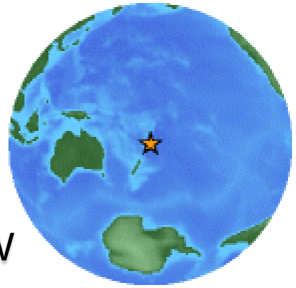
Magnitude 7.4 KERMADEC ISLANDS REGION

Friday, October 21, 2011 at 17:57:16 UTC

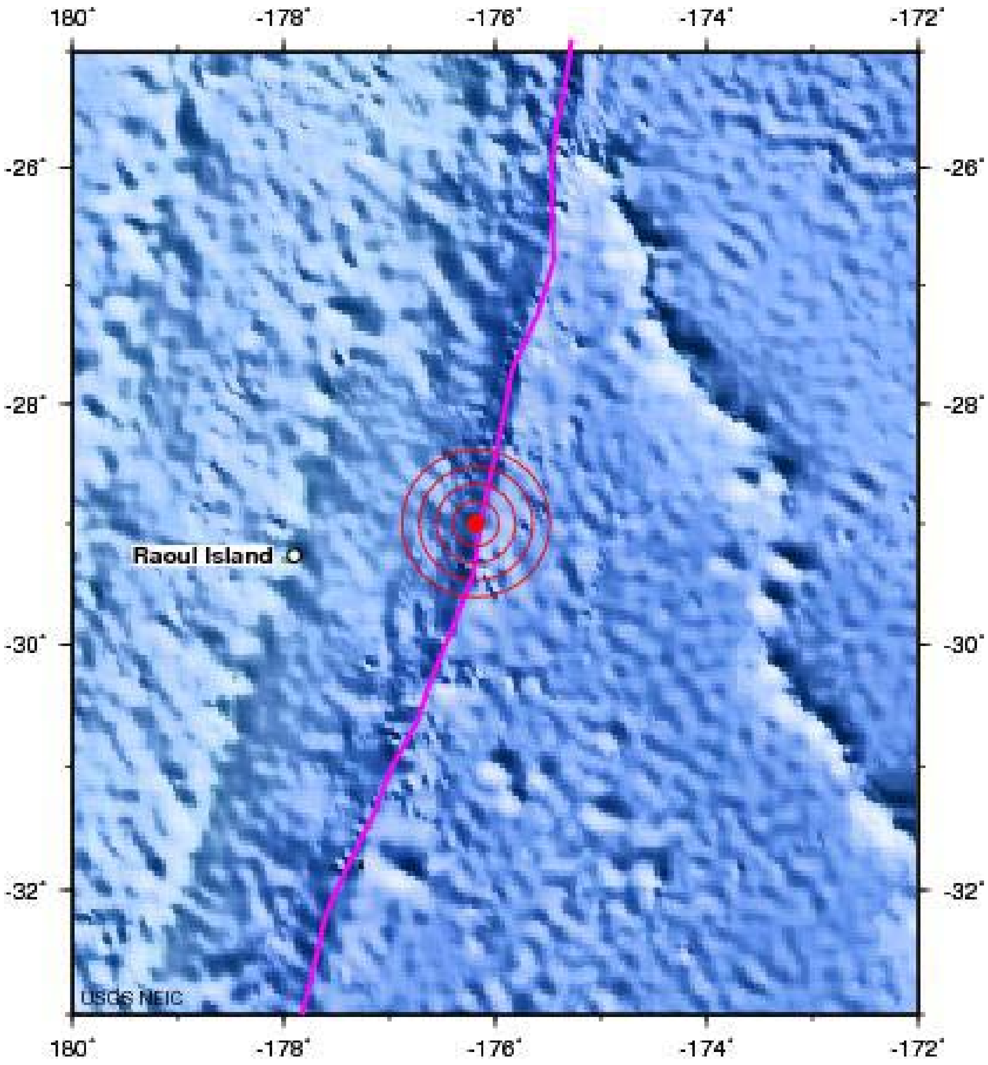


Local Time 5:57 AM
Latitude 28.998° S
Longitude 176.183° W
Depth 32.9 km

This earthquake struck in an oceanic region with few nearby populations, approximately 500 km south of Tonga and 700 km north of New Zealand.

