Magnitude 7.2 PERU

Friday, June 28, 2024 at 5:36:37 UTC

Latitude 15.811° S
Longitude 74.445°W
Depth 28 km

A 7.2 magnitude earthquake occurred off the coast of southern Peru just after midnight local time (12:36 am) on Friday at a depth of 28 kilometers (17 miles).

The earthquake occurred 317 kilometers (197 miles) northwest of Ariquipa, and about 600 kilometers (372 miles) south of the capital Lima.

Eight people have been reported injured in the earthquake and landslides have been reported on local roads. At least four aftershocks greater than magnitude 4.0 have been felt in the region.

Authorities initially issued tsunami warnings for coastal areas of Peru and Chile following the earthquake, but these warnings have since been rescinded.

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Video of stone that has slid on the Southern portion of the Pan-American Highway following the earthquake.

Video courtesy X @JovenesUnidosP

The Pan-American Highway from Prudhoe Bay, Alaska, to Quellón, Chile, and Ushuaia, Argentina, with official and unofficial routes shown in Mexico and Central and South America.

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The city of Arequipa, Peru is a UNESCO World Heritage site recognized for its architecture that reflects its Incan and Spanish-colonial history as well as its geologic history. It is nicknamed the “white city” due to the use of sillar -white volcanic stone- used in its historic buildings.

Besides the Basilica Cathedral (right), plazas, and food, visitors enjoy hiking the nearby Chachani (lower left; part of the Central Volcano Zone of the Andes) and Colca Canyon (lower right; one of the deepest canyons in the world) which supports a high biodiverse population due to multiple climates found within it.

These points of interest provide evidence of the tectonic nature of the region.

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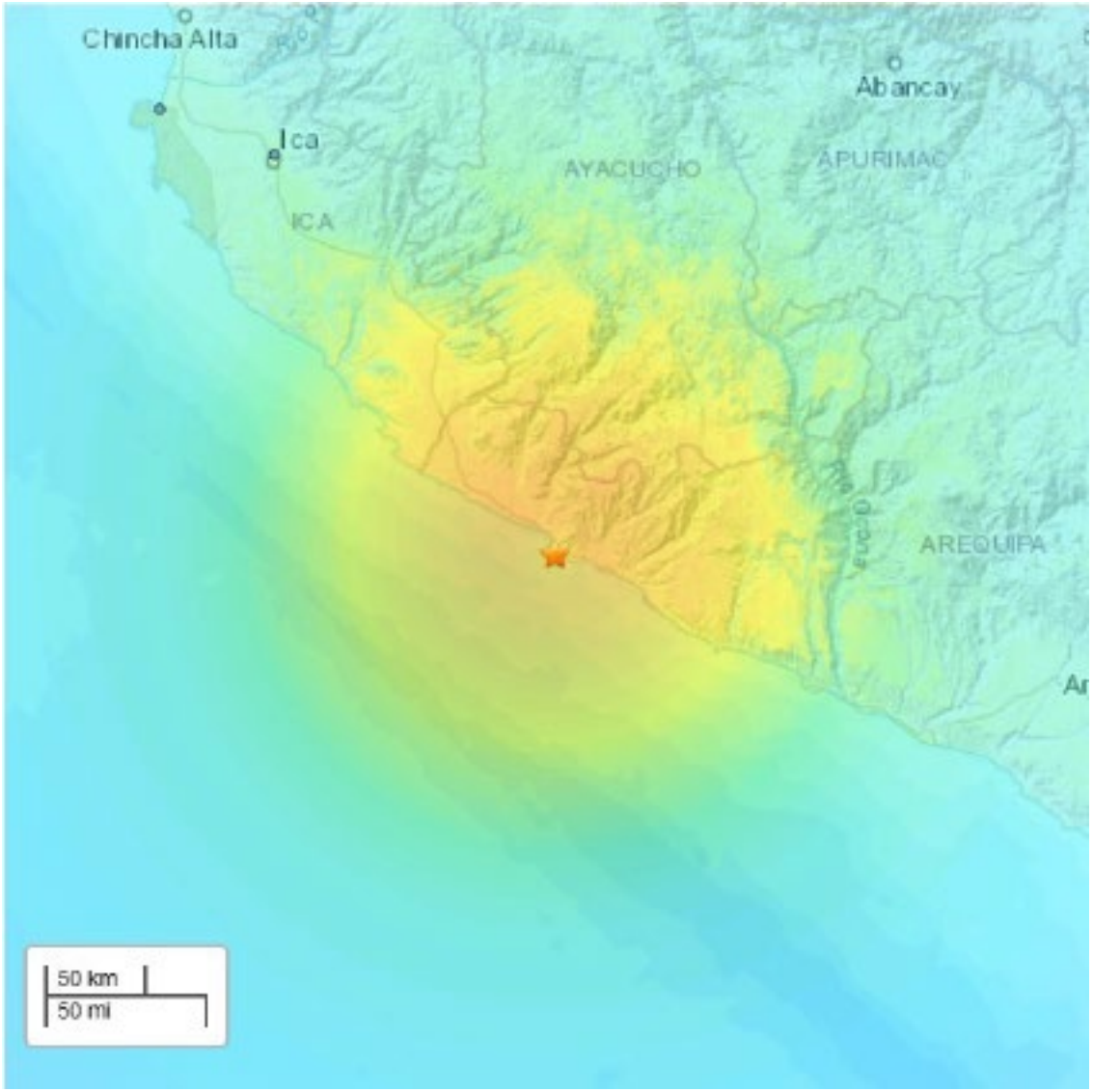
The Modified-Mercalli Intensity (MMI) scale is a ten-stage scale, from I to X, that indicates the severity of ground shaking.

