Magnitude 7.1 SOUTH SANDWICH ISLANDS

Sunday, August 22, 2021 at 21:33:20 UTC

Latitude 60.311° S
Longitude 24.886° W
Depth 14 km

A magnitude 7.1 earthquake occurred at a depth of 14 km (8.7 miles) in the South Sandwich Islands, an uninhabited British territory off the coast of Argentina in the southern Atlantic Ocean. This earthquake is an aftershock of a M8.1 earthquake that occurred on Aug 12.

The South Sandwich Islands consist of 11 volcanic islands formed as a result of subduction. Because of the remote location of the islands and the volatile nature of the seas and climate, human expeditions are rare. The islands are home to a large colony of penguins (Chinstrap and Adelie).

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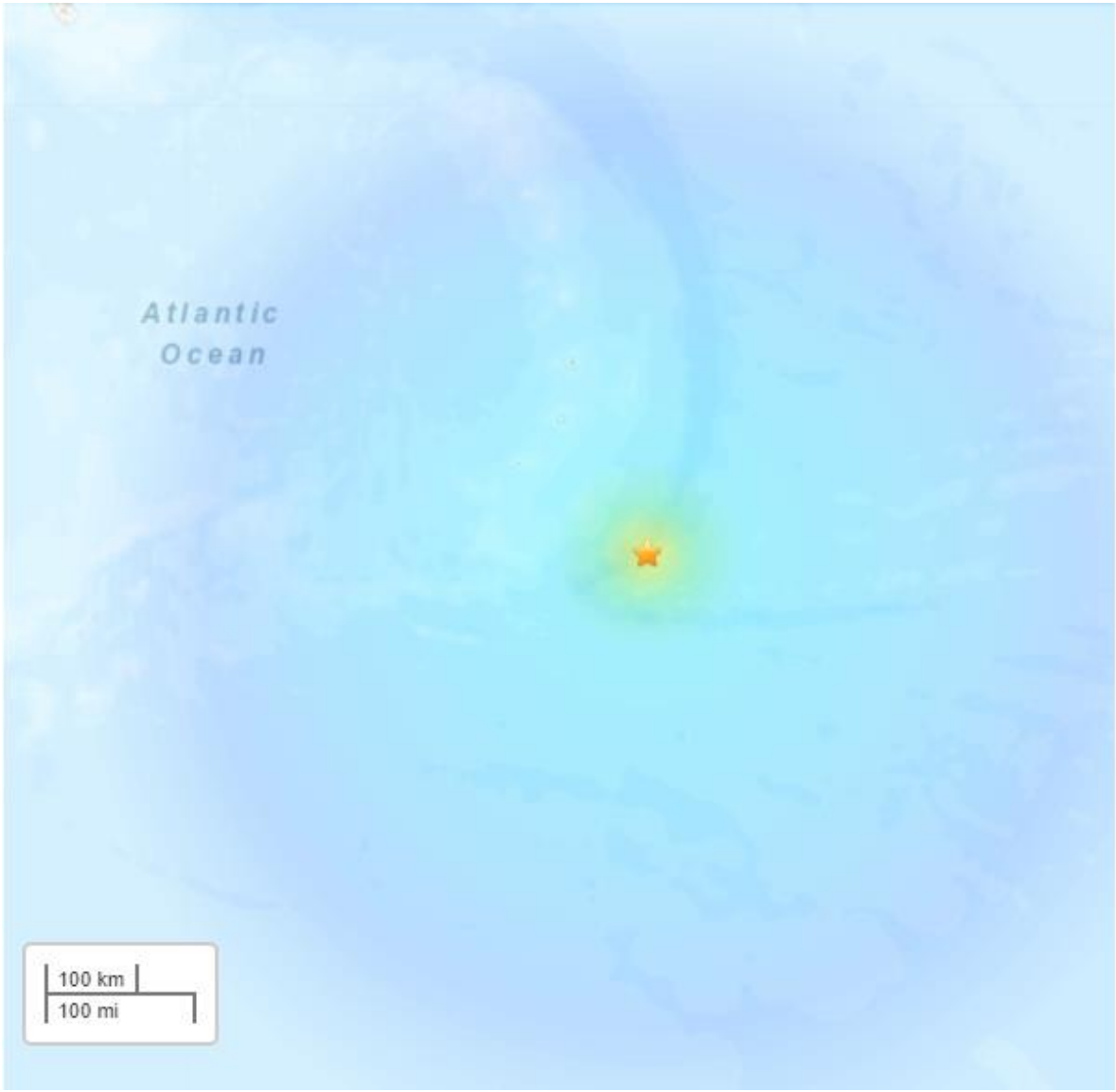
The Modified-Mercalli Intensity (MMI) scale is a ten-stage scale that indicates the severity of ground shaking. Intensity is dependent on the magnitude, depth, bedrock, and location.

The uninhabited islands nearest the earthquake experienced light shaking.

