Magnitude 7.1 JAPAN

Thursday, August 8, 2024 at 7:42:55 UTC

Latitude: 31.719 °N
Longitude: 131.527 °E
Depth: 25.0 km

A major magnitude 7.1 earthquake took place northeast of Nichinan, Japan on August 8th, 2024, at a depth of 25 km (15.5 miles).

After the earthquake occurred seismologists held a meeting to analyze the earthquake's effect on the nearby Nankai Trough, an area that has experienced large earthquakes in the past. Their consensus was to issue a "mega earthquake caution" due to a higher likelihood of larger earthquakes being triggered in the area after this one. This warning is the first of its kind since new protocol was established in 2019 but does not mean a larger earthquake will take place. It only warns that the possibility is slightly increased.

Such a warning is significant because the 2011 M 9.1 Tohoku-Oki earthquake was proceeded by a largely ignored 7.2 foreshock.

Tectonic background in and around the Japan Islands. Red triangles denote active volcanoes. Black lines with teeth symbols show the oceanic trenches where the oceanic plates are subducting into the mantle. The bright red star denotes this earthquake. (Image courtesy of Schmincke, 2004 and Zhao, 2012.)

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Larger losses of life and property were largely avoided due to Japan’s strict building codes.

A regional tsunami advisory was issued, and a small tsunami (50 cm) wave was recorded close to the event.

A house is seen collapsed in Oosaki town, Kagoshima prefecture, southern Japan Friday, Aug. 9, 2024, following Thursday's powerful earthquake. (Kyodo News via AP)

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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