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



USGS estimated shaking intensity from M 7.2 Earthquake

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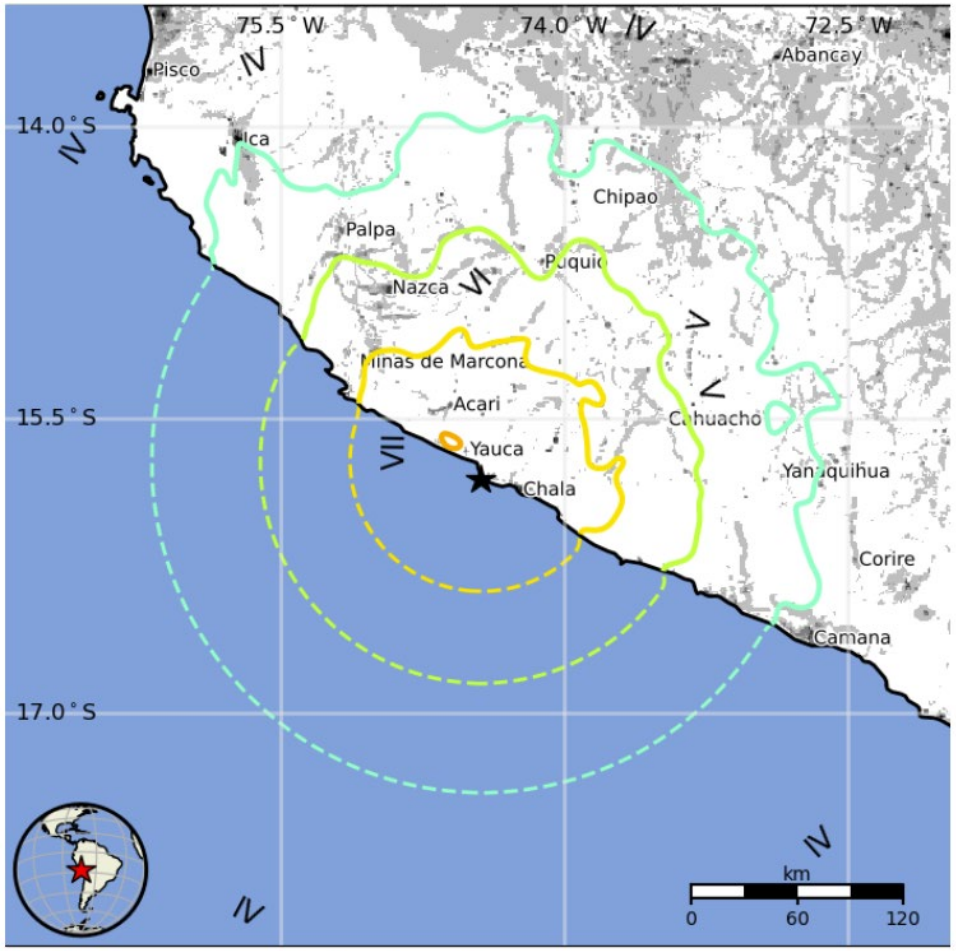
The USGS PAGER map shows the population exposed to different Modified Mercalli Intensity (MMI) levels. The USGS estimates that approximately 1,000 people felt severe shaking from this earthquake.

MMI	Shaking	Population
I	Not Felt	0 k*
II-III	Weak	0 k*
IV	Light	1,874 k*
V	Moderate	417 k
VI	Strong	97 k
VII	Very Strong	67 k
VIII	Severe	1 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 the contour lines. The estimated population exposure to each MMI Intensity is shown in the table.

Image courtesy of the US Geological Survey

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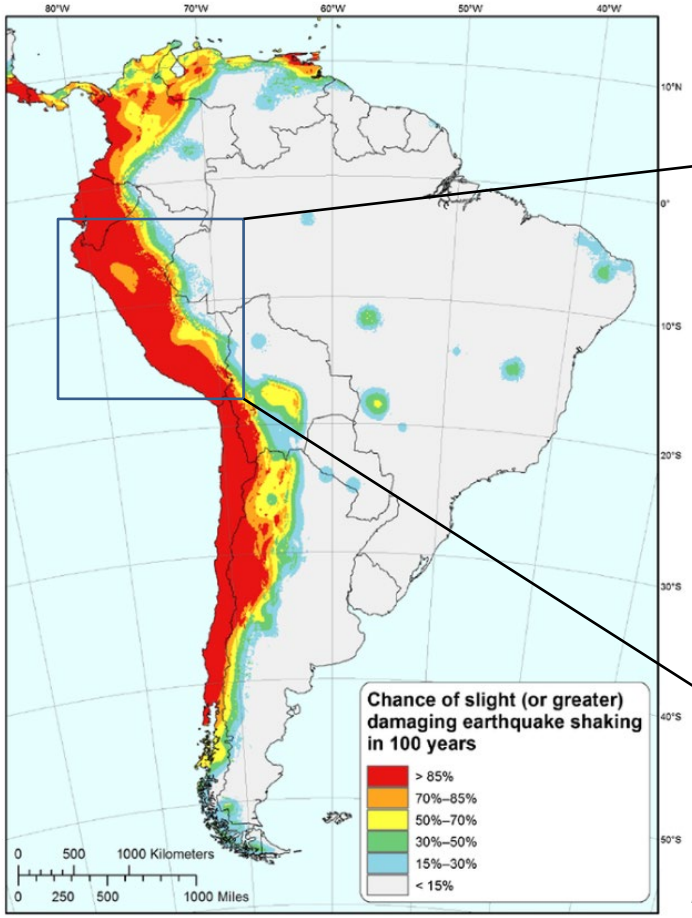
Over 160 million people (or about a third of the total population of South America) live in areas with significantly elevated seismic hazard, primarily within the northern and western portions of the continent where earthquakes associated with subduction and crustal faulting are most common. Fortunately, the June 28 earthquake occurred in a sparsely populated area.



