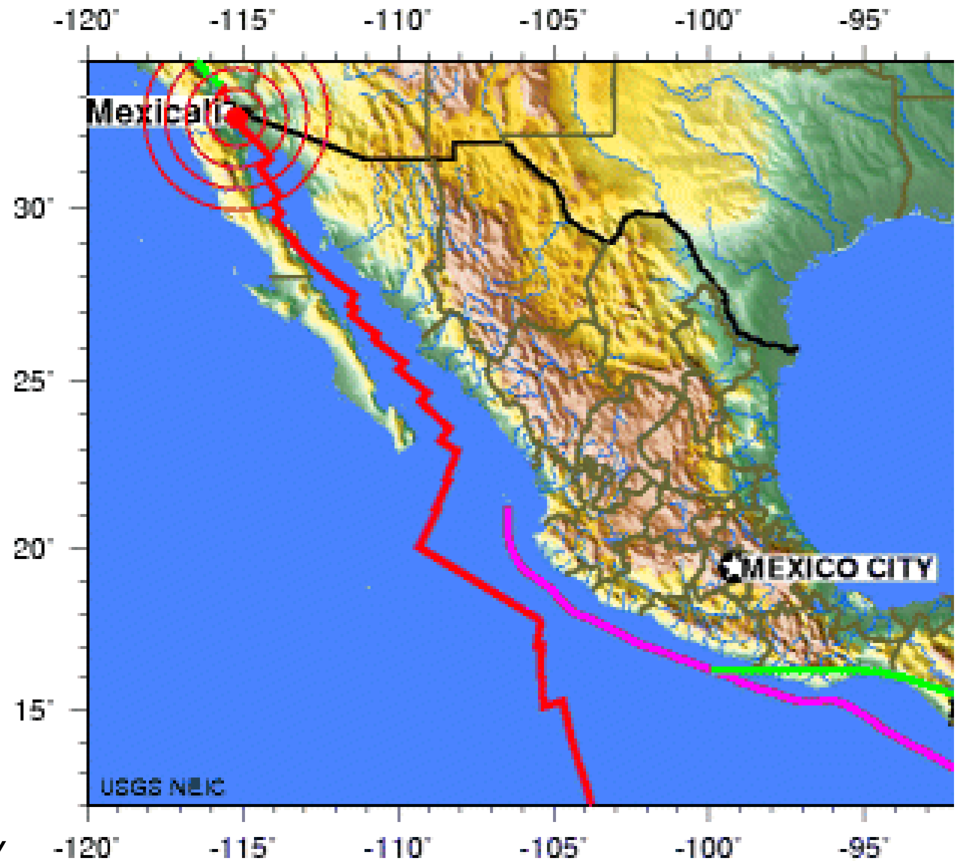
USGS

Residents along the California-Mexico border reported intense shaking but no major damage or injuries from today's 5.8 earthquake. There was minor damage reported in the Mexicali area, including cracked walls and broken windows.

According to the U.S. Geological Service, residents across Imperial County, San Diego County, Orange County and even Los Angeles County reported feeling the temblor.

In downtown San Diego, about 100 miles north of the epicenter, buildings swayed briefly, but there were no reports there of damage or injuries.