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 7.1 Earthquake

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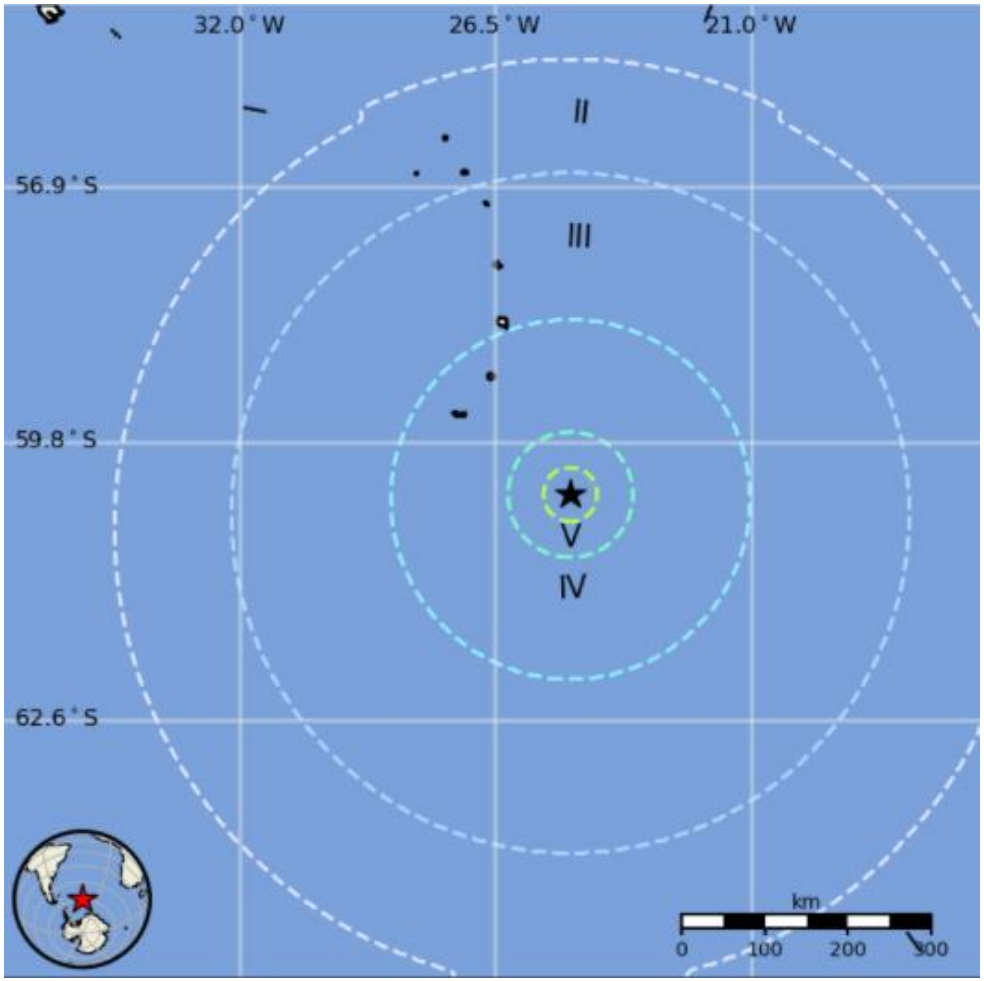
The USGS PAGER map shows the population exposed to different Modified Mercalli Intensity (MMI) levels.

The USGS estimates that no one felt this earthquake.

