Magnitude 7.0 KYUSHU, JAPAN

Friday, April 15, 2016 at 16:25:06 UTC

Three strong to major earthquakes have occurred in Japan, including two foreshocks of M 6.2 and M 6.0 on April 14th and a M 7.0 early Saturday morning local time. The foreshocks caused severe shaking in the region and resulted in 9 reported fatalities and more than 1000 injuries. Early reports indicate that 32 people have died in the M 7.0 earthquake.

Resident houses are seen destroyed after an earthquake in Mashiki, Kumamoto prefecture, southern Japan, Saturday, April 16, 2016. Powerful earthquakes a day apart shook southern Japan, trapping many beneath flattened homes and sending thousands to seek shelter in gymnasiums and hotel lobbies.

(Yusuke Ogata/Kyodo News via AP)

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The earthquakes have caused extensive damage, overturning cars, splitting roads and triggering a landslide. These earthquakes were shallow (~10 km) underneath the city of Kumamoto (~ population 700,000). Shallower earthquakes result in more motion at the surface than do deeper earthquakes. Early estimates report that over 92,000 people have been evacuated.

Buildings are collapsed by a landslide caused by an earthquake in Minamiaso village, Kumamoto prefecture, Japan, Saturday, April 16, 2016 (local time). The powerful earthquake struck southwestern Japan early Saturday, barely 24 hours after a smaller quake hit the same region.

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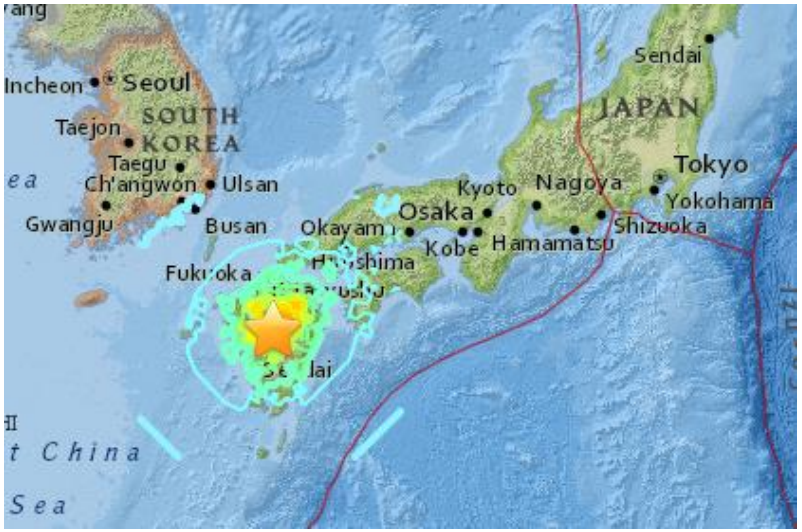
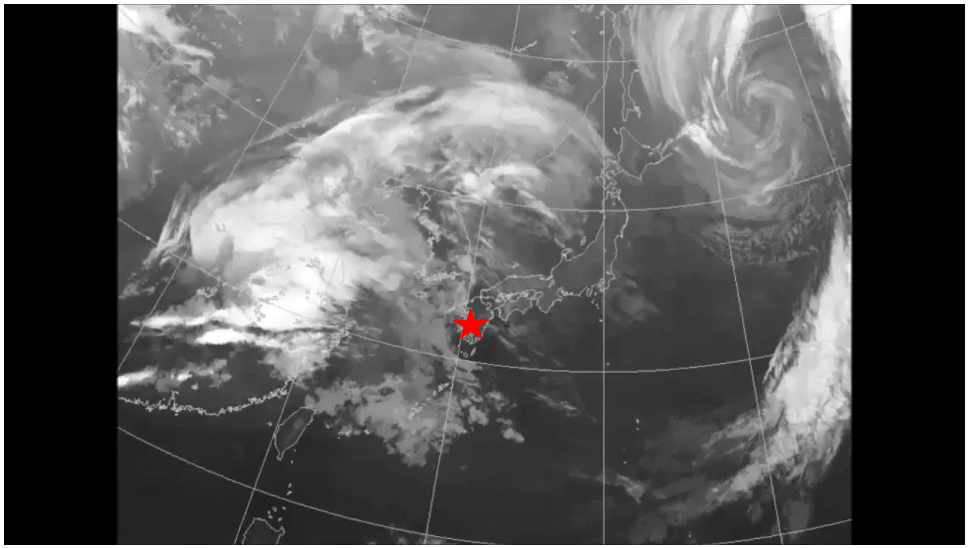
Heavy rains were expected through Sunday adding to the complexity of recovery efforts. The weather, together with the aftershocks, contribute to the threat of additional landslides.