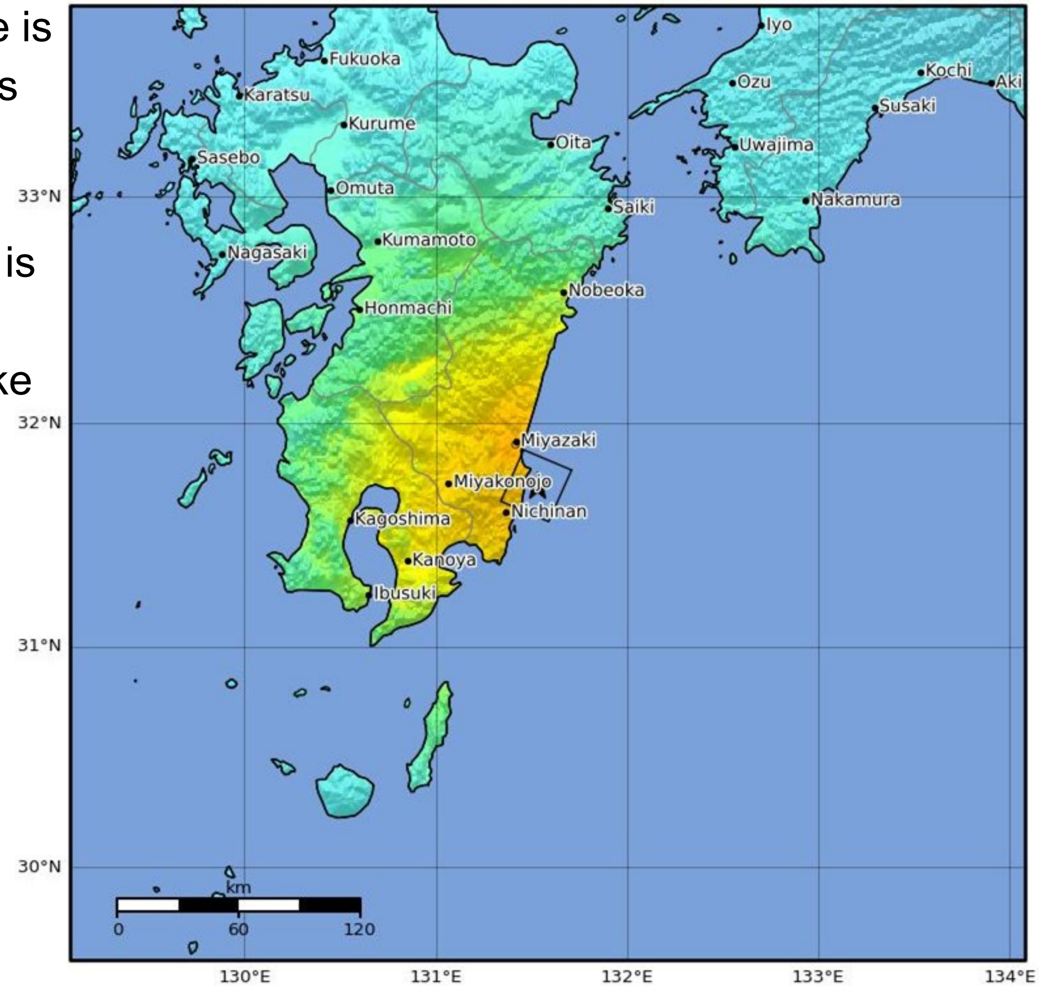

Image courtesy of the US Geological Survey

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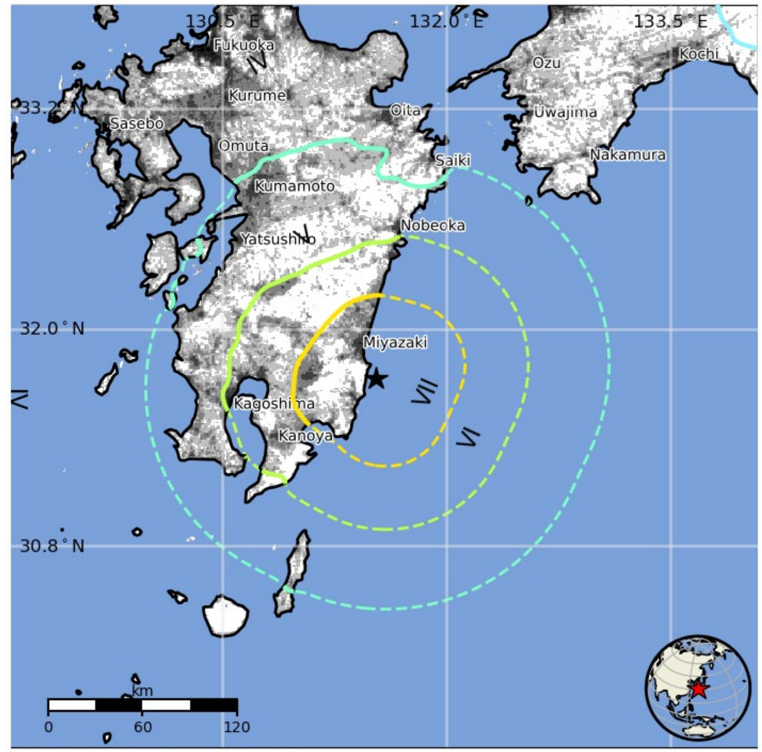
The USGS PAGER map shows the population exposed to different Modified Mercalli Intensity (MMI) levels. The USGS estimates that more than 400,000 people felt very strong shaking from this earthquake.

MMI	Shaking	Population
I	Not Felt	0 k*
II-III	Weak	5,041 k*
IV	Light	5,645 k
V	Moderate	1,481 k
VI	Strong	777 k
VII	Very Strong	400 k
VIII	Severe	0 k
IX	Violent	0 k
X	Extreme	0 k



Population per ~1 sq. km. from LandScan

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.

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This animation explains that Japan sits on the ring of fire and showcases the seismic activity that relates to the tectonic boundary.