The Kermadec Islands, 750 to 1,000 km north-north-east of New Zealand, are of volcanic origin. They are uninhabited, except for Raoul Island where a team of New Zealand's Department of Conservation staff work. All the islands are scientific reserves for the protection of fauna and flora.

While this earthquake was likely not felt by anyone, the seismic waves that reached the US reveal different phases at different distances.



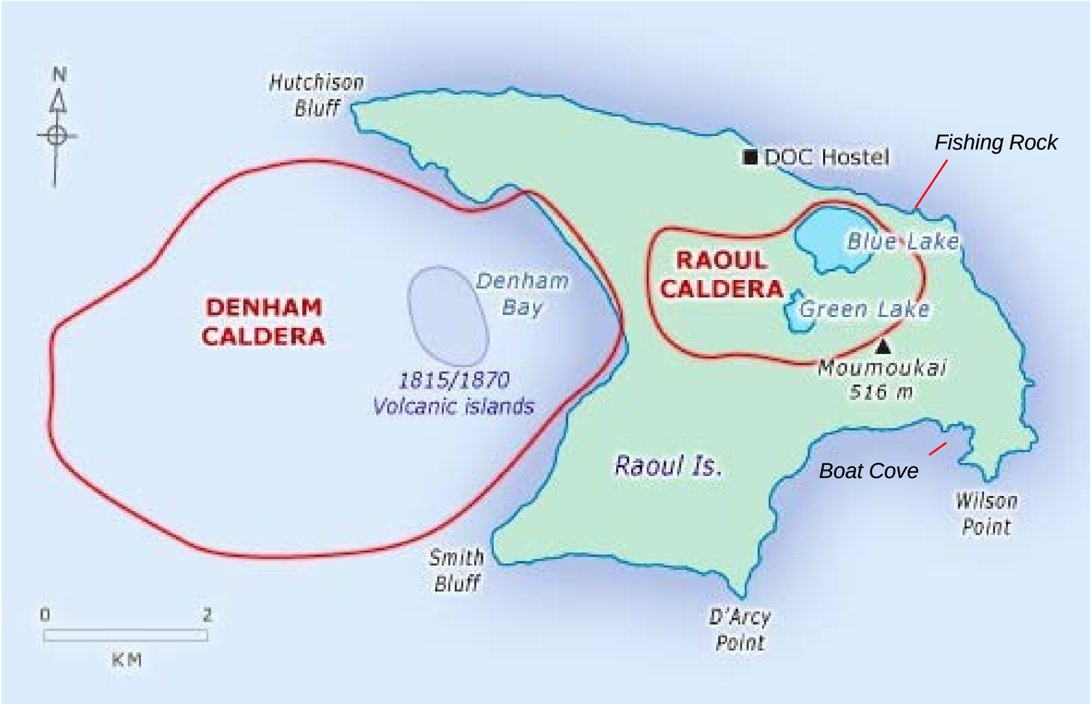
Images courtesy of the US Geological Survey

Magnitude 7.4 KERMADEC ISLANDS REGION
Friday, October 21, 2011 at 17:57:16 UTC

Raoul is the most active volcanic island of all of the Kermadec Islands. The permanently manned Raoul Island Station represents the northernmost outpost of New Zealand. It includes a government meteorological and radio station and hostel for Department of Conservation (DOC) officers and volunteers. The station stands on the northern terraces of the island, about 50 m (164 ft) in elevation above the cliffs of Fleetwood Bluff.

No tsunami warning was issued by the Pacific Tsunami Warning Center, although it cautioned there is a low chance of a local tsunami. "…earthquakes of this size sometimes generate local tsunamis that can be destructive along coasts located within a hundred kilometers of the earthquake epicenter."

Measurements on Raoul Island included 0.10 m (0.3 ft) amplitude measured relative to normal sea level at Boat Cove, and 0.17 m (0.6 ft) amplitude measured at Fishing Rock.



