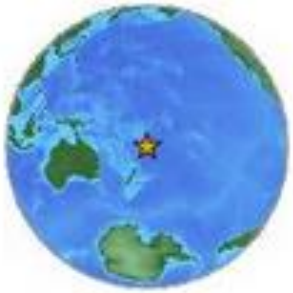
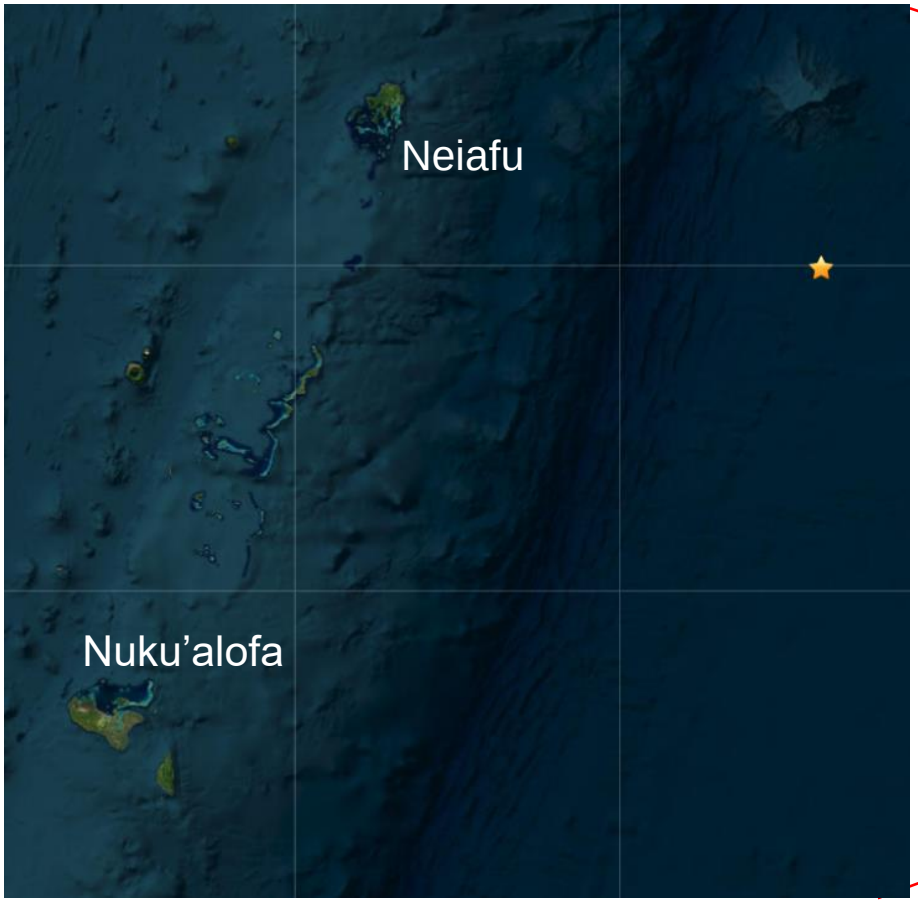
# Magnitude 7.3 TONGA
## Friday, November 11, 2022 at 10:48:45 UTC



A magnitude 7.3 earthquake occurred about 211 km (131 miles) east south-east of Neiafu, Tonga at a depth of 24.8 km (15.4 miles). There are no reports of damage or injuries. A tsunami advisory was issued and later lifted.





Nuku‘alofa is the capital and largest city of Tonga. It is located on the north coast of the island of Tongatapu, in the country's southernmost island group.