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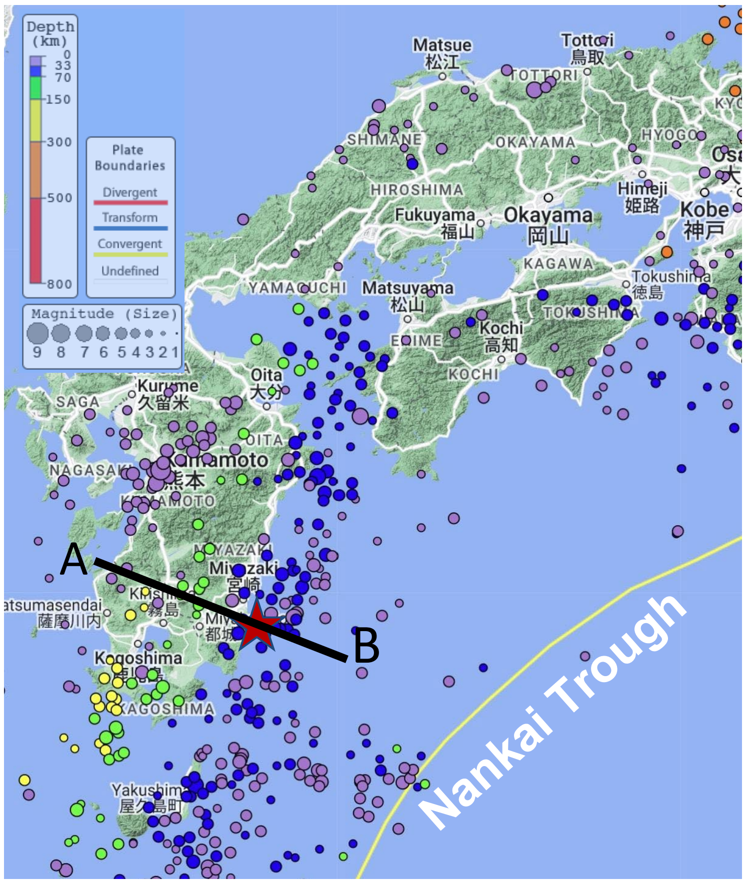
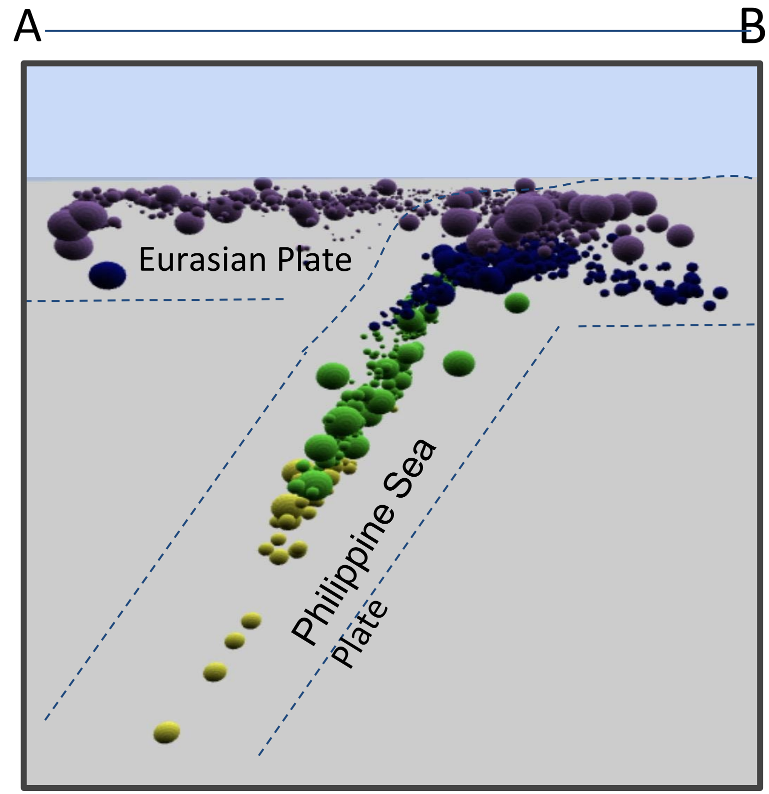
There have been more than 16,000 events recorded over the past decade in this region with about eight having been M6 or larger.