Map courtesy USGS

Population Density of Peru (2018)

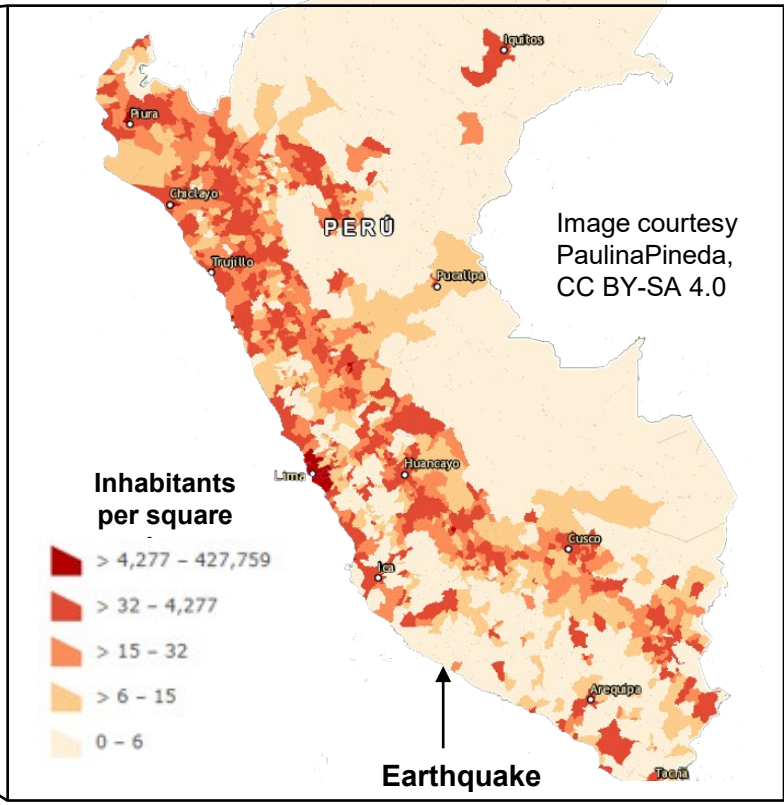


Image courtesy PaulinaPineda, CC BY-SA 4.0

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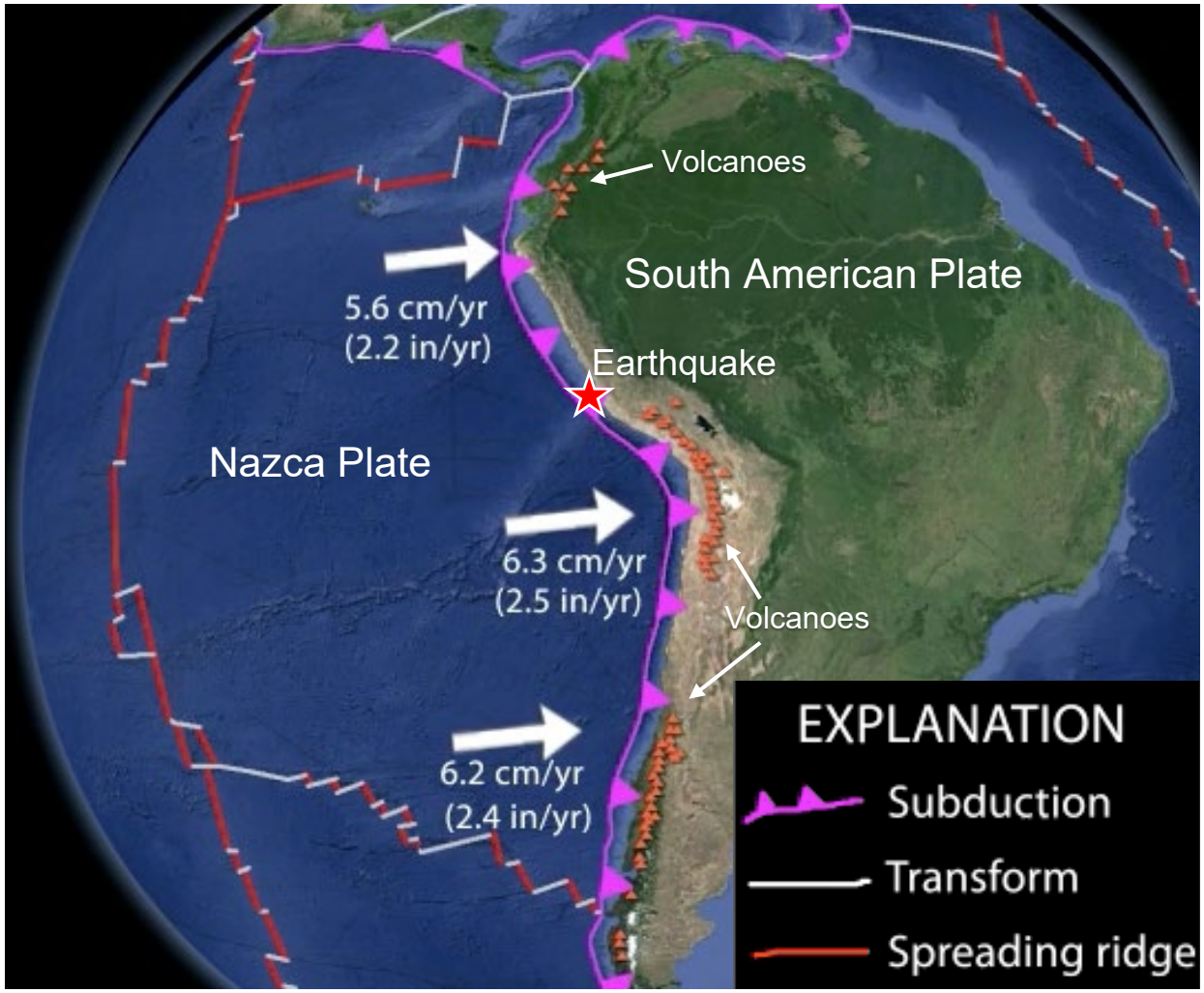
This illustration shows the rate and direction of motion of the Nazca Plate with respect to the South American Plate. Locations of active Andean volcanoes are shown by the orange triangles.