This animation shows satellite imagery from the Himawari series of geostationary meteorological satellites looped from shortly after the earthquake for the following 24 hours.

Animation courtesy of the Japan Meteorological Agency

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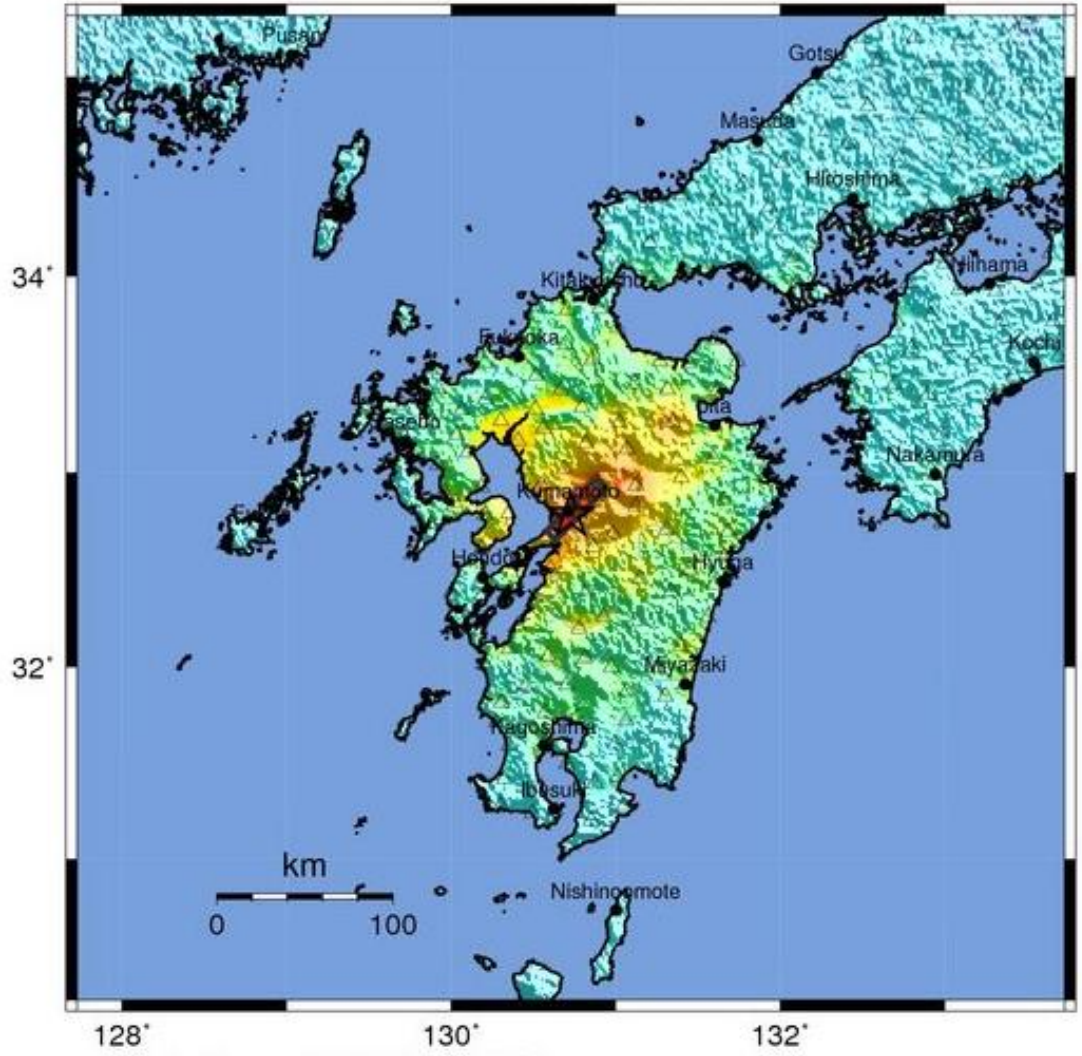
The Modified-Mercalli Intensity scale is a twelve-stage scale, from I to XII, that indicates the severity of ground shaking.