This map shows the most recent 25,000 earthquakes of the area. With the inset showing a static cross-section from A to B



The image above shows the area in cross-section, we can see this seismicity “outlines” a large subduction zone. Displayed are the most recent 25,000 earthquakes between the Eurasian Plate in the west and the Philippine Sea Plate in the east. Most events are shallow (purple) and become increasingly deeper as the progress westward (Blue, Green, and Yellow).

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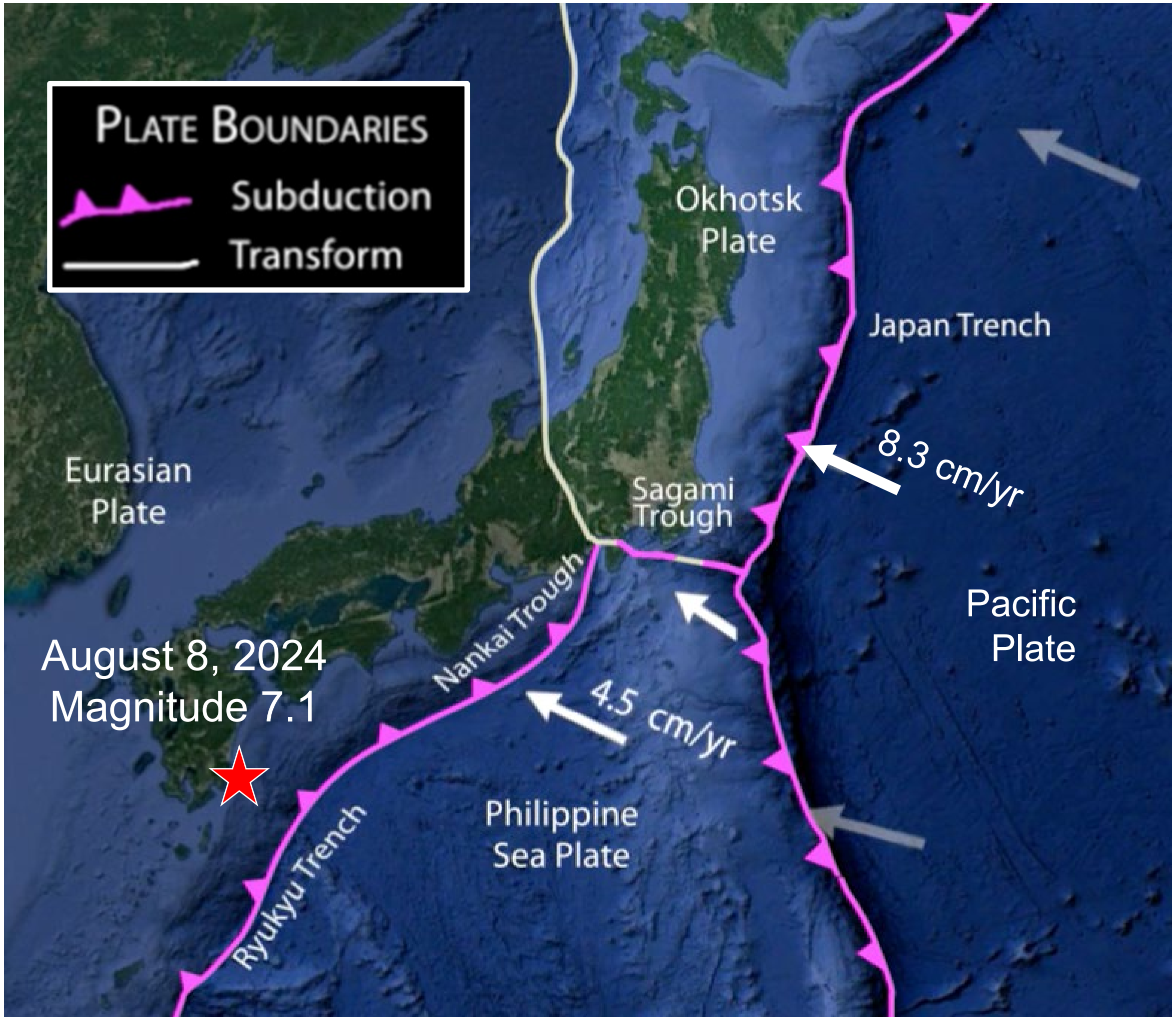
Active tectonics and earthquakes of Japan are the result of subduction zone and transform boundaries between the Pacific, Okhotsk, Philippine Sea, and Eurasian plates.