I	Not Felt	0 k*
II-III	Weak	0 k*
IV	Light	0 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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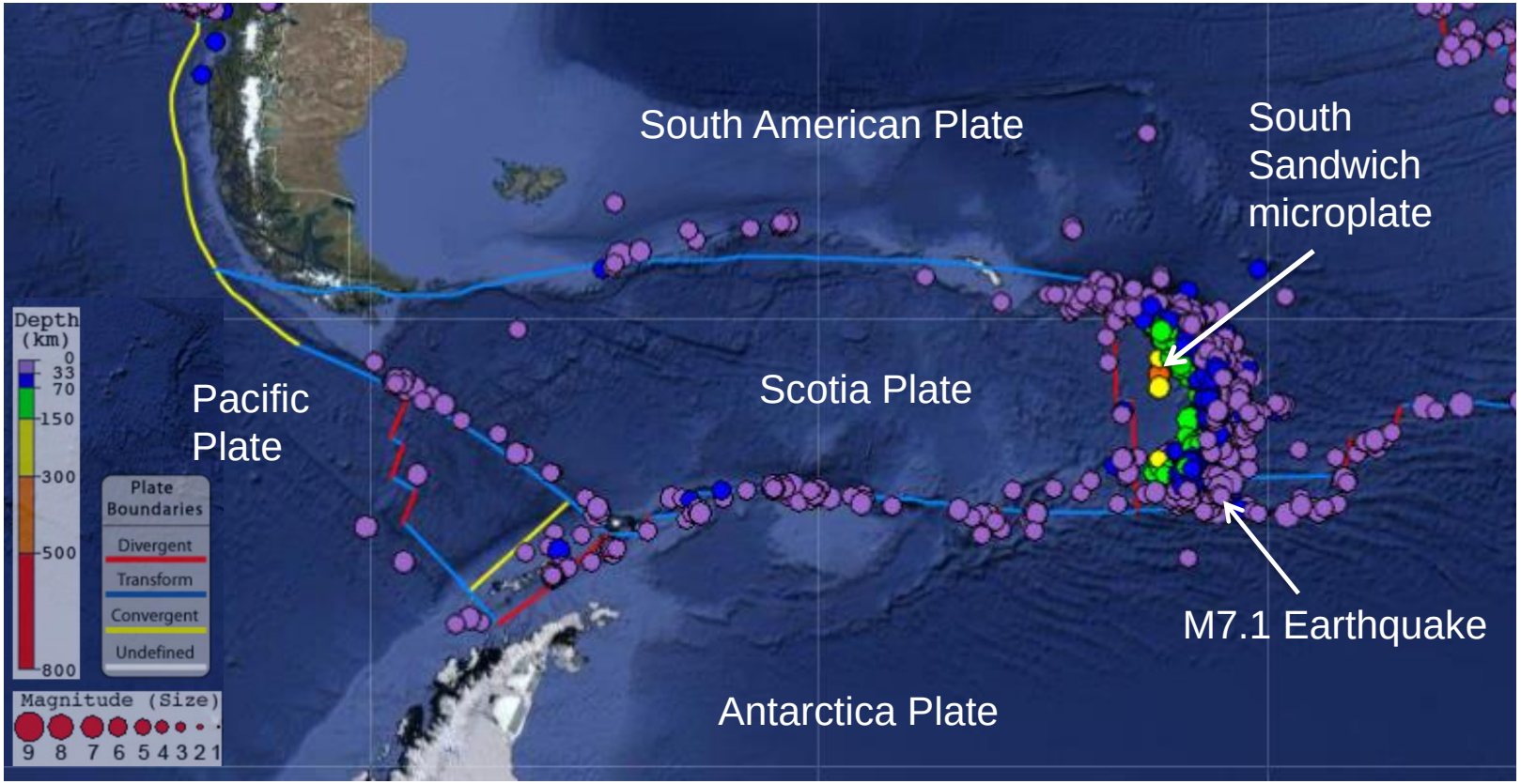
This earthquake epicenter is labeled on the map below along with the most recent 2000 earthquakes of magnitude ≥ 5. The subduction zone between the South Sandwich microplate and South American Plate has frequent earthquakes with depths increasing from east-to-west across the convergent plate boundary.



Map created with the IRIS Earthquake Browser

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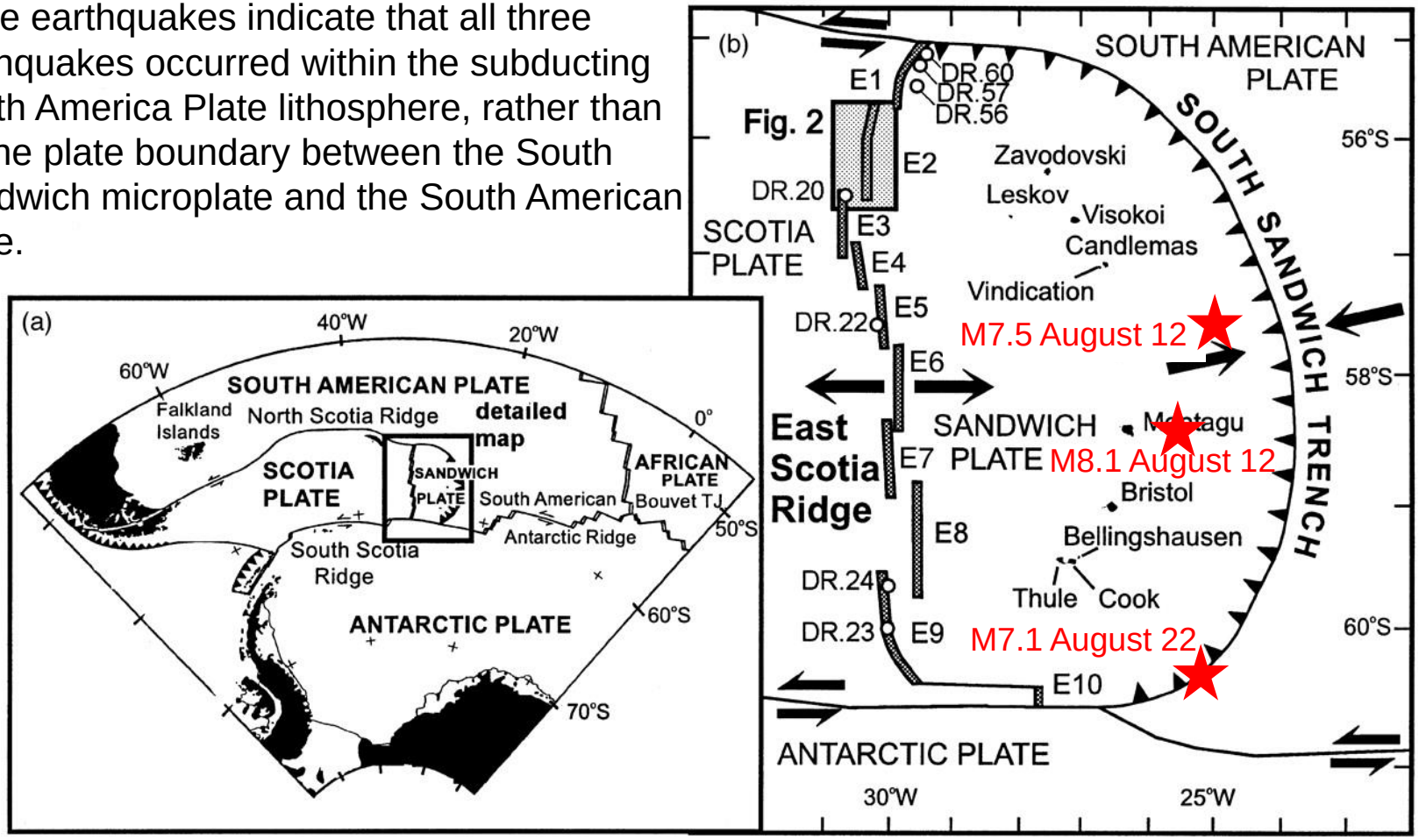
Epicenters (red stars) for the August 12 M7.5 foreshock and M8.1 mainshock and the August 22 M7.1 aftershock are shown on the map below. The South American Plate subducts towards the west beneath the South Sandwich microplate. In the region of the mainshock, the South America Plate subducts at a rate of ~7 cm/yr. According to the US Geological Survey, the depths to the top of the South American Plate compared with the depths of the hypocenters of these earthquakes indicate that all three earthquakes occurred within the subducting South America Plate lithosphere, rather than on the plate boundary between the South Sandwich microplate and the South American Plate.