This region has experienced severe to violent shaking from three earthquakes in two days.

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



USGS Estimated Shaking Intensity

Image courtesy of the US Geological Survey

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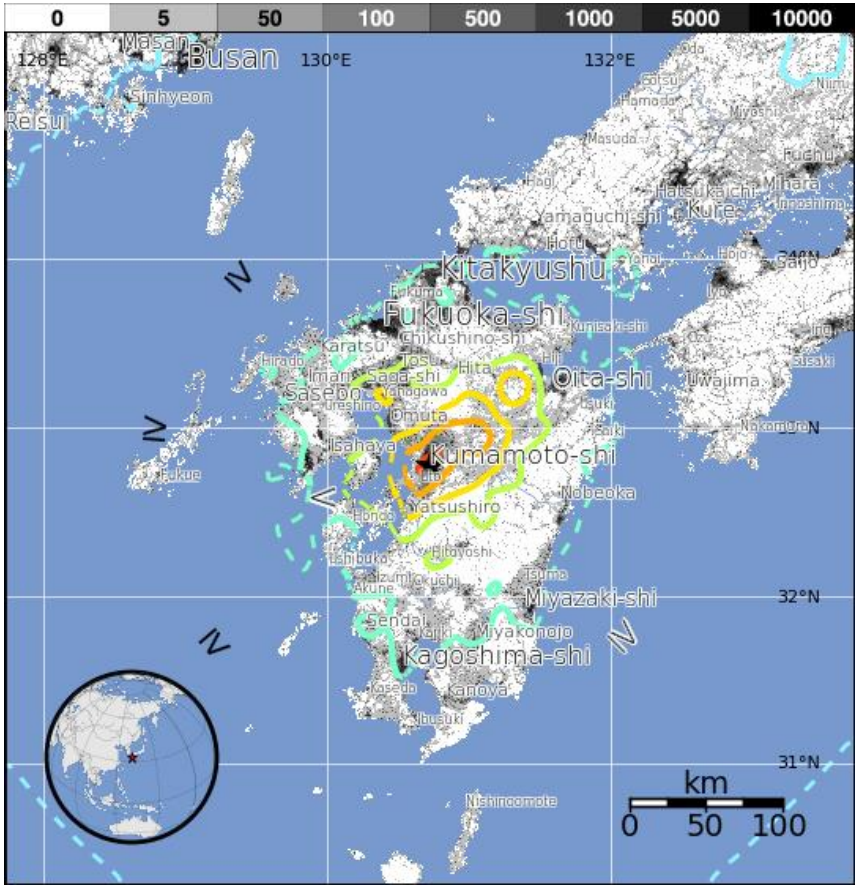
USGS PAGER

Population Exposed to Earthquake Shaking

The USGS PAGER map shows the population exposed to different Modified Mercalli Intensity (MMI) levels.

The USGS estimates that 716,000 people experienced violent shaking from this earthquake.

MMI	Shaking	Pop.
I	Not Felt	--*
II-III	Weak	2,048 k*
IV	Light	11,214 k*
V	Moderate	8,496 k
VI	Strong	2,669 k
VII	Very Strong	551 k
VIII	Severe	391 k
IX	Violent	716 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 the contour lines. The estimated population exposure to each MMI Intensity is shown in the table below.

Image courtesy of the US Geological Survey

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The plate tectonic map below shows rates of motion between the Pacific, Philippine, and Eurasian plates. In the region of Kyushu Island, the Philippine Plate subducts beneath the Eurasian Plate at a rate of about 5 cm/yr.