The June 28th earthquake is shown by the red star. At this location, the Nazca Plate subducts beneath the South America Plate at a velocity of about 6.2 cm/yr.



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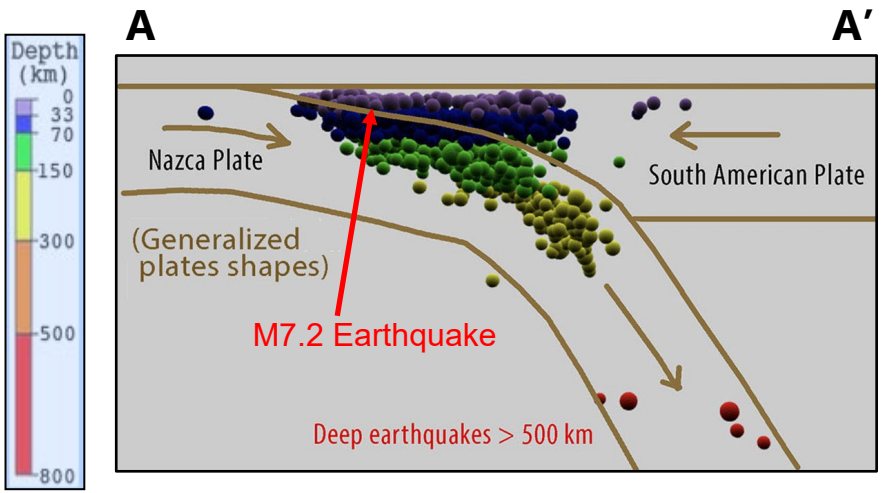
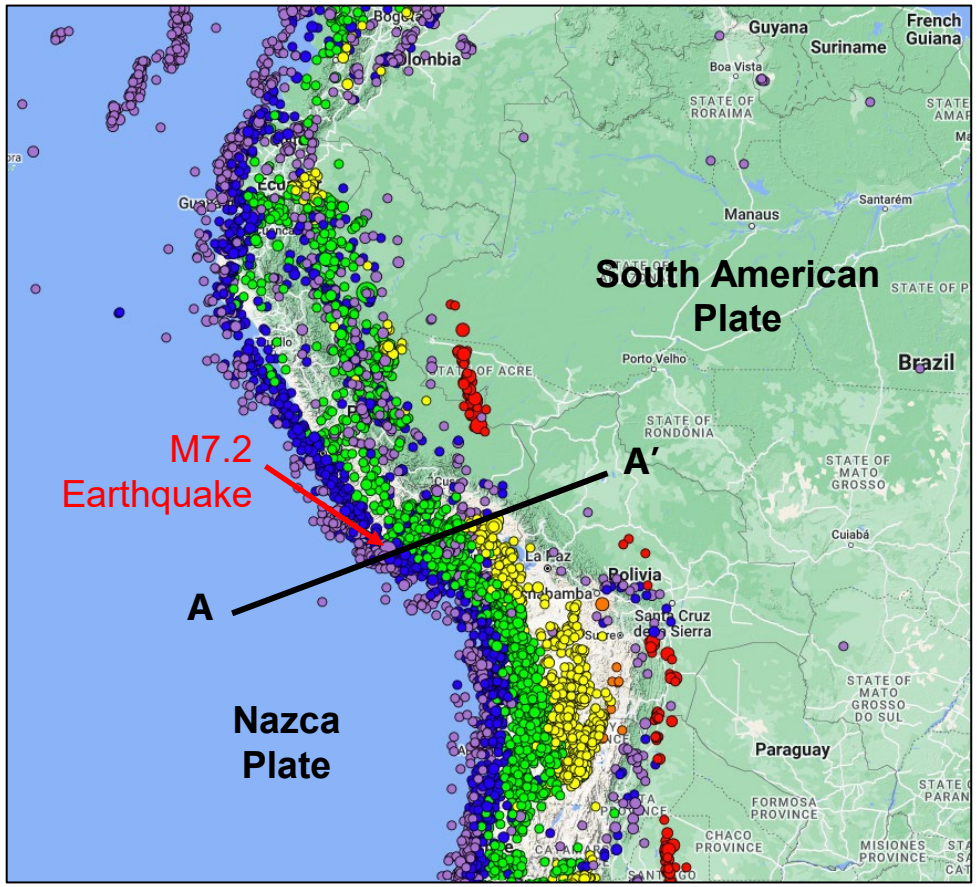
Epicenters are shown on a map of historic seismicity on the right. Earthquakes between the Nazca and South American plates and within the Nazca Plate increase in depth from west to east.