Anna Gorman and Tony Perry
Los Angeles Times



Images courtesy of the U.S. Geological Survey

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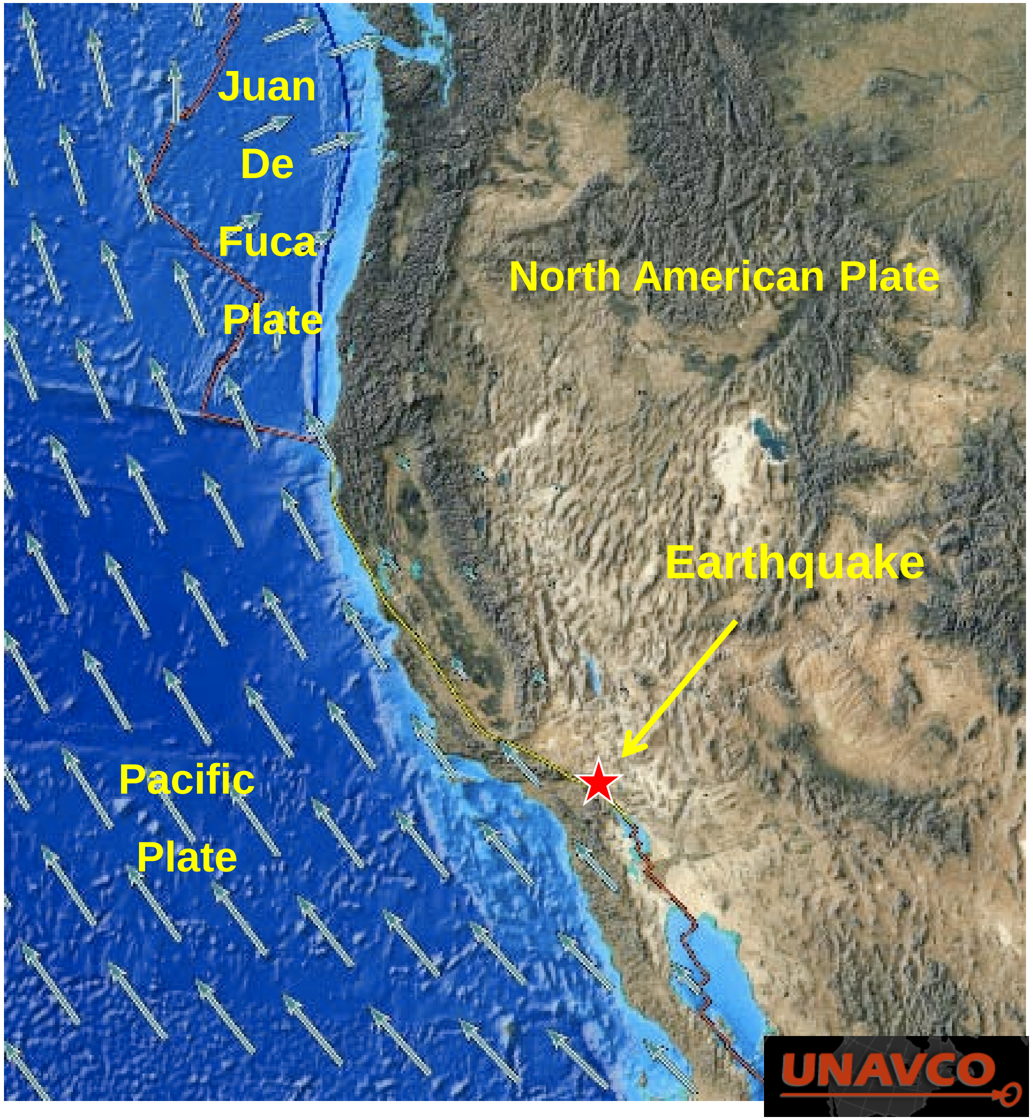
The epicenter of the December 30, 2009 earthquake is indicated by the red star on the map below.

This map also shows the rates and directions of motion of the Pacific and Juan de Fuca plates and with respect to the North American Plate. The rate of transform motion between the Pacific and North American plates is about 55 mm/yr (5.5 cm/year). The M5.8 earthquake that occurred Wednesday December 30 is typical of moderate and shallow earthquakes on this transform plate boundary.

For comparison, the rate of subduction of the Juan de Fuca Plate beneath the North American Plate at the Cascadia subduction zone is about 35 mm/yr (3.5 cm/year).