The Pacific Plate subducts into the Japan Trench and beneath northern Japan at a rate of 8.3 cm/year. In southern Japan, the Philippine Sea Plate subducts into the Nankai Trough and the Ryukyu Trench and beneath the Eurasian Plate at a rate of 4.5 cm/yr.

The epicenter of the magnitude 7.1 August 8, 2024 earthquake is shown by the red star.



Given the 25 km (15.5 miles) depth of this earthquake and its thrust-fault focal mechanism, the August 8 earthquake occurred on or near the subduction zone boundary between the Eurasian and Philippine Sea plates.

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This animation showcases the fundamental tectonics of Japan with a focus on the Nankai Trough region.

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Over 60% of Japan's nearly 124 million residents may be exposed to high intensity seismic shaking in the next 30 years. Seismic hazards are highest along the east coasts of Hokkaido and Honshu associated with subduction, while Kyūshū has a lower seismic hazard. Fortunately, the August 8 earthquake occurred in a less populated area.

Seismic Hazard of Japan (2024)

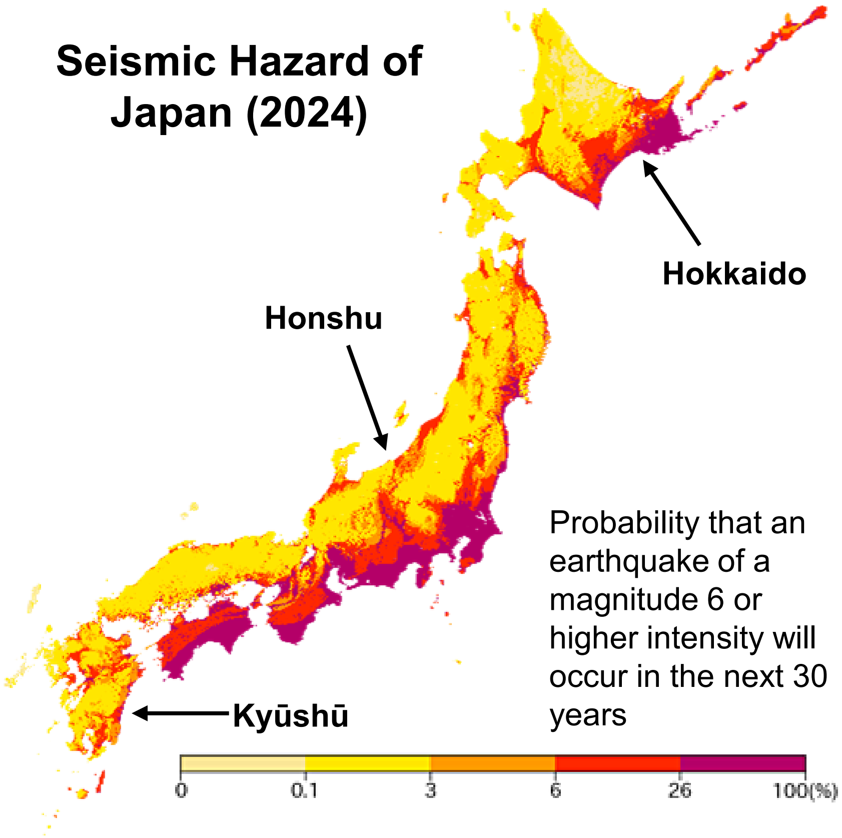

Image courtesy of Japan Seismic Hazard Information Station

Population Density of Japan (2009)