A 3D view along the cross section (**A-A'**) is shown below. This earthquake occurred within the top of the Nazca Plate as it bends to dive more steeply beneath the South American Plate.



25 years of earthquakes > M4

1999–2024



Maps generated using the IRIS Earthquake Browser

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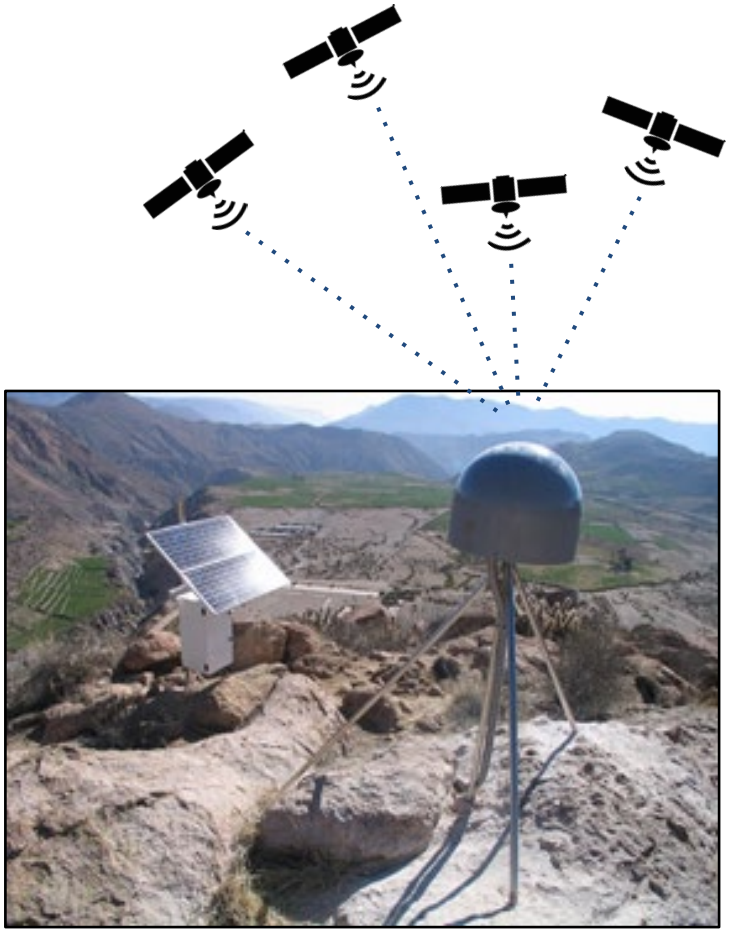
One of the ways we determine locations on Earth's surface is from GPS observations.

The time between when a signal leaves a satellite and when it arrives at a GPS station determines distance from satellite to station. If a GPS station receives signals from four or more satellites, these observations can be used to determine the location of the station. This is the same way GPS works in your phone that can determine your location within 5 to 10 meters (15-30 feet). But high-precision GPS observations used in tectonics research can determine location within millimeters (<¼ inch).

When high-precision GPS observations are available from a collection of stations over an interval of years to decades, changes in station locations allow scientists to determine motions between lithospheric plates and even deformation within plates.



GPS station at Putre in northern Chile

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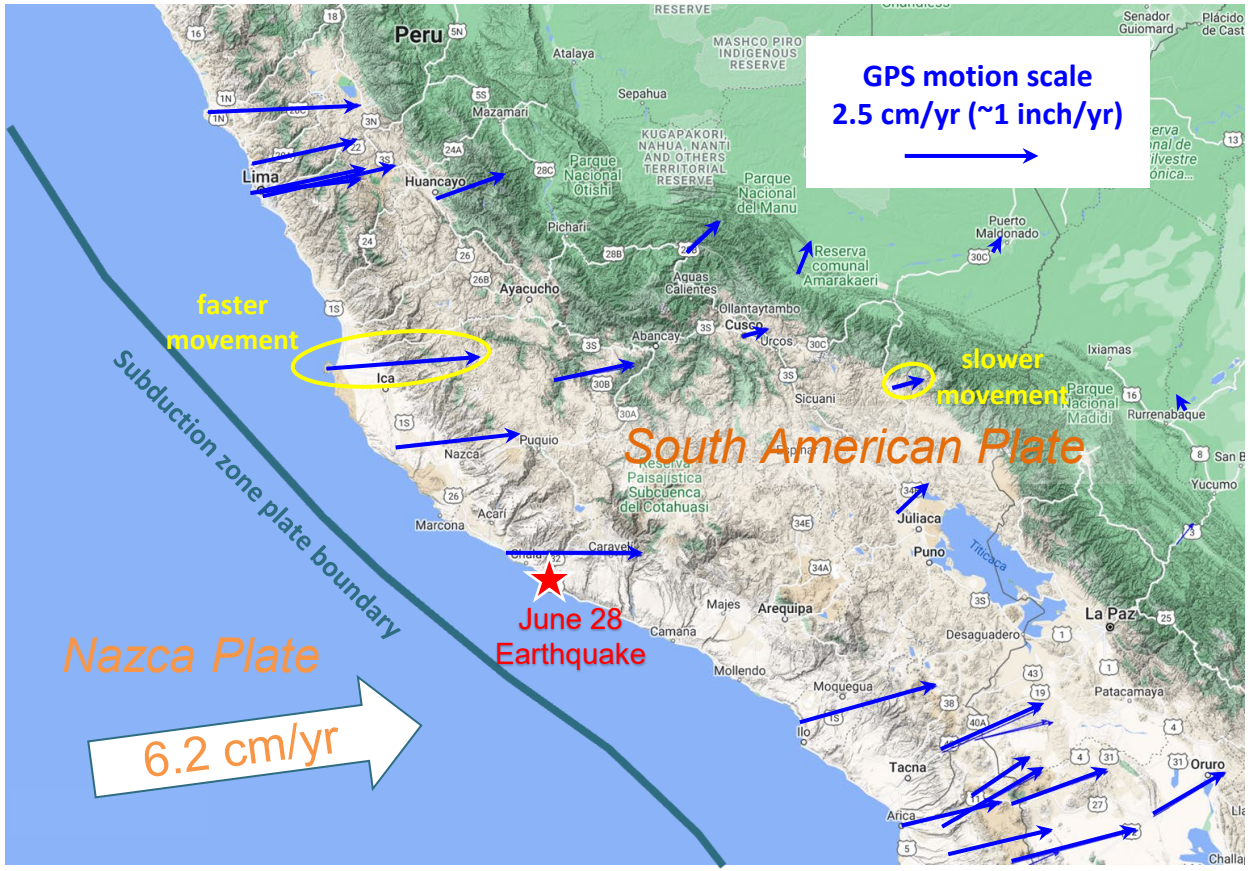
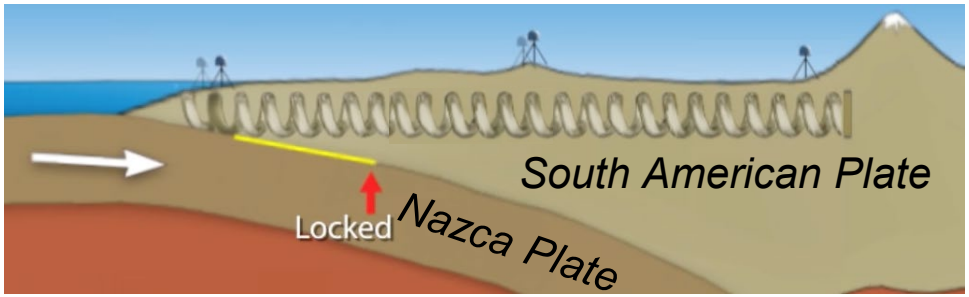
Peru and neighboring countries have GPS stations that record the deformation of the South American continental margin. Compared to stations east of the Andes Mountains, GPS stations along the coast are moving as much as 3 cm/yr (~1.2 inch/yr) towards the northeast as indicated by the blue arrows.