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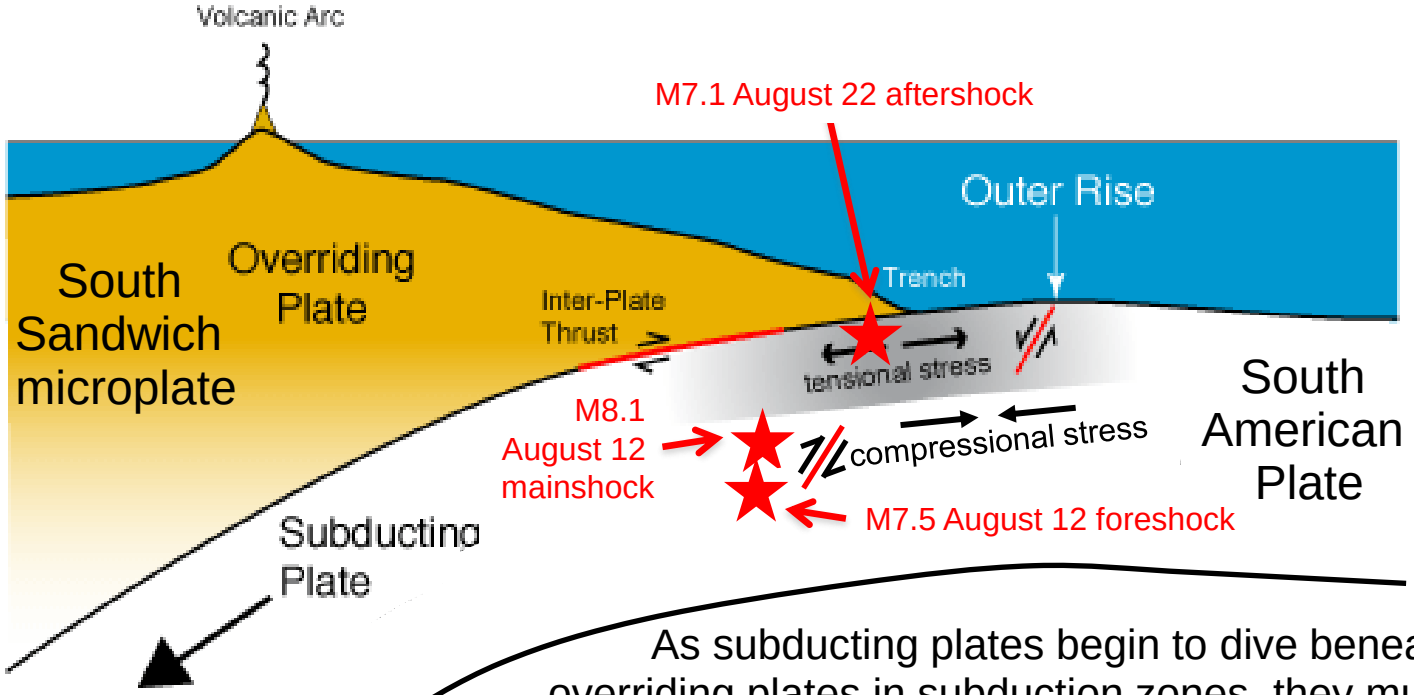

As subducting plates begin to dive beneath overriding plates in subduction zones, they must curve or “bend” beneath the megathrust plate boundary that is gently dipping near the trench but more steeply dipping at deeper levels. This change in curvature of the subducting plate leads to “bending stresses”. The top part of the subducting plate experiences tensional (or extensional) stress while the deeper part of the subducting plate experiences compressional stress. The August 12 M7.5 foreshock occurred at 63 km depth and the M8.1 mainshock occurred at 48 km depth. Both the foreshock and mainshock are within the zone of compressional stress and both have thrust-faulting focal mechanisms. But the M7.1 August 22 aftershock occurred at 14 km depth within the zone of tensional stress and it has a normal-faulting focal mechanism.