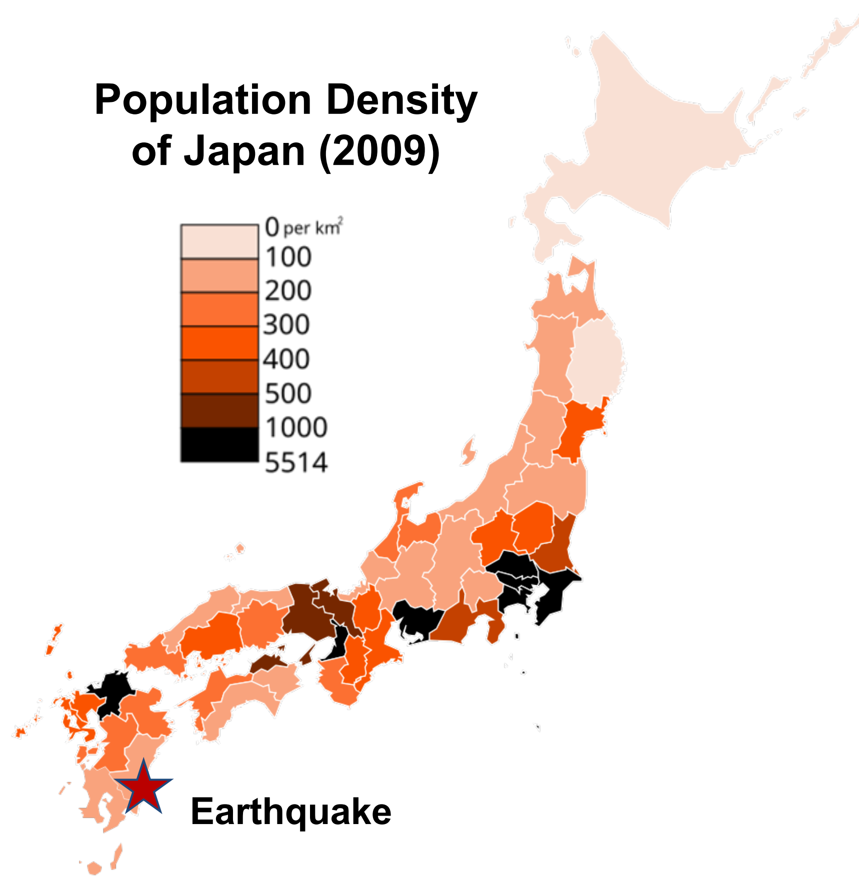

Image courtesy of Zuanzuanfuwa CC BY-SA 3.0

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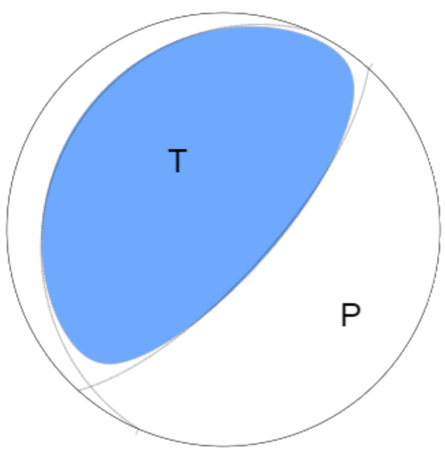
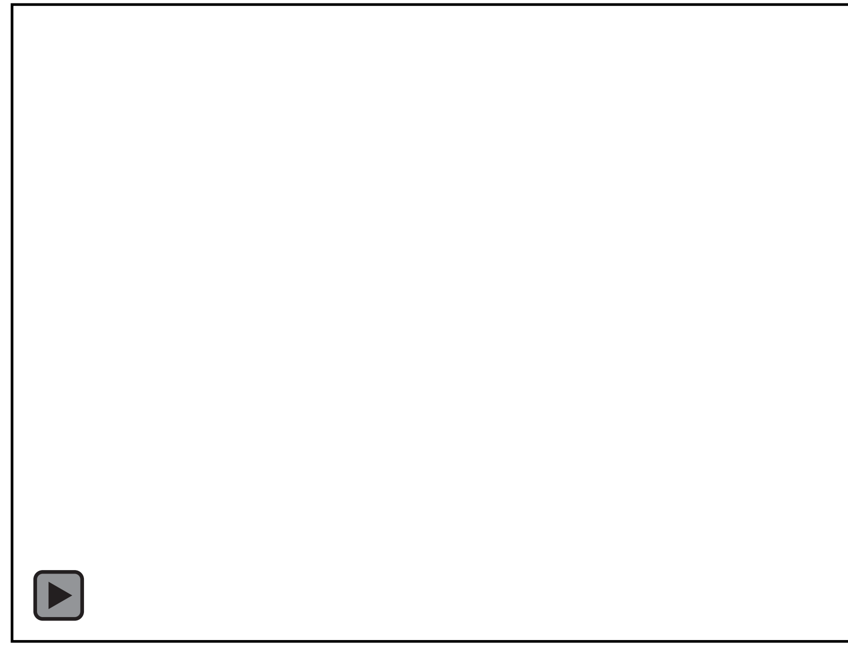
The focal mechanism is how seismologists plot the 3-D stress orientations of an earthquake. Because an earthquake occurs as