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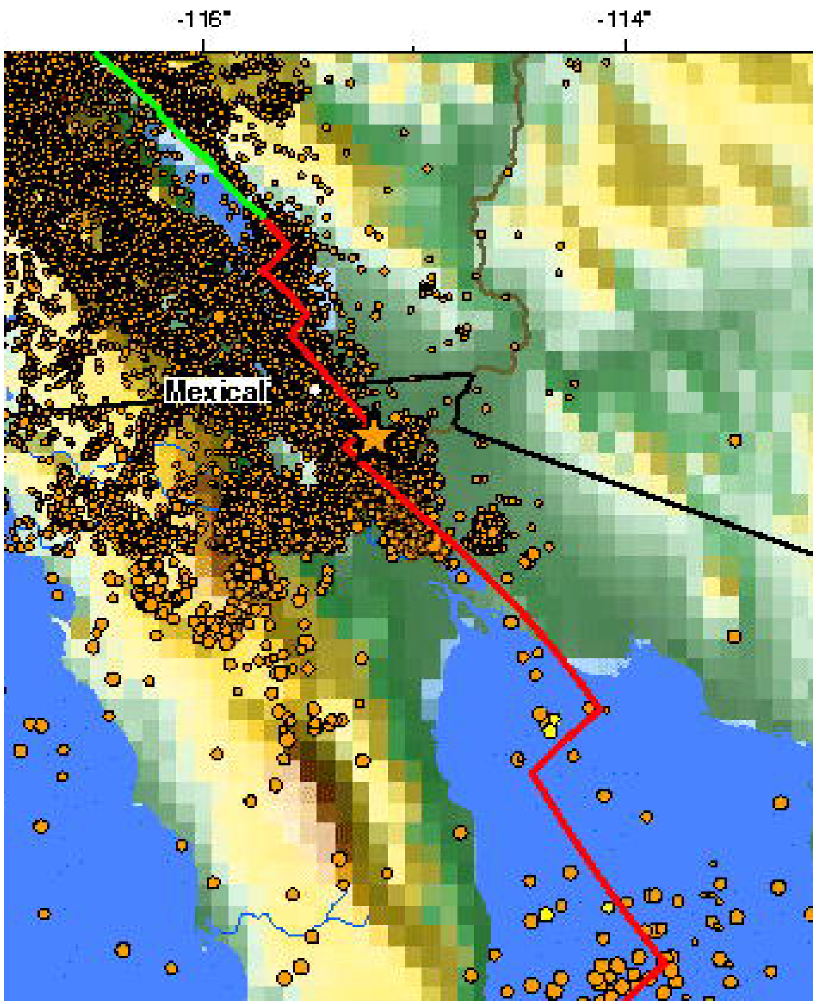

Image courtesy of the U.S. Geological Survey

This map shows historic earthquake activity near the epicenter (star) from 1990 to present. The earthquake of December 30, 2009 occurred on the transform plate boundary between the North American and Pacific Plates.

Northwest of the M 5.8 event, this transform boundary connects to the northwest – southeast oriented San Andreas Fault that is shown by the green line on the map of historic earthquake activity. Essentially all of the earthquakes in this region are shallow with depths less than 30 km as expected for earthquakes on transform plate boundaries.

Notice that there are many earthquakes distributed southwest of the North America – Pacific plate boundary on strike-slip faults that are parallel to the San Andreas Fault. This indicates that some of the relative motion between the North American and Pacific Plates occurs across this zone of distributed deformation. It is not all concentrated on the San Andreas Fault.