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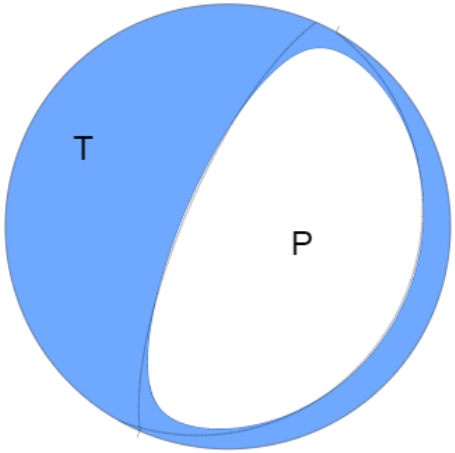
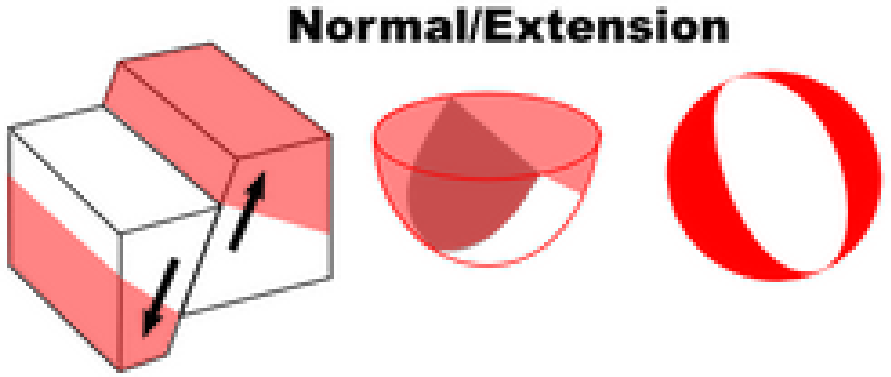
The focal mechanism is how seismologists plot the 3-D stress orientations of an earthquake. Because an earthquake occurs as slip on a fault, it generates primary (P) waves in quadrants where the first pulse is compressional (shaded) and quadrants where the first pulse is extensional (white). The orientation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

This earthquake occurred as the result of normal faulting within the subducting South American Plate.



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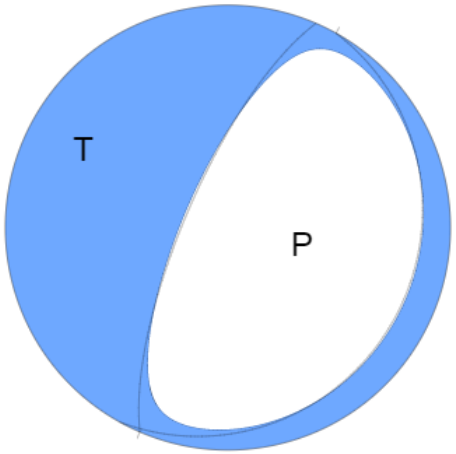
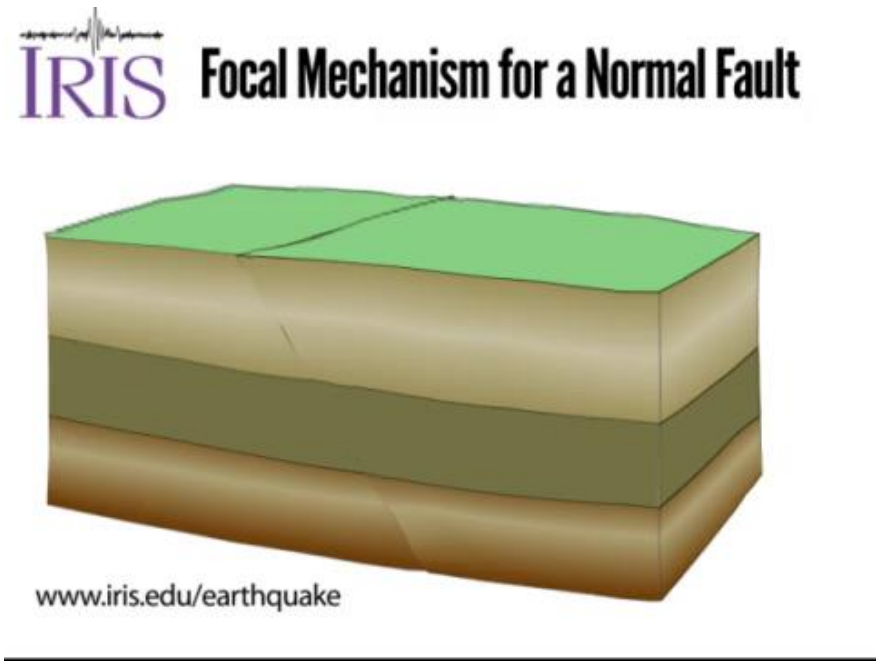
This animation explores how normal faults are represented in a focal mechanism.