slip on a fault, it generates primary (P) waves in quadrants where the first pulse is compressional (shaded) and quadrants where the first pulse is extensional (white).

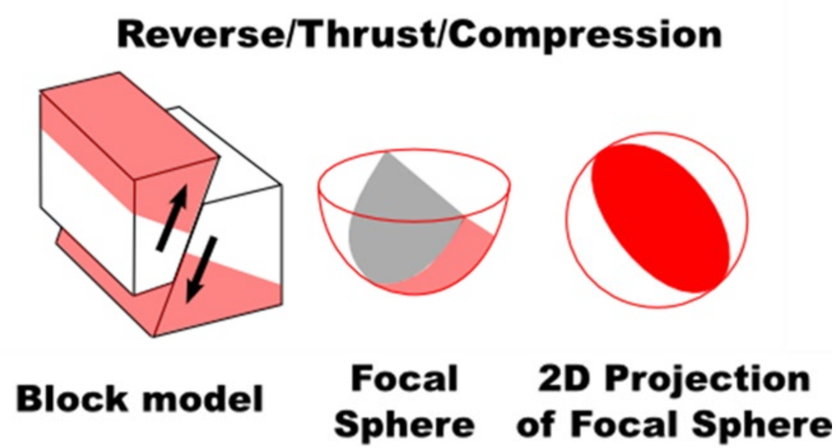
The orientation of these quadrants determined from recorded seismic waves determines the type of fault that produced the earthquake.