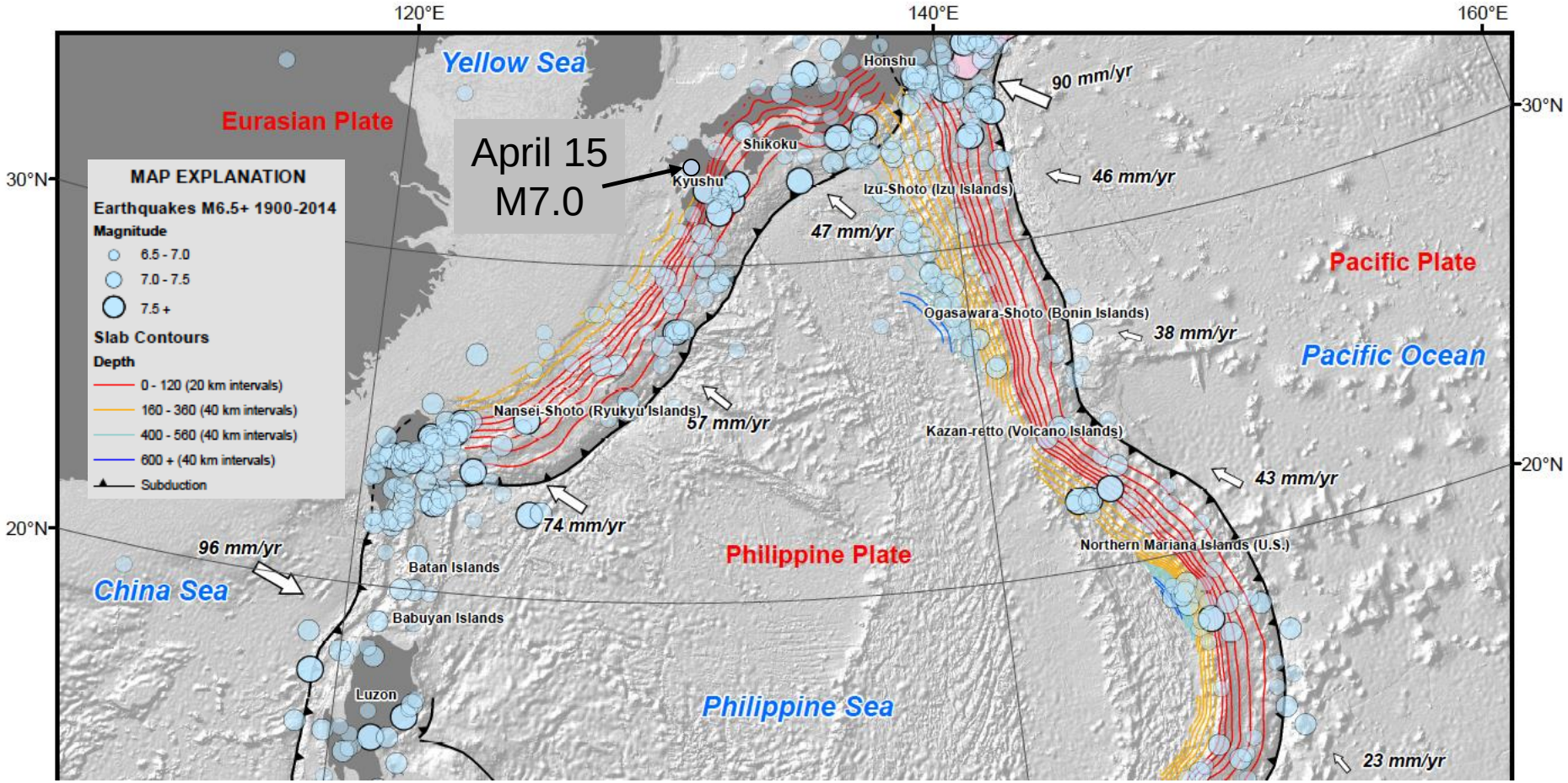

Image courtesy of the US Geological Survey

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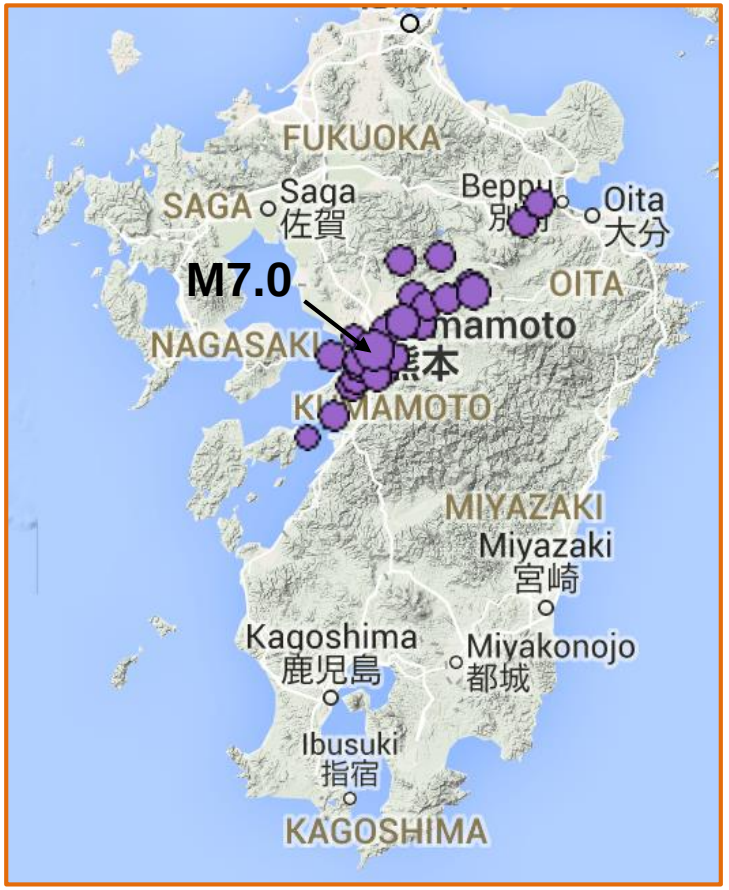
April 14 Foreshocks

M 7.0 & April 15 – 16 Aftershocks



Maps generated using IRIS Interactive Earthquake Browser

On April 14, eighteen earthquakes occurred near Kumamoto, including a magnitude 6.2 event that killed 9 people. In retrospect, the April 14 events are recognized as foreshocks to the April 15 magnitude 7.0 earthquake (main shock). In the 25 hours following the M7.0 earthquake, 25 aftershocks occurred with magnitudes up to 5.7.

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In a sequence of earthquakes, the earthquake with the largest magnitude is called the main shock; anything before it is a foreshock and anything after it is an aftershock. There is no way to know before a main shock occurs that the previous earthquakes have been foreshocks.

Aftershock sequences follow predictable patterns as a group, although the individual earthquakes are themselves not predictable.

The graph shows how the number of aftershocks and the magnitude of aftershocks decay with increasing time since the main shock. The number of aftershocks also decreases with distance from the main shock.