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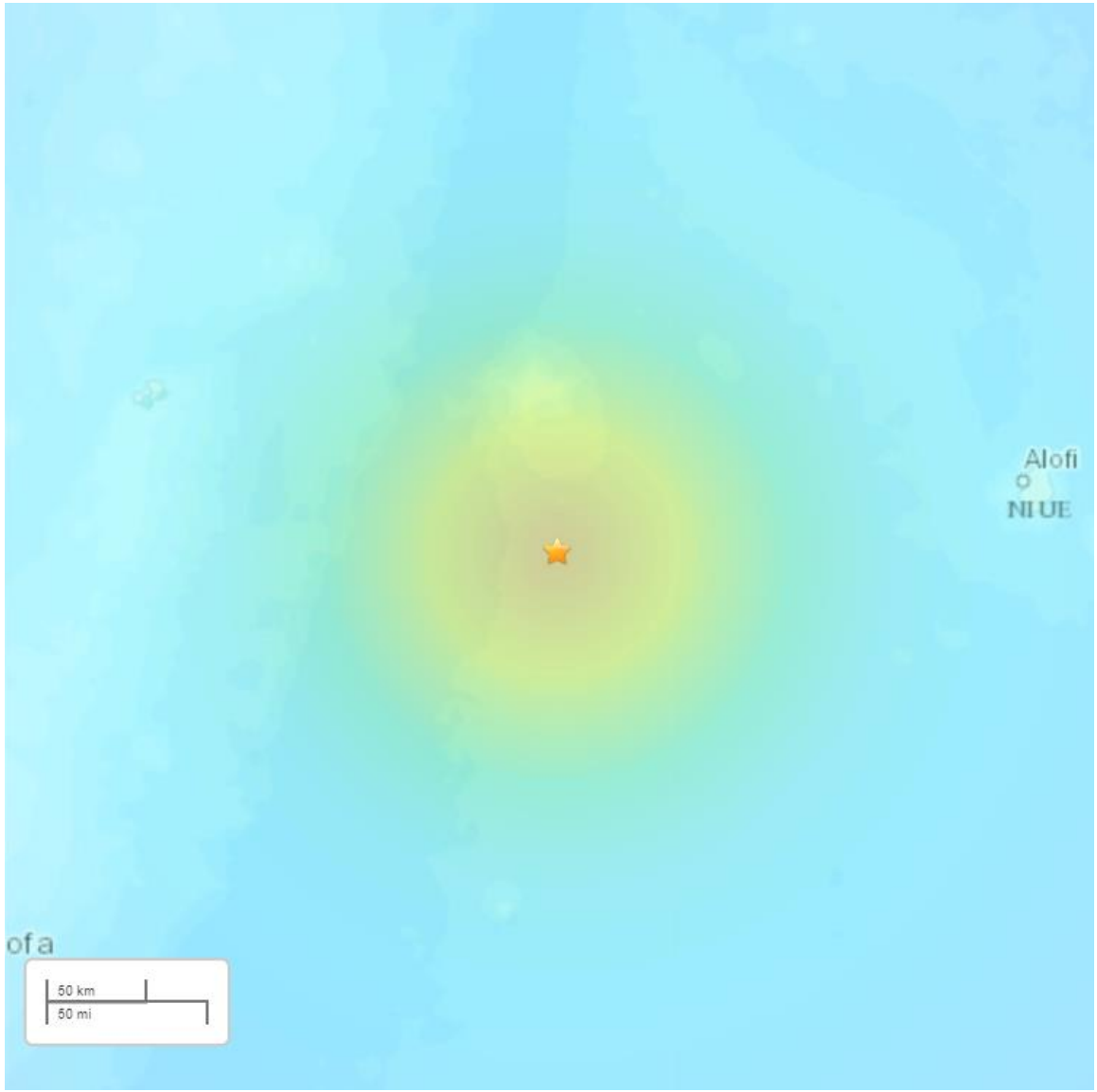
The Modified-Mercalli Intensity (MMI) scale is a ten-stage scale, from I to X, that indicates the severity of ground shaking. Intensity is based on observed effects and is variable over the area affected by an earthquake. Intensity is dependent on earthquake size, depth, distance, and local conditions.