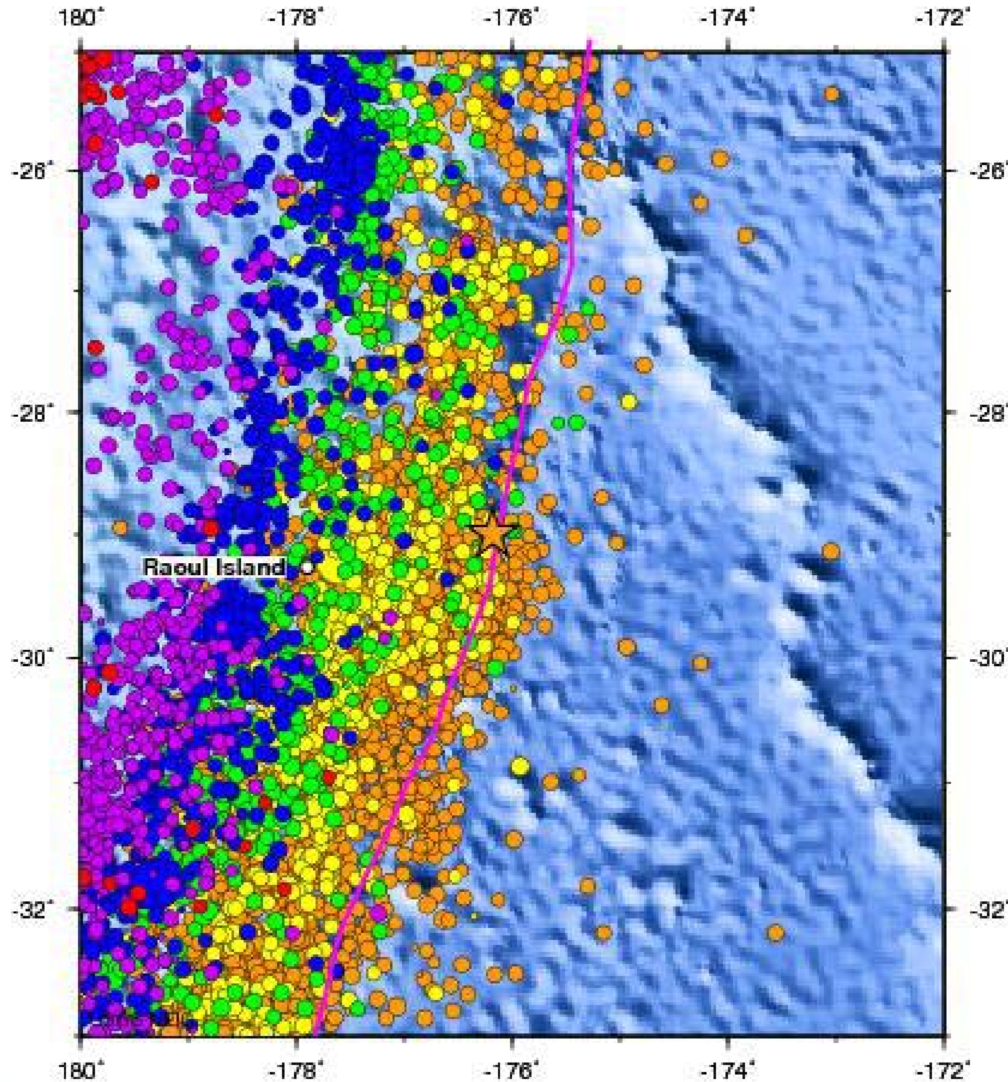
Raoul Island Calderas, Image © GNS Science

Magnitude 7.4 KERMADEC ISLANDS REGION
Friday, October 21, 2011 at 17:57:16 UTC

A major earthquake occurred near the Kermadec Trench about 1215 km (754 miles) northeast of Auckland, New Zealand.

This region of the Tonga-Kermadec subduction zone experiences reasonably high levels of seismic activity, with nearly 50 events of M 6.5 and above over the past 38 years, and 5 greater than M 7.5.

The map below on the right shows earthquakes recorded from 1990 to present in this region with this earthquake represented as an orange star.