As shown in the cross section below, the continental margin above the subduction zone plate boundary is being compressed by the eastward motion of the Nazca Plate. Over decades and centuries this compression stores elastic energy that is occasionally released in major earthquakes, such as the M 7.2 June 28 earthquake, and great earthquakes, such as the 2001 M 8.4 earthquake that affected the same region.



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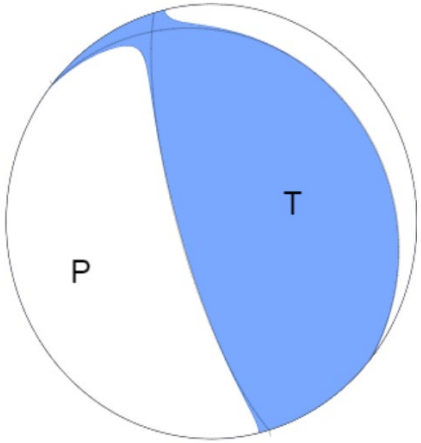
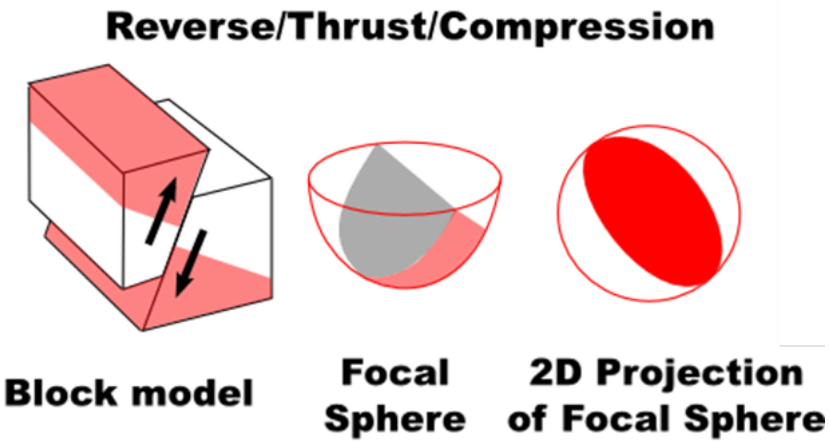
The focal mechanism is how seismologists plot the 3-D stress orientations of an earthquake. Because an earthquake occurs as slip on a fault, it generates primary (P) waves in quadrants where the first pulse is compressional (shaded) and quadrants where the first pulse is extensional (white).