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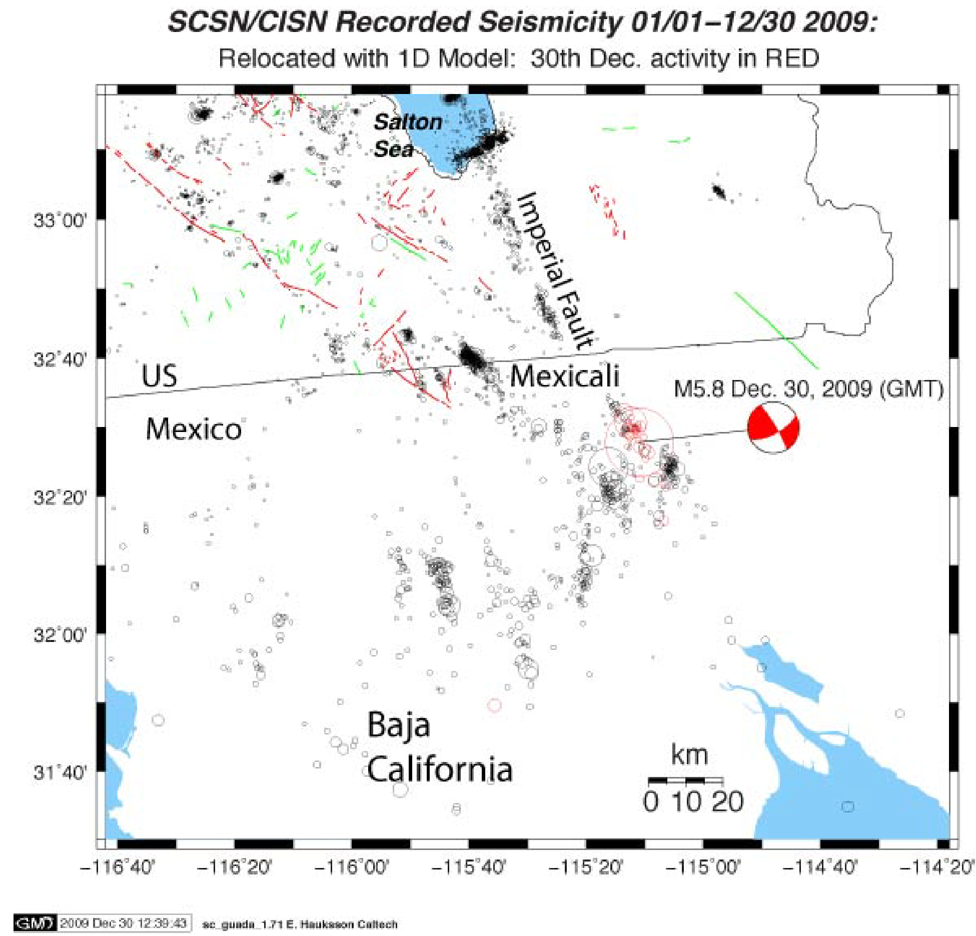
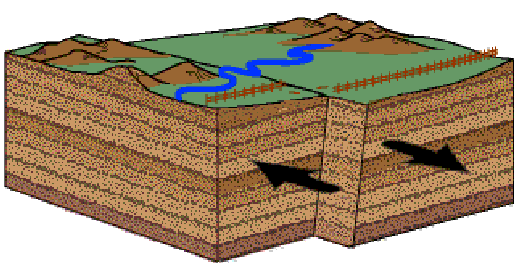
The principal plate boundary in northern Baja California consists of a series of northwest-trending strike-slip (transform) faults that are separated by pull-apart basins. The faults are distinct from, but parallel to, the San Andreas fault. The December 30 main-shock occurred near the southeastern end of a strike-slip segment of the plate boundary that coincides with the Imperial fault, and the focal-mechanism of the earthquake is consistent with the shock having occurred on the Imperial fault.



USGS



Strike-Slip Faulting

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USGS Centroid Moment Tensor Solution

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

Images courtesy of the U.S. Geological Survey

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USGS

Time-dependent map giving the probability of strong shaking at any location in California for the 24 hour period around the earthquake.

The map is showing the probability of a certain type of earthquake shaking- Modified Mercalli Intensity VI, or the level of shaking that throws objects off shelves. This is not magnitude, which would describe the size of the earthquake itself.

MMI VI is the shaking directly above a M4.5, 20 miles from a M6, or 50 miles from a M7.

Aftershocks occur at a defined rate but the time of any one is random. We can therefore never say when the next aftershock will happen but we can determine a probability that an aftershock will occur during a given interval of time.