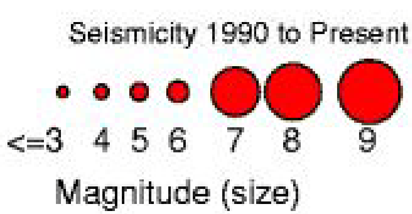


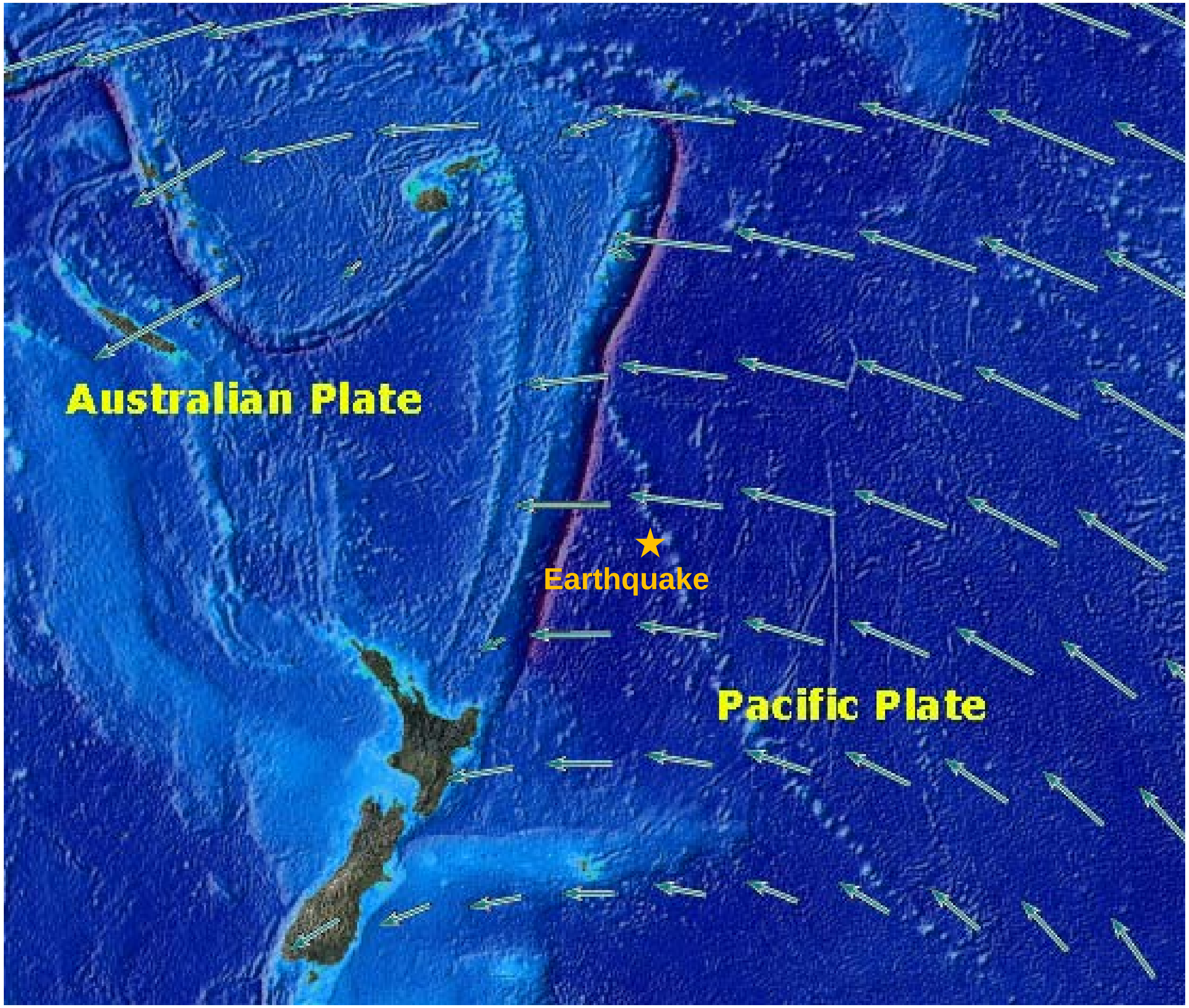
Image courtesy of the US Geological Survey