| 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 M7.3 Earthquake*

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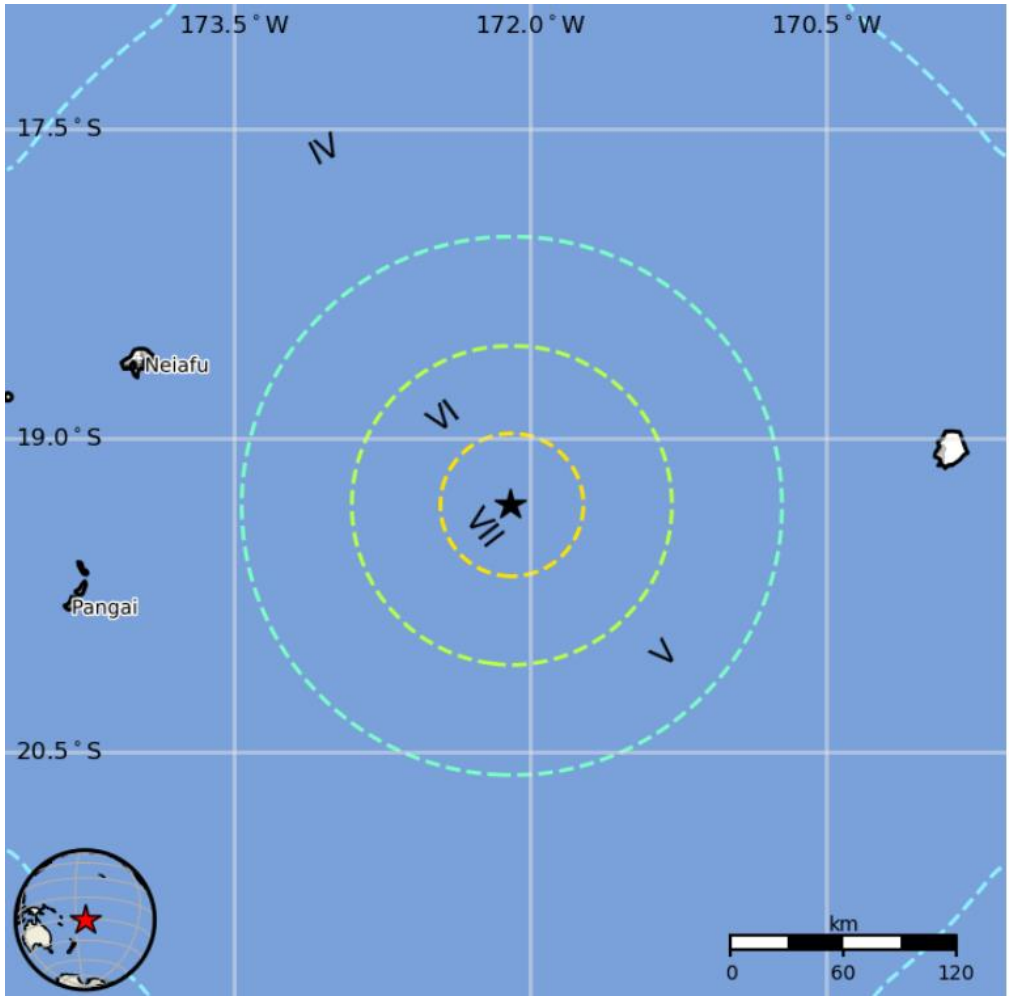
The USGS PAGER map shows the population exposed to different Modified Mercalli Intensity (MMI) levels.

The USGS estimates that 21,000 people felt light shaking from this earthquake.

| | | |
|---|---|---|
| I | Not Felt | 0 k* |
| II-III | Weak | 0 k* |
| IV | Light | 21 k |
| V | Moderate | 0 k |
| VI | Strong | 0 k |
| VII | Very Strong | 0 k |
| VIII | Severe | 0 k |
| IX | Violent | 0 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.