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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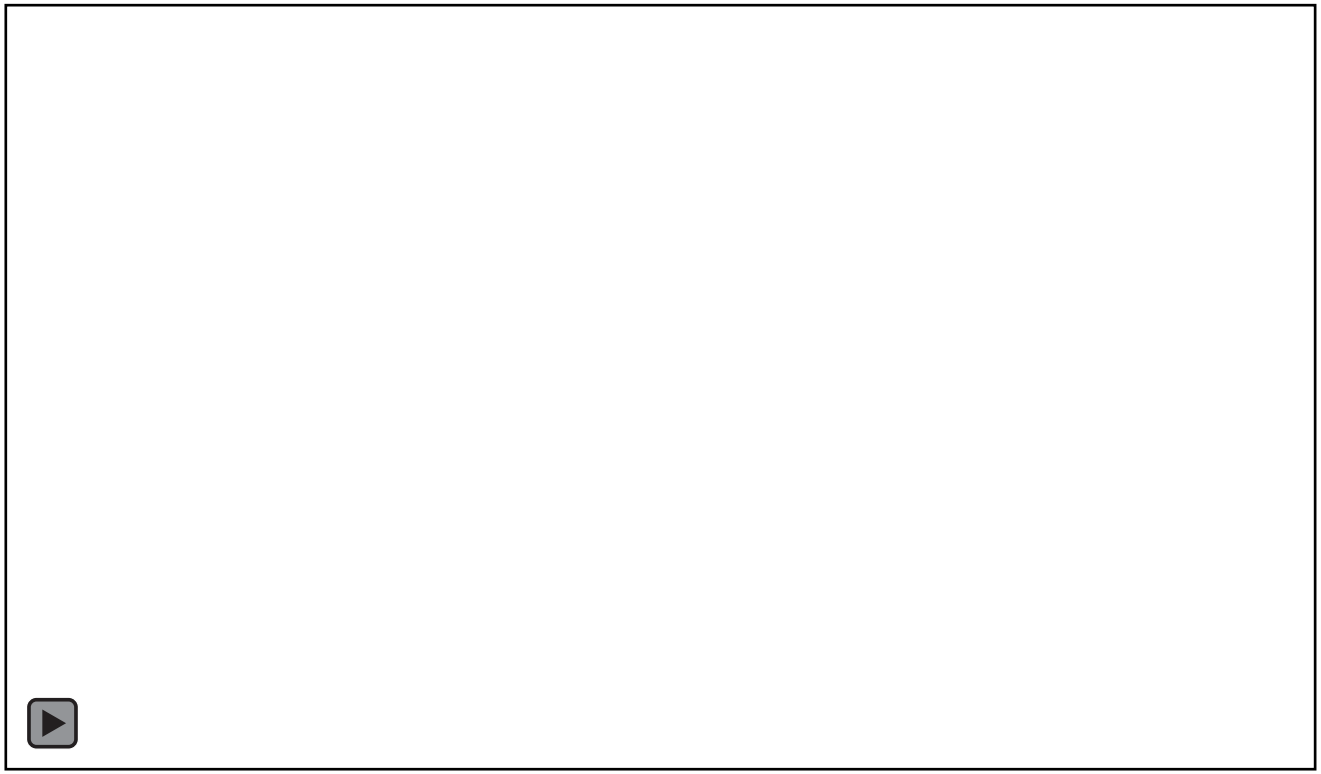
The animation below illustrates subduction of the oceanic Nazca Plate into the Peru-Chile Trench and beneath the South American Plate. The location, depth and focal mechanism solution of today's earthquake are consistent with it occurring on the megathrust interface between the two plates.



Animation exploring plate tectonics and earthquakes of the Nazca – South America plate boundary region.

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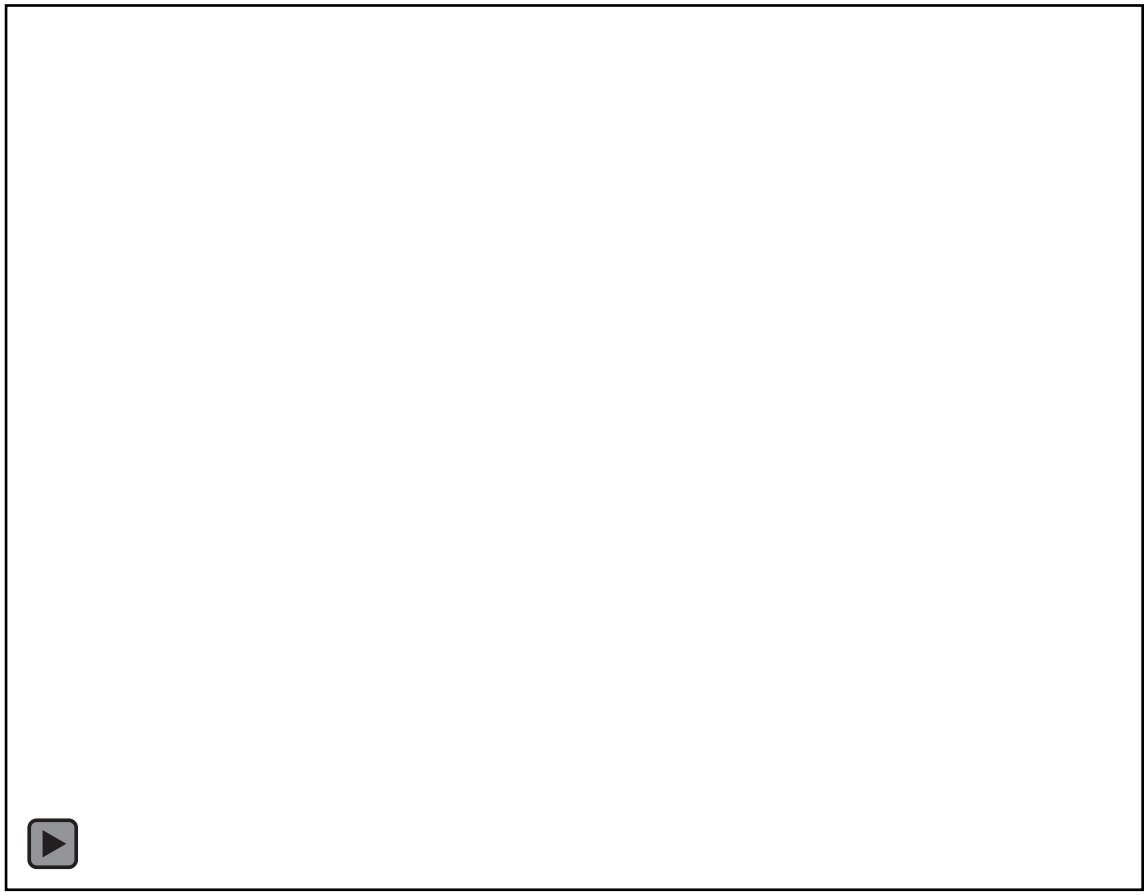
The area where the earthquake took place has experienced several earthquakes in the past two weeks, beginning with a M 6.0 quake on June 16. These lesser earthquakes are now classified as “foreshocks”.