Remember, this was the focal mechanism solution for this earthquake. It was estimated by an analysis of observed seismic waveforms, recorded after the earthquake, observing the pattern of "first motions", that is, whether the first arriving P waves break up or down.



USGS W-phase Moment Tensor Solution



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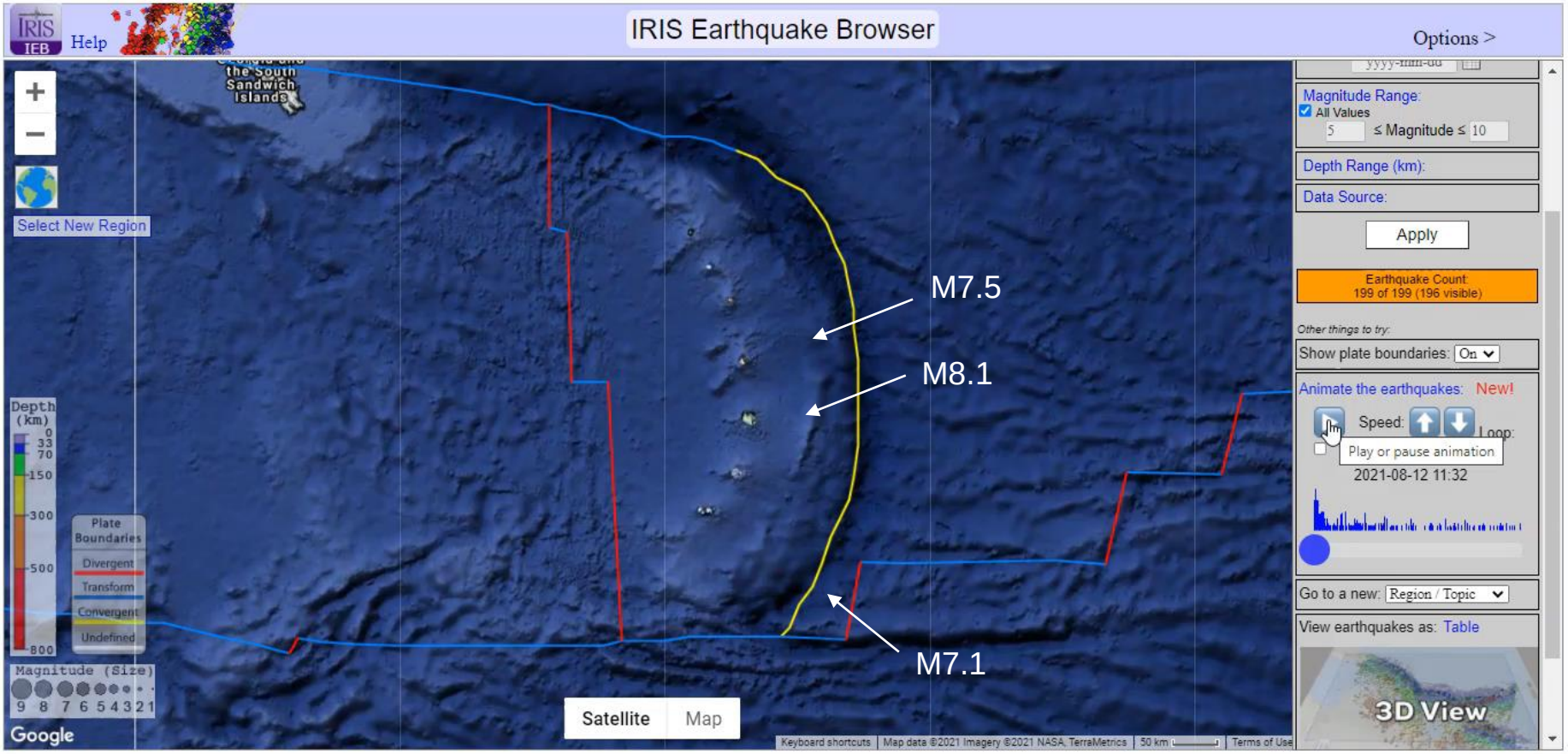
Animating the earthquakes including the M7.5 foreshock, M8.1 mainshock and aftershocks including this M7.1 aftershock.



Animation created with the IRIS Earthquake Browser

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A **foreshock** is a smaller magnitude earthquake that precedes the mainshock.

There are no special characteristics of a foreshock that let us know it is a foreshock until the mainshock occurs. There were no foreshocks for this earthquake.

A **mainshock** is largest magnitude earthquake during an earthquake sequence.

Aftershocks are smaller earthquakes occurring after a large earthquake as the fault adjusts to the new state of stress.

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.