*Image courtesy of the US Geological Survey*

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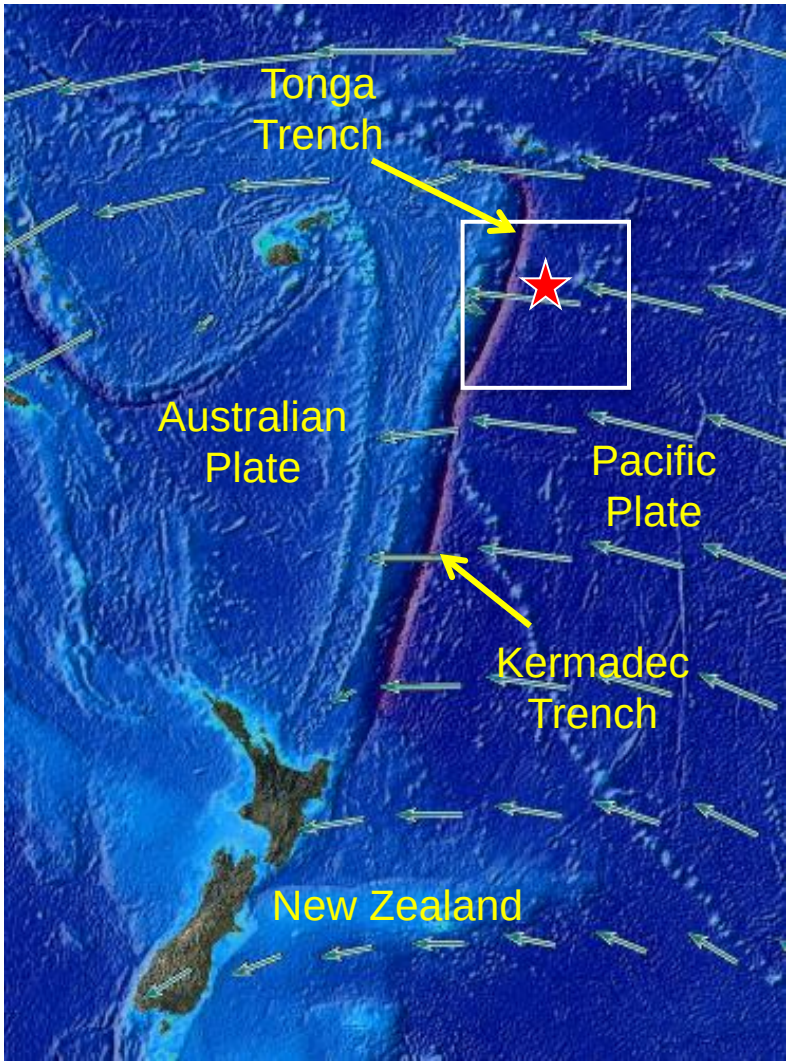
The blue arrows show the motion of the Pacific Plate with respect to the Australian Plate. The epicenter of the earthquake is shown by the red star while the white square outlines the area of historic seismicity shown on the next slide.

North of New Zealand, the Australia-Pacific boundary stretches east of Tonga and Fiji to 250 km south of Samoa.

Australia-Pacific convergence rates increase northward from 60 mm/yr at the southern Kermadec trench to 90 mm/yr at the northern Tonga trench



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This map shows 1900 earthquakes greater than M5 for the past 10 years. Star shows the location of the M7.3 earthquake that occurred within the Pacific Plate east of the Tonga Trench. Noted are the group of M6.4–7.0 deep earthquakes from November 9.

Earthquakes are shallow near the Tonga Trench on the east side of the map area. Earthquakes increase in depth to the west where the Pacific Plate subducts beneath the Australian Plate.

Earthquakes are color coded by depth. See the cross section on next slide.