Foreshocks are earthquakes that precede larger earthquakes in the same location. Unfortunately, it is impossible to predict beforehand if a small earthquake will ultimately be a foreshock to a larger earthquake.

The earthquake sequence from June 16 – June 28 is animated including 5 foreshocks, the M 7.2 mainshock and 4 aftershocks.



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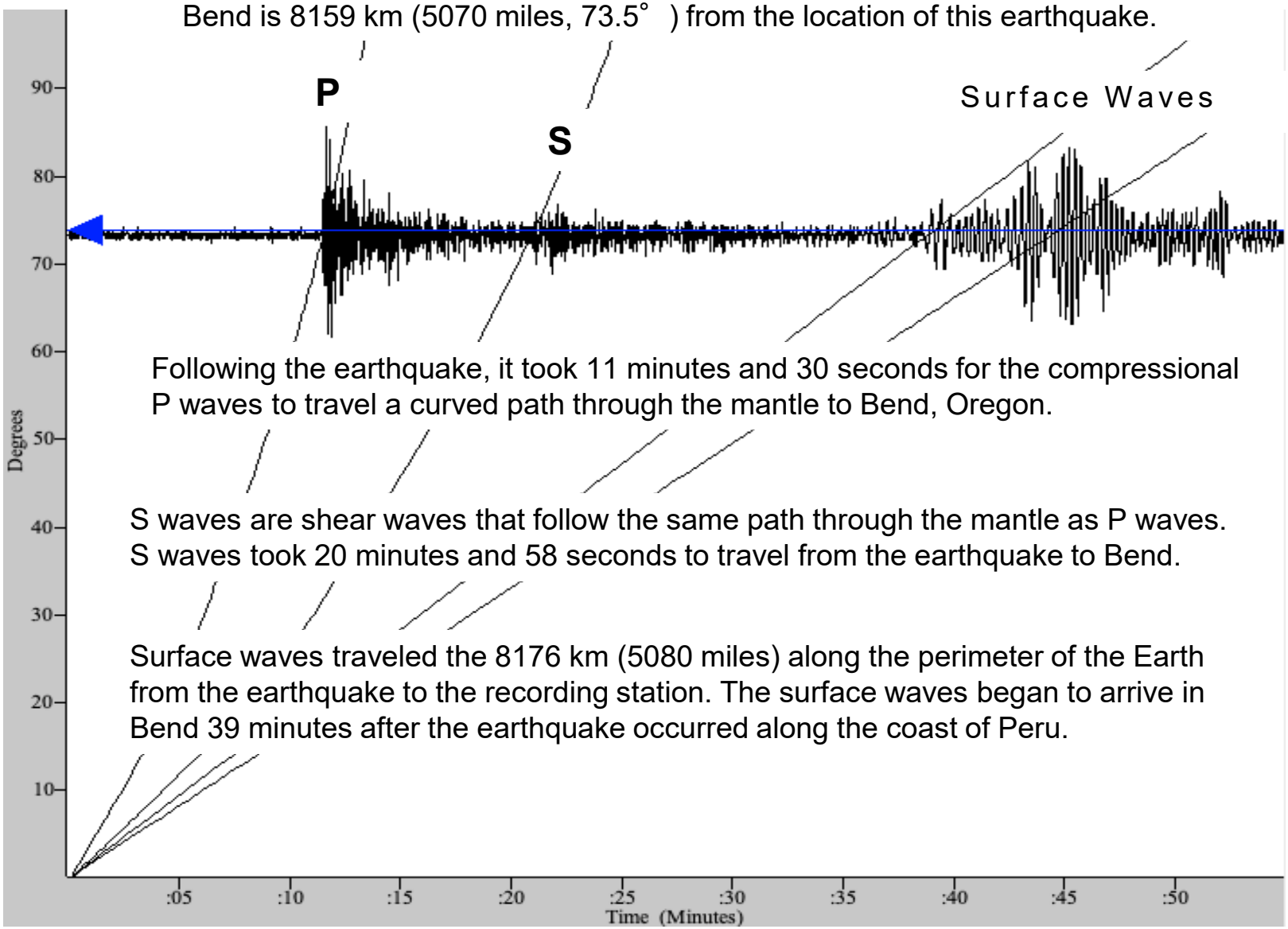
The record of the earthquake in Bend, Oregon (BNOR) is illustrated below. Bend is 8159 km (5070 miles, 73.5˚) from the location of this earthquake.



Following the earthquake, it took 11 minutes and 30 seconds for the compressional P waves to travel a curved path through the mantle to Bend, Oregon.

S waves are shear waves that follow the same path through the mantle as P waves. S waves took 20 minutes and 58 seconds to travel from the earthquake to Bend.

Surface waves traveled the 8176 km (5080 miles) along the perimeter of the Earth from the earthquake to the recording station. The surface waves began to arrive in Bend 39 minutes after the earthquake occurred along the coast of Peru.

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