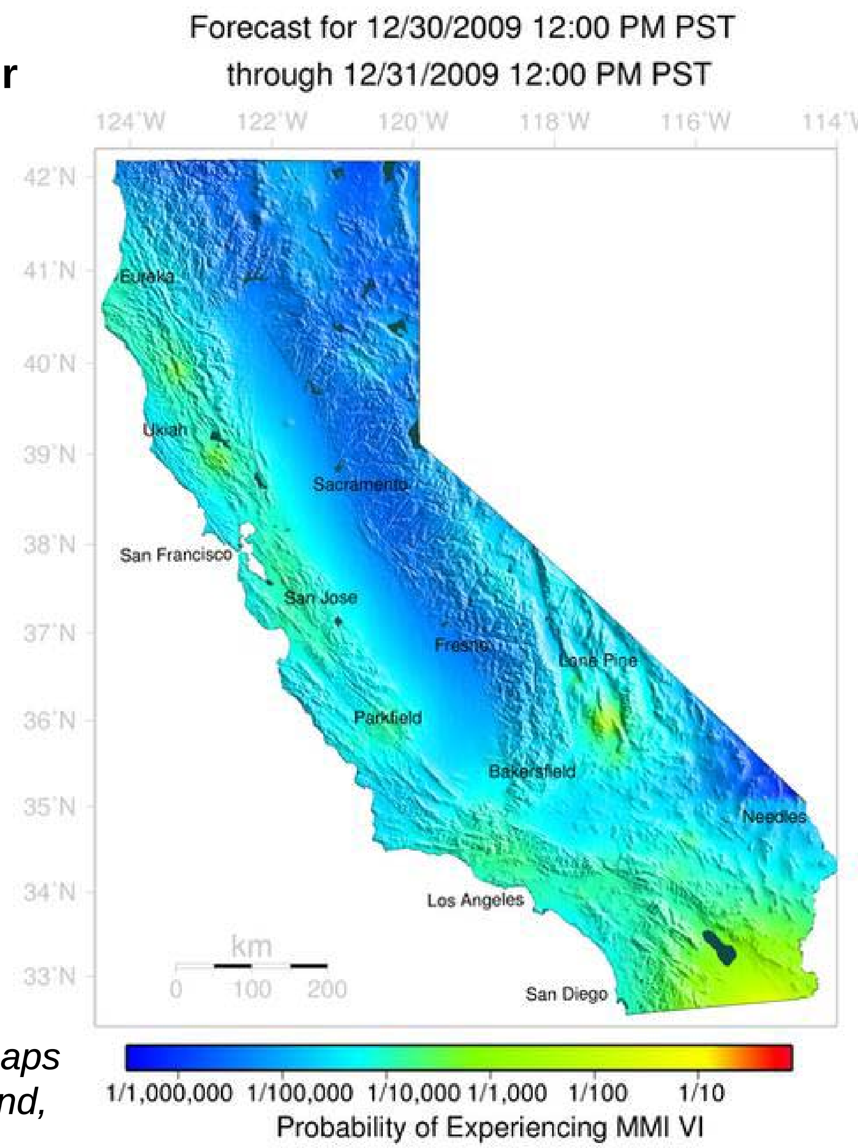

Image courtesy of the U.S. Geological Survey. These maps are made with contributions from ETH- Zurich, Switzerland, and the Southern California Earthquake Center.

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In a cluster, the earthquake with the largest magnitude is called the main shock, anything before is a foreshock, anything after is an aftershock. These aftershocks occur as the area around the displaced fault plane adjusts to the effects of the main shock.