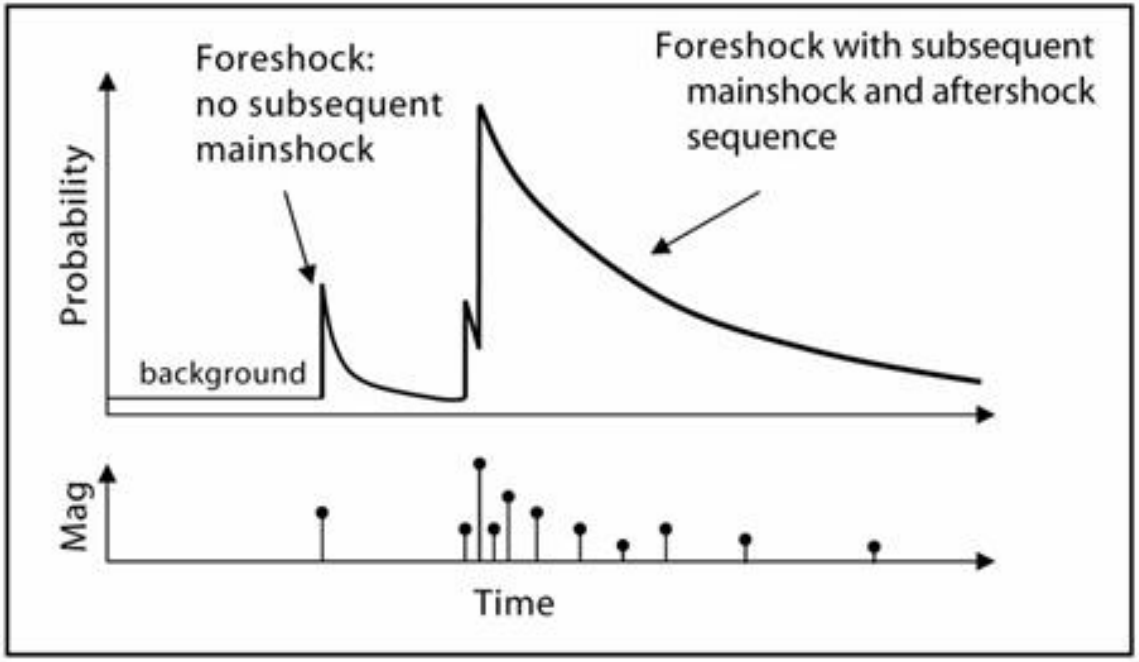

Image and text courtesy of the US Geological Survey

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