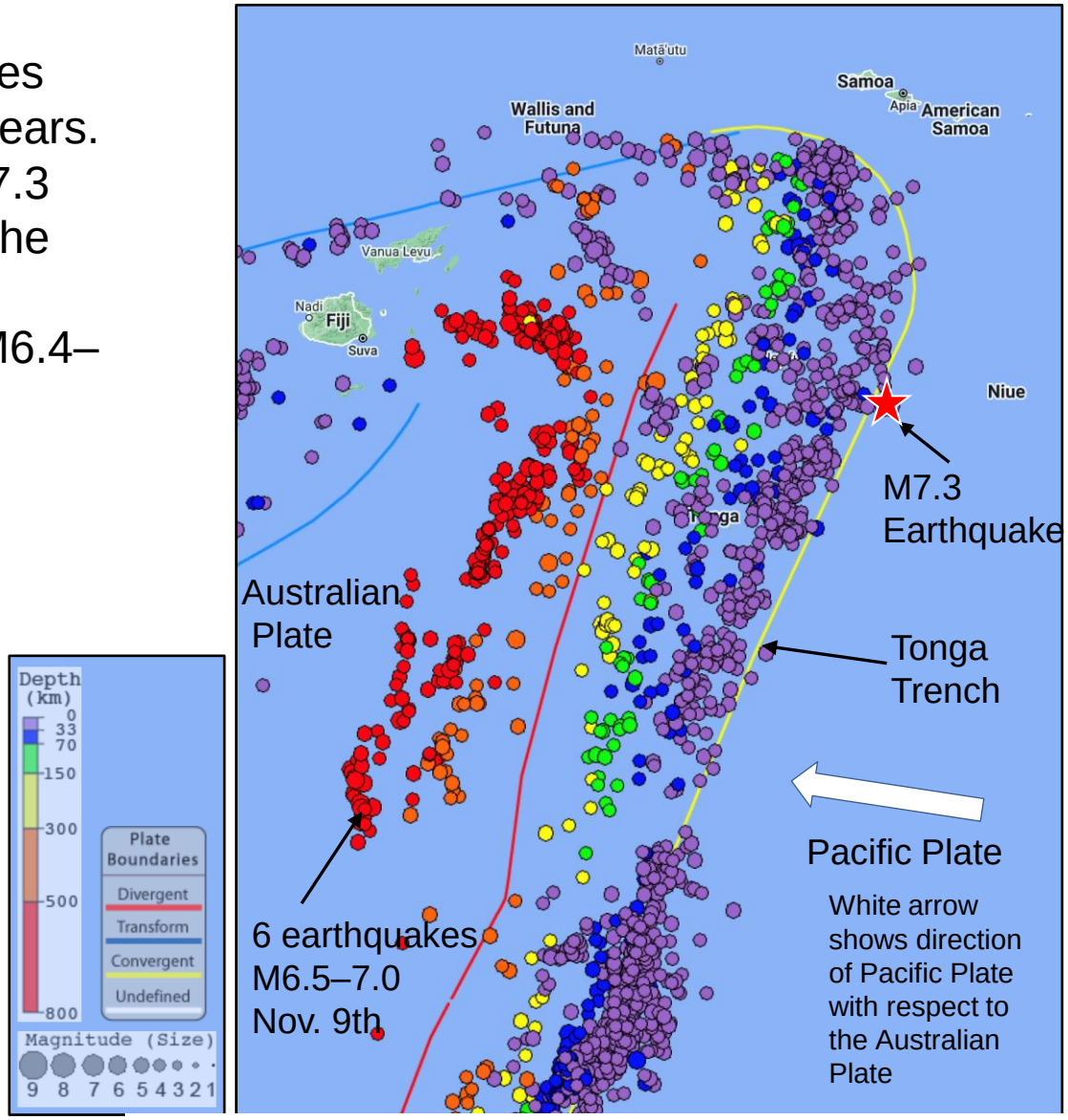


*Image from IRIS Earthquake Browser http://www.iris.edu/ieb*

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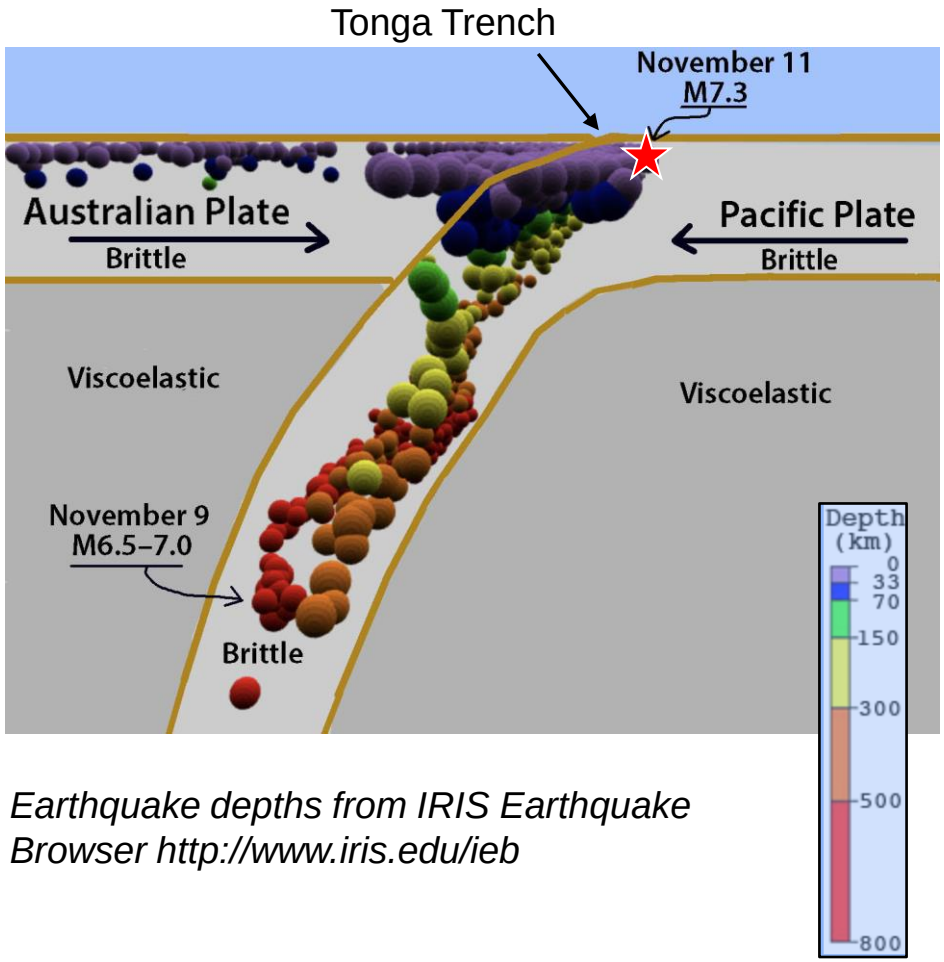
These earthquakes, located where the Pacific Plate is bending to dive beneath the Australian Plate, were shallow, in contrast to the deep-focus earthquakes on November 9th. The hypocenters, shown here in 3D view, define the subducting plate.