17:54 : magnitude 3.5
17:57 : magnitude 2.6
18:48 : magnitude 5.8
18:53 : magnitude 4.8
18:55 : magnitude 3.6
18:57 : magnitude 3.0
18:58 : magnitude 3.0
19:04 : magnitude 2.7
19:07 : magnitude 4.0
19:10 : magnitude 3.4
19:11 : magnitude 2.7
19:12 : magnitude 2.9
19:15 : magnitude 2.8
19:17 : magnitude 2.6
19:21 : magnitude 3.1
19:22 : magnitude 3.3
19:24 : magnitude 3.2
19:26 : magnitude 2.7
19:30 : magnitude 2.7
19:35 : magnitude 2.9
19:38 : magnitude 2.5
19:51 : magnitude 2.8
19:55 : magnitude 2.6
19:59 : magnitude 3.3
20:03 : magnitude 2.8
20:06 : magnitude 3.5
20:10 : magnitude 2.5
20:18 : magnitude 2.7
20:20 : magnitude 2.9
20:22 : magnitude 2.6
20:24 : magnitude 3.9
20:30 : magnitude 3.6
20:32 : magnitude 3.2
20:37 : magnitude 2.5
20:52 : magnitude 2.5
20:52 : magnitude 3.0
21:01 : magnitude 2.6
21:42 : magnitude 2.8
22:03 : magnitude 2.6

Google Earth

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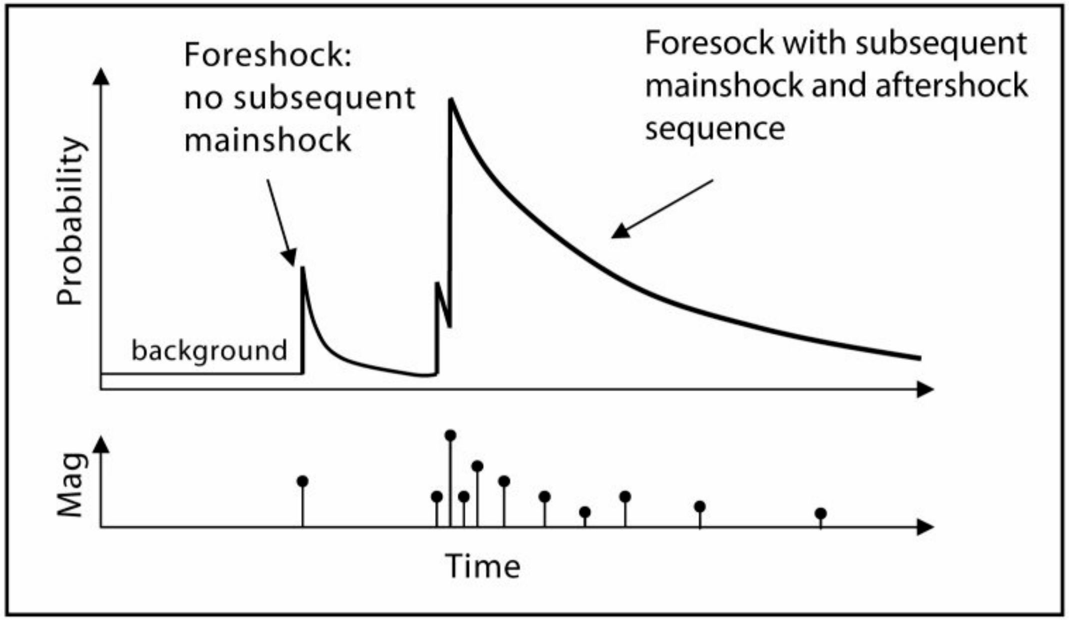
Aftershock sequences follow predictable patterns as a group, although the individual earthquakes are random and unpredictable. This pattern tells us that aftershocks decay with increasing time, increasing distance, and increasing magnitude. It is this average pattern that is used to make real-time predictions about the probability of ground shaking.

Aftershocks usually occur geographically near the main shock. The stress on the main shock's fault changes drastically during the main shock and that fault produces most of the aftershocks. Sometimes the change in stress caused by the main shock is great enough to trigger aftershocks on other, nearby faults, and for a very large main shock sometimes even farther away.