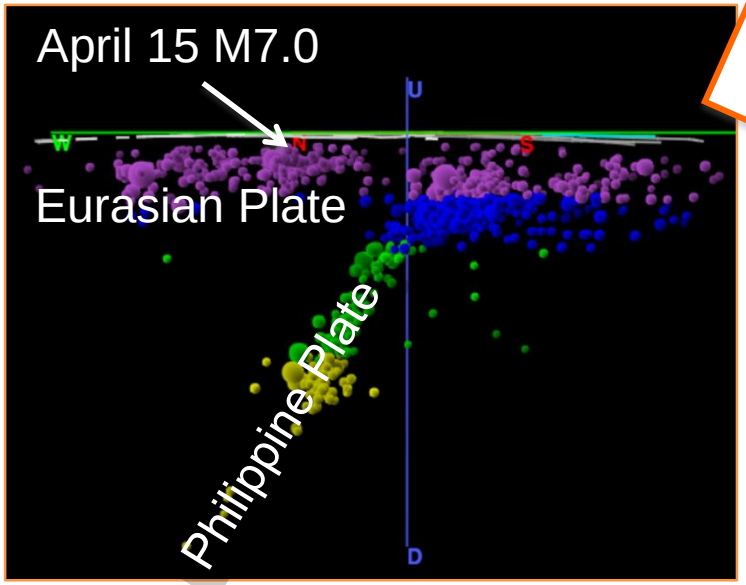
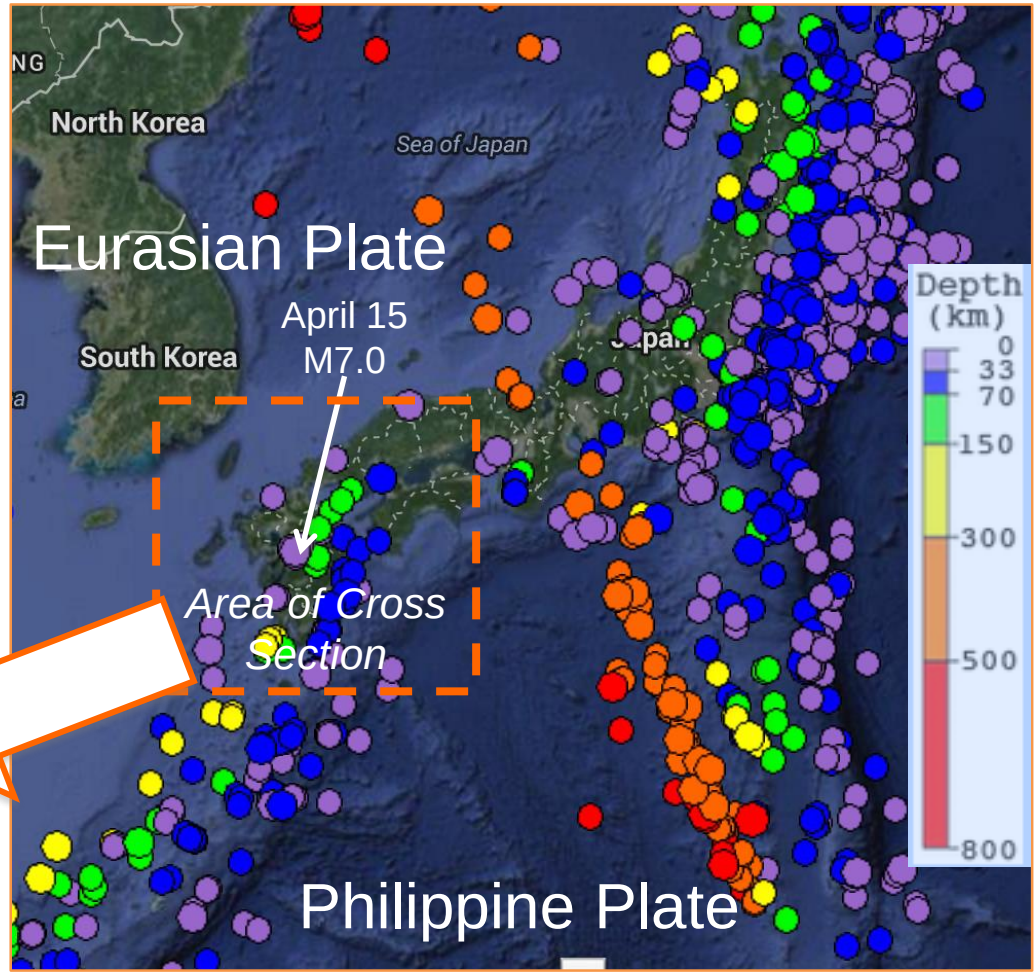
Earthquake and Historic Seismicity