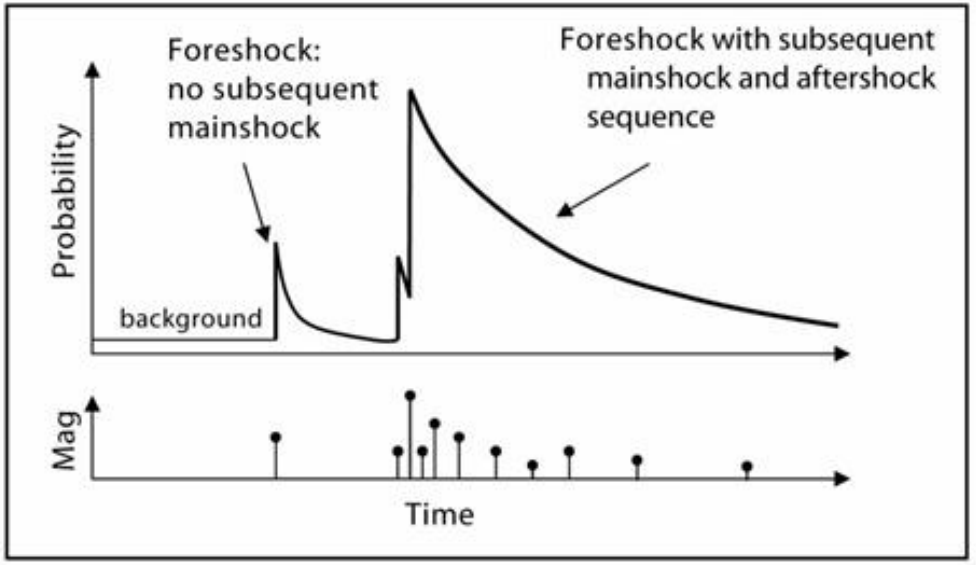

Image courtesy of the US Geological Survey

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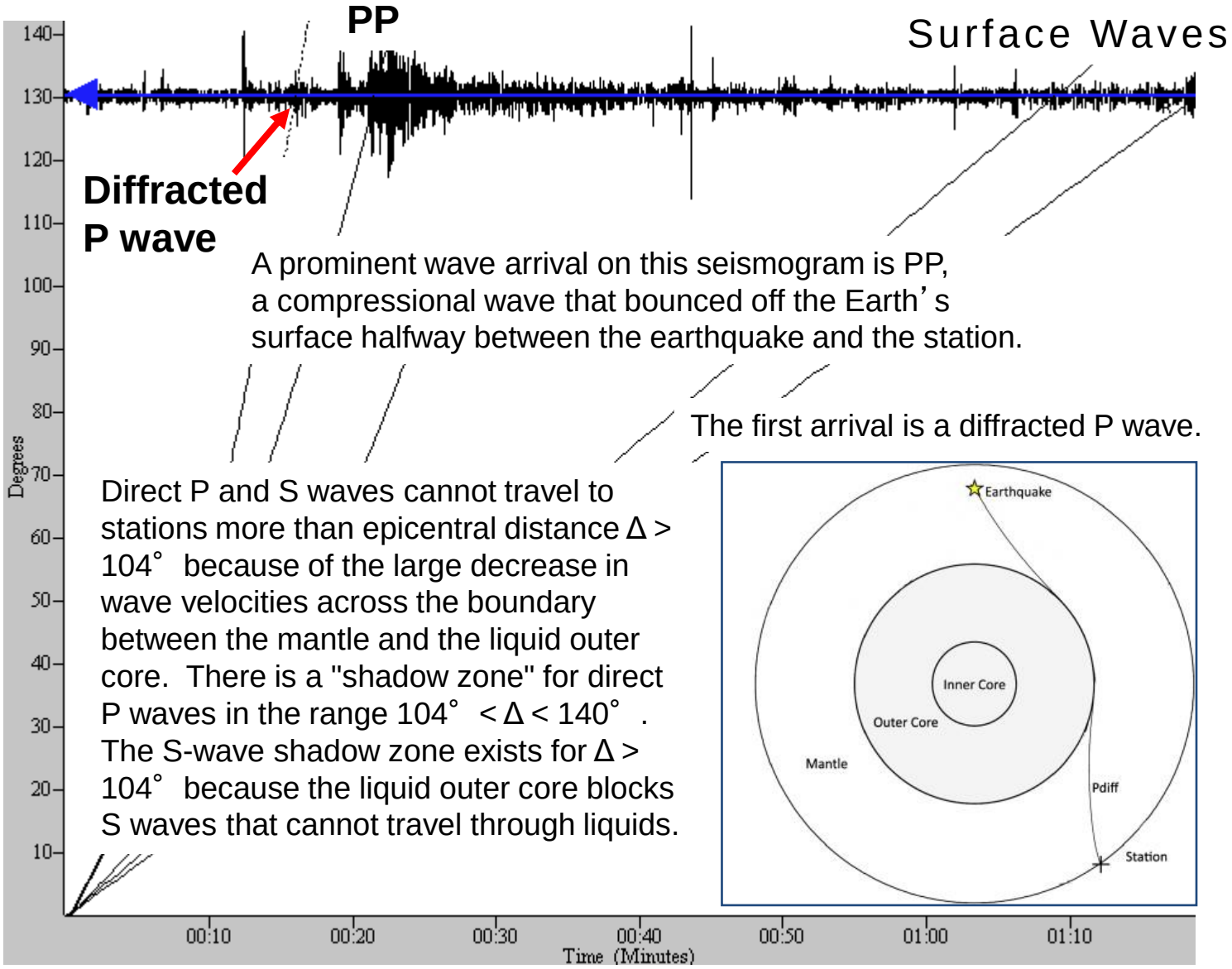
The record of the earthquake in Bend, Oregon (BNOR) is illustrated below. Bend is 14,463 km (8,987 miles, 130.3˚) from the location of this earthquake.