Deep earthquakes (>300 km depth) occur exclusively within subducting oceanic lithosphere, especially within old oceanic lithosphere that is subducting rapidly. To produce earthquakes rocks must be brittle. Brittle rock accumulates elastic energy as they bend then rapidly releases that energy during earthquake rupture.

With the exception of subducting oceanic plates, rock in Earth's mantle below about 100 km depth is viscoelastic and cannot rupture to produce earthquakes. Rocks are brittle at low temperatures but become viscoelastic when they reach temperatures of about 600° C. Rapidly subducting cool oceanic plates, however, can remain brittle up to about 700 km in the hot mantle.




*Earthquake depths from IRIS Earthquake Browser http://www.iris.edu/ieb*

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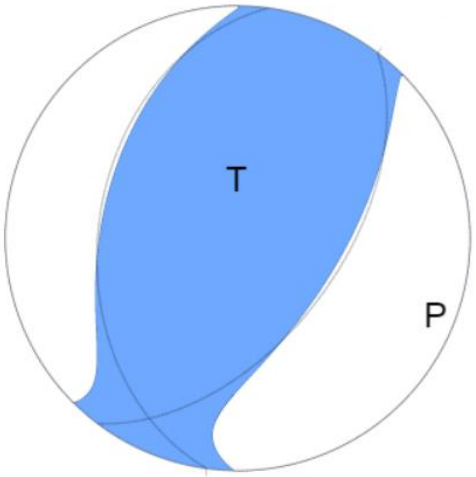
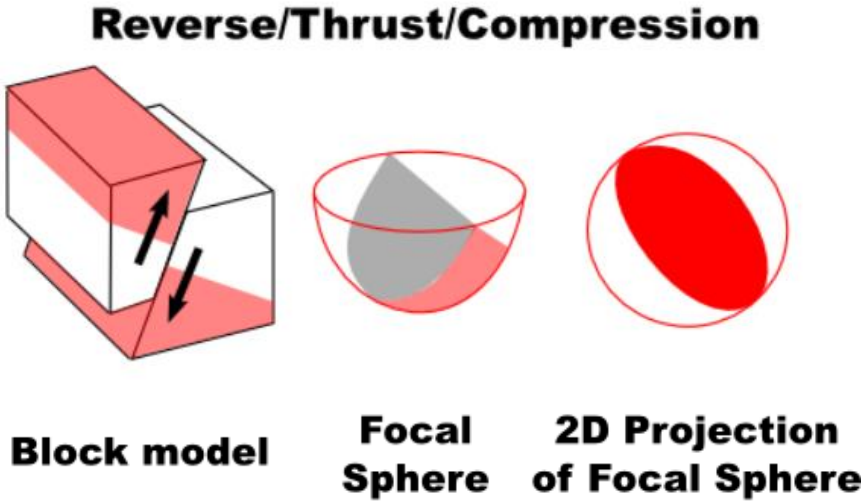
The focal mechanism is how seismologists plot the 3-D stress orientations of an earthquake. Because an earthquake occurs as slip on a fault, it generates primary (P) waves in quadrants where the first pulse is compressional (shaded) and quadrants where the first pulse is extensional (white). The orientation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

In this case, the earthquake occurred as the result of thrust faulting near the outer rise of the Pacific Plate east of the trench.