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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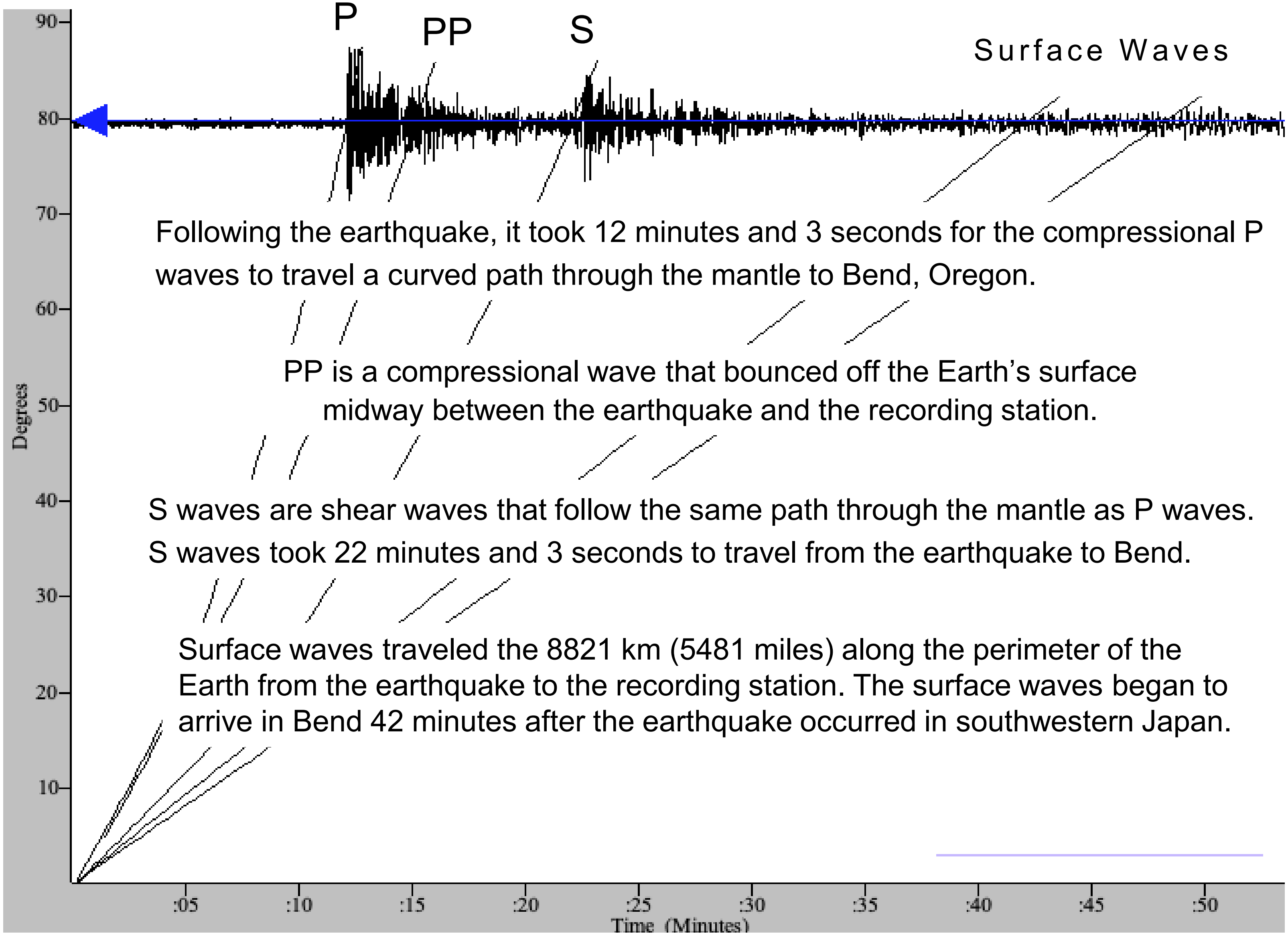
The record of the earthquake in Bend, Oregon (BNOR) is illustrated below. Bend is 8821 km (5481 miles, 79.5°) from the location of this earthquake.



Following the earthquake, it took 12 minutes and 3 seconds for the compressional P waves to travel a curved path through the mantle to Bend, Oregon.

PP is a compressional wave that bounced off the Earth's 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. S waves took 22 minutes and 3 seconds to travel from the earthquake to Bend.

Surface waves traveled the 8821 km (5481 miles) along the perimeter of the Earth from the earthquake to the recording station. The surface waves began to arrive in Bend 42 minutes after the earthquake occurred in southwestern Japan.

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