The epicenter of the April 15 M 7.0 earthquake is shown on the regional seismicity map at right. The cross section below, shows the Philippine Plate subducting below the Eurasian Plate. The April 15 earthquake occurred on a crustal fault within the Eurasian Plate.





Map generated using IRIS Interactive Earthquake Browser

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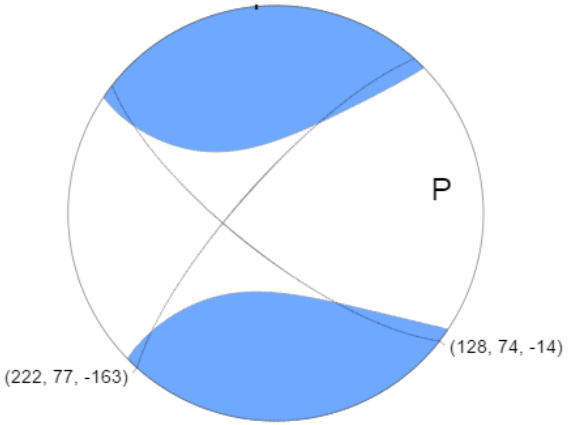
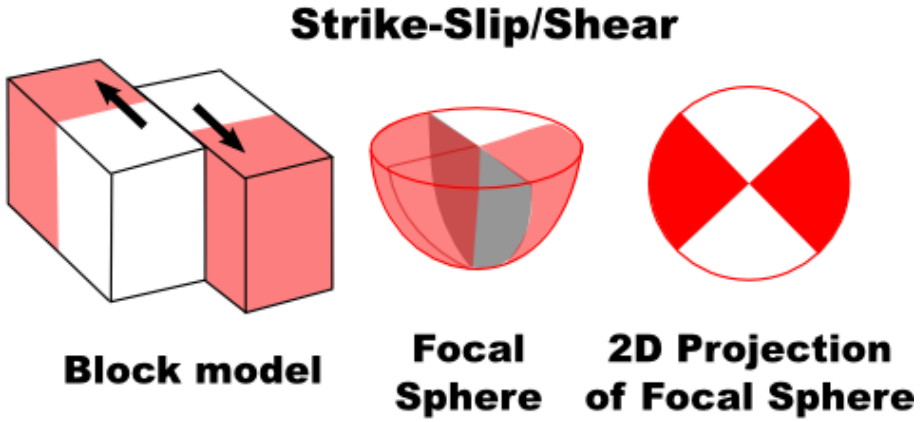
The focal mechanism for the earthquake indicates this was a strike-slip fault. Slip occurred on either a left lateral fault striking to the northwest, or on a right lateral fault striking northeast. The northeast-southwest orientation of the aftershock distribution speaks strongly that the fault plane is oriented in that direction and the earthquake was caused by right-lateral strike-slip motion on a NE-SW oriented fault plane.

According to the USGS, while the earthquake occurred several hundred kilometers northwest of the Ryukyu Trench where the Philippine Sea Plate begins its northwestward subduction beneath Japan and the Eurasian Plate, the shallow depth and faulting mechanism of this earthquake indicate it occurred on a crustal fault within the overriding Eurasian Plate.