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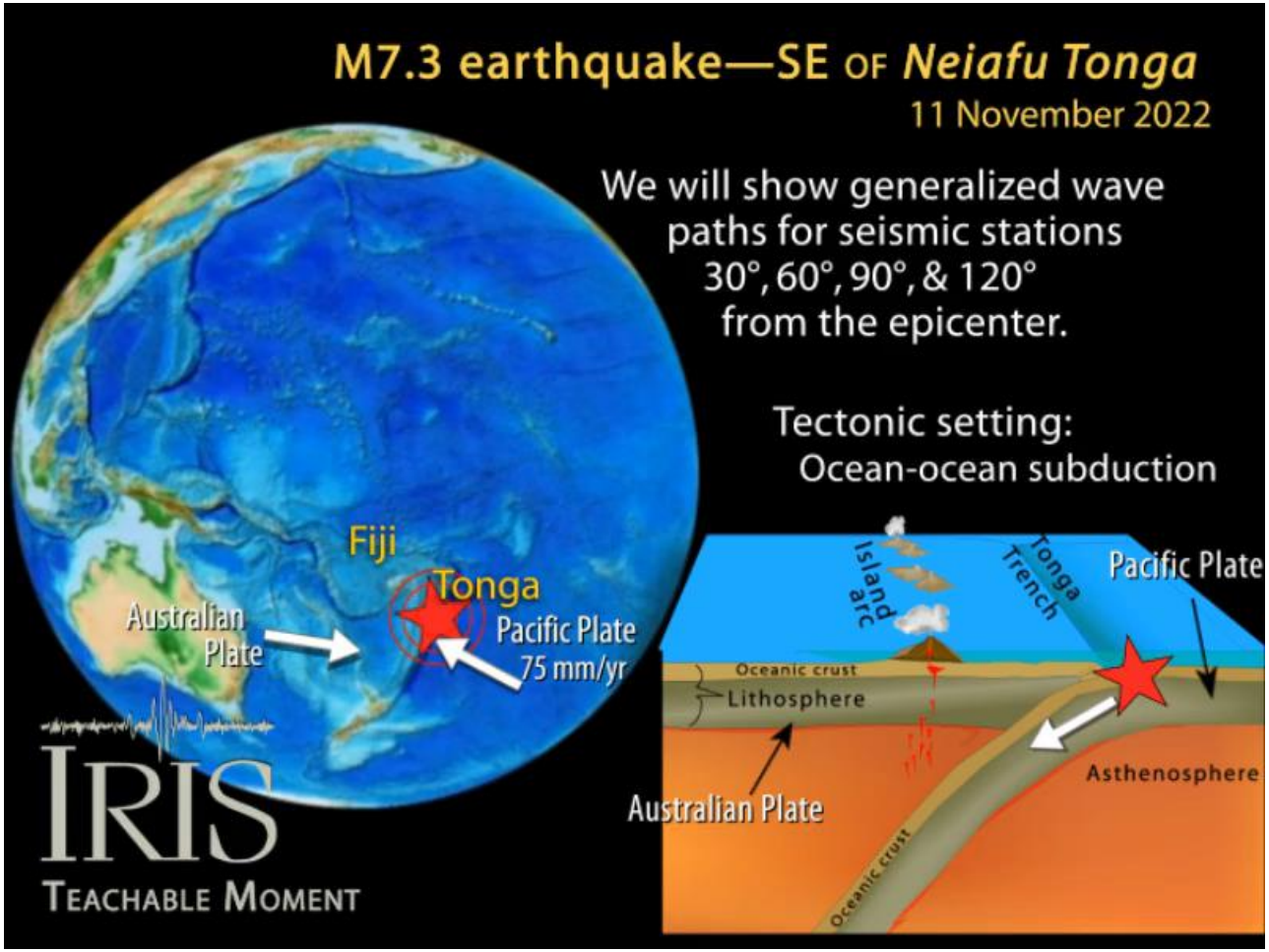
Generalized wave paths for seismic stations following an earthquake (click for animation).