A prominent wave arrival on this seismogram is PP, a compressional wave that bounced off the Earth's surface halfway between the earthquake and the station.

The first arrival is a diffracted P wave.

Direct P and S waves cannot travel to stations more than epicentral distance Δ > 104˚ because of the large decrease in wave velocities across the boundary between the mantle and the liquid outer core. There is a "shadow zone" for direct P waves in the range 104˚ < Δ < 140˚. The S-wave shadow zone exists for Δ > 104˚ because the liquid outer core blocks S waves that cannot travel through liquids.

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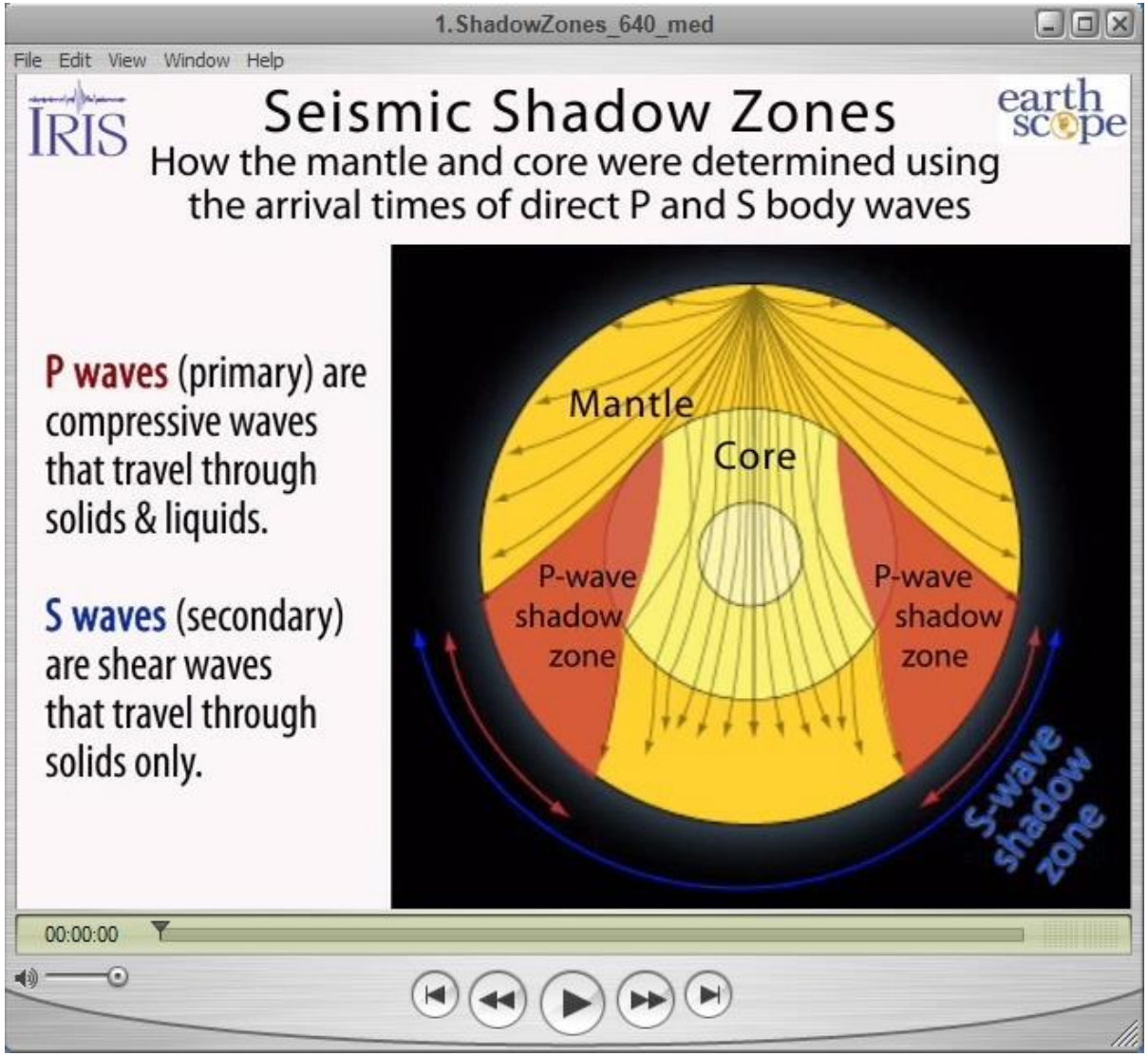
Animation explaining the seismic shadow zone.

Epicentral distance is the angle formed by the intersection of the line from the earthquake to Earth's center with the line from the observing point to the Earth's center.

S waves are observed up to a distance of 104° from an earthquake, but direct S waves are not recorded beyond this distance.

P waves also have a shadow zone between 104° and 140° .



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