Generalized pattern of foreshock / mainshock / aftershock sequence

Image courtesy of the U.S. Geological Survey

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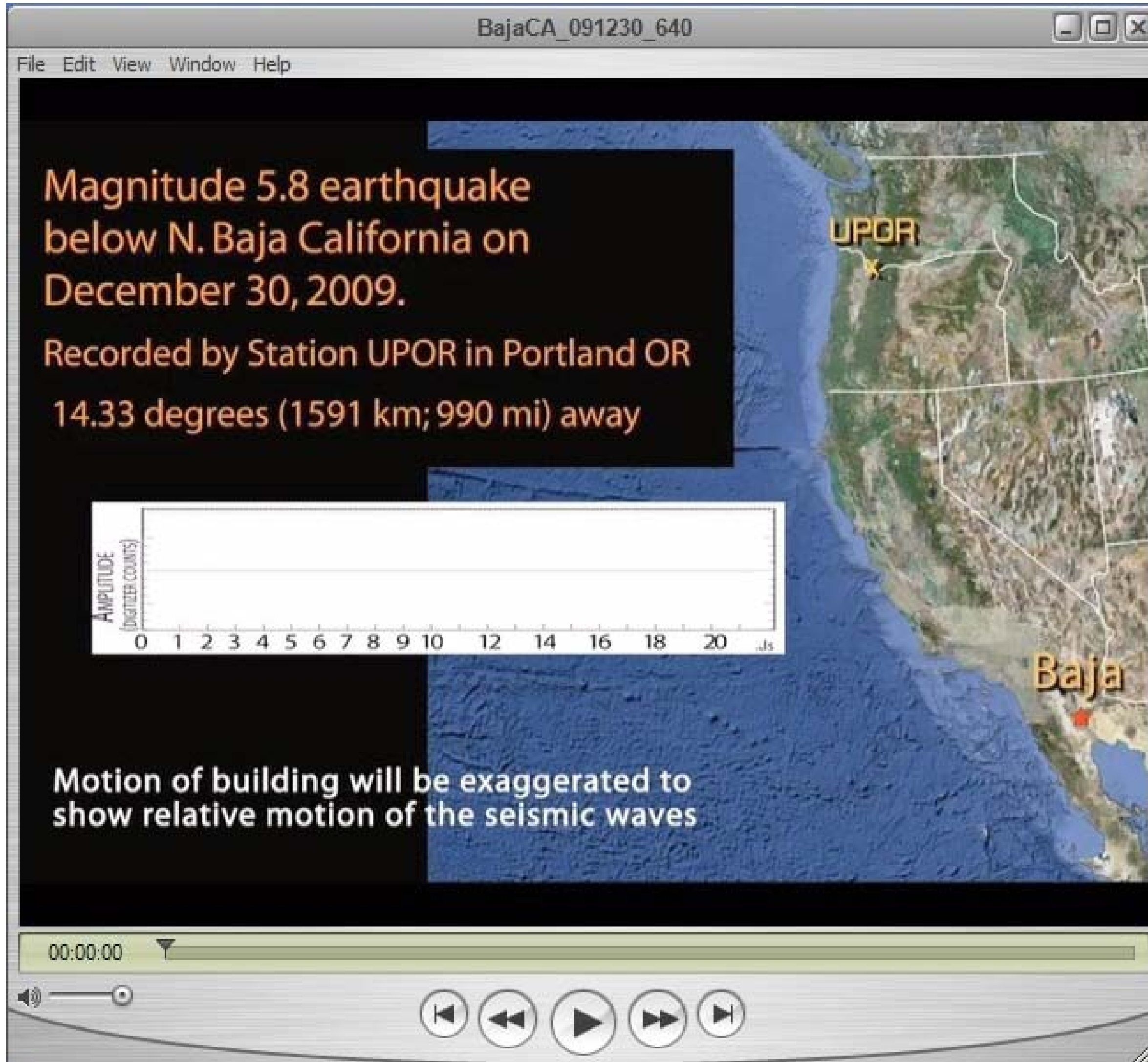
Quick Time Required

Animation of the generalized path of seismic waves traveling from the Baja earthquake to a seismometer in Portland, Oregon



Jenda Johnson

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The record of the Baja earthquake on the University of Portland AS-1 seismometer is illustrated below. Portland is about 989 km (5200 miles, 14.3 degrees) from the location of this earthquake.