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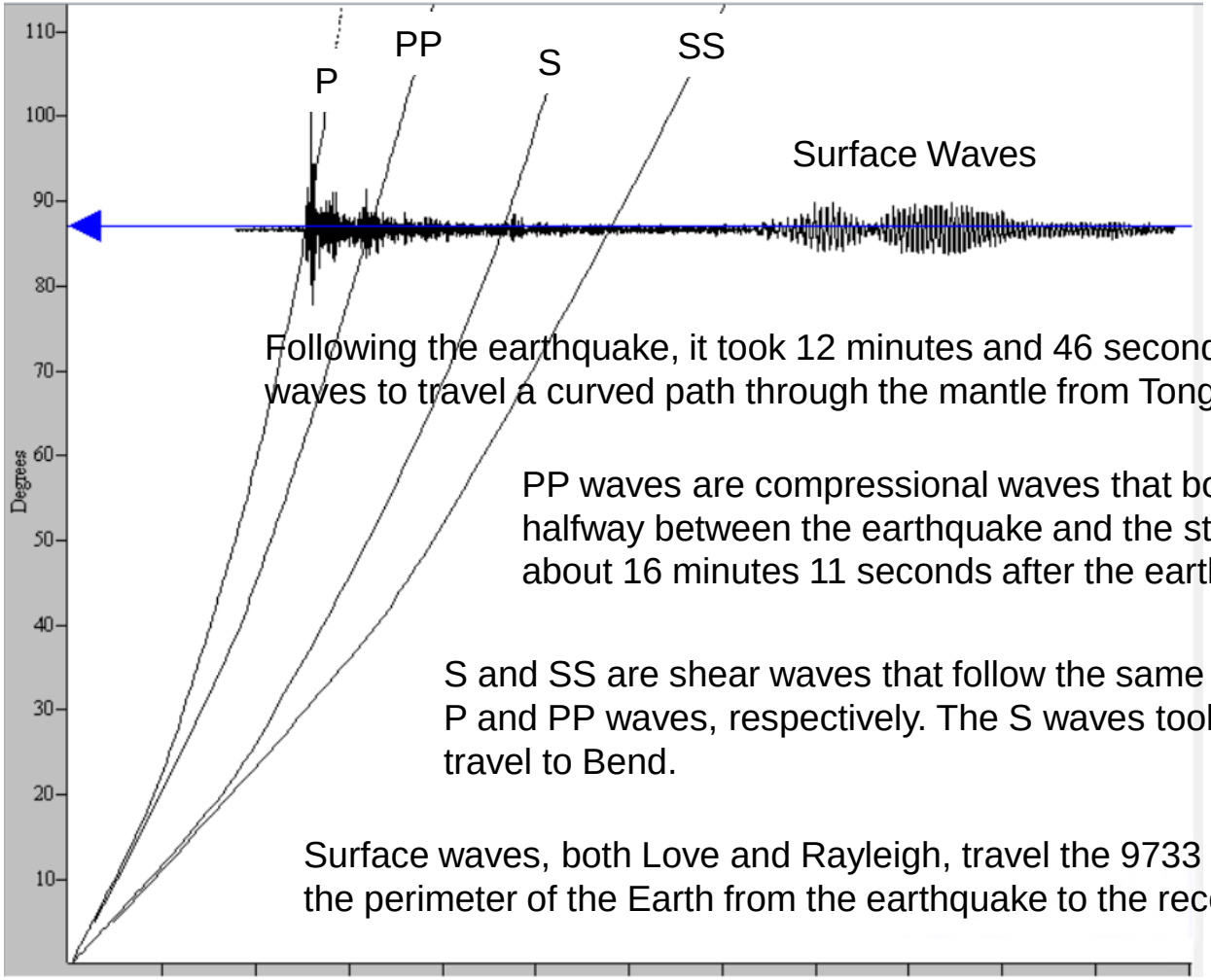
The record of the earthquake on the BNOR (Bend, Oregon) seismometer is illustrated below. Bend is 9733 km (6047 miles, 87.69˚ ) from the location of this earthquake.




Following the earthquake, it took 12 minutes and 46 seconds for the compressional P waves to travel a curved path through the mantle from Tonga to Bend, Oregon.

PP waves are compressional waves that bounce off the Earth's surface halfway between the earthquake and the station. PP energy arrived about 16 minutes 11 seconds after the earthquake.

S and SS are shear waves that follow the same path through the mantle as P and PP waves, respectively. The S waves took 23 minutes 27 seconds to travel to Bend.

Surface waves, both Love and Rayleigh, travel the 9733 km (6047 miles) along the perimeter of the Earth from the earthquake to the recording station.

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