USGS Centroid Moment Tensor Solution

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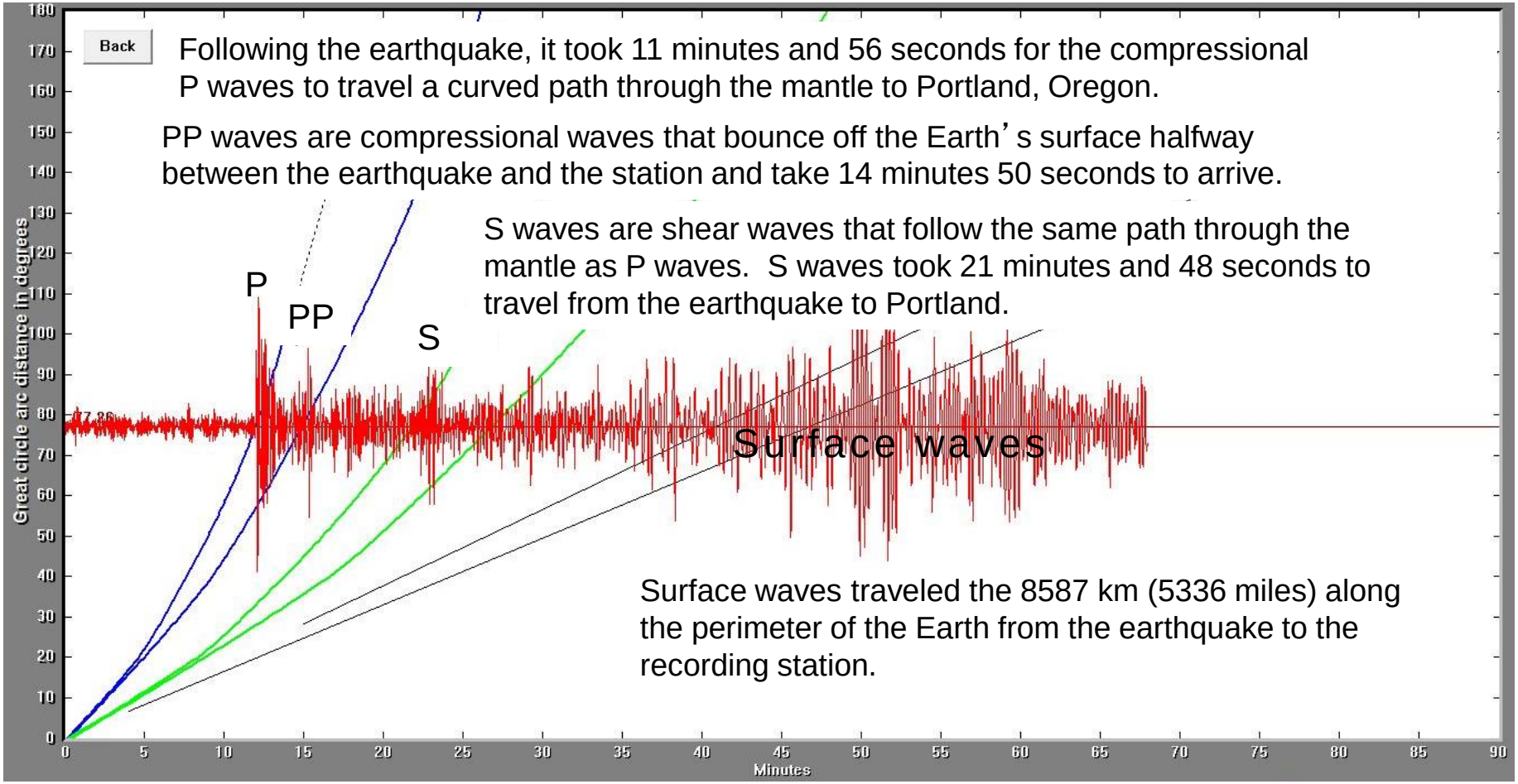
The record of the earthquake on the University of Portland seismometer (UPOR) is illustrated below. Portland is 8587 km (5336 miles, 77.36˚) from the location of this earthquake.



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