Magnitude 7.4 KERMADEC ISLANDS REGION
Friday, October 21, 2011 at 17:57:16 UTC

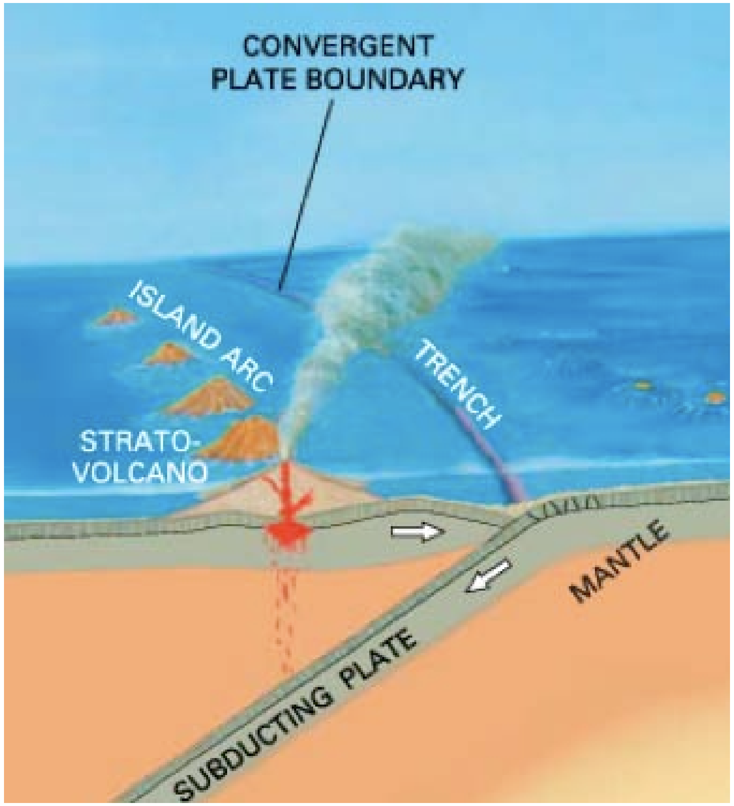
The arrows show the motion of the Pacific Plate relative to the Australian Plate.

Near the location of this earthquake the Pacific Plate bends into the trench to subduct below the eastern edge of the Australia Plate

The rate of convergence at the location of Wednesday's earthquake is about 60 mm/yr (6 cm/yr).



Magnitude 7.4 KERMADEC ISLANDS REGION
Friday, October 21, 2011 at 17:57:16 UTC



The preliminary mechanism and depth of the event suggest it ruptured a reverse fault within the oceanic lithosphere of the Pacific Plate.

The initial location indicate a source slightly to the east of the trench and the subduction zone. Therefore, it appears this earthquake is not on the thrust interface between the Pacific and Australian plates.

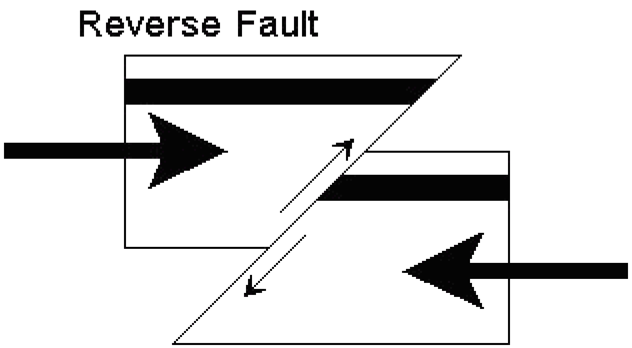
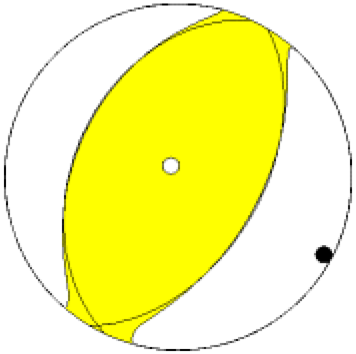


Image courtesy of
Richard Harwood, Black Hawk College



Shaded areas show quadrants of the focal sphere in which the P-wave first-motions are away from the source, and unshaded areas show quadrants in which the P-wave first-motions are toward the source. The dots represent the axis of maximum compressional strain (in black, called the "P-axis") and the axis of maximum extensional strain (in white, called the "T-axis") resulting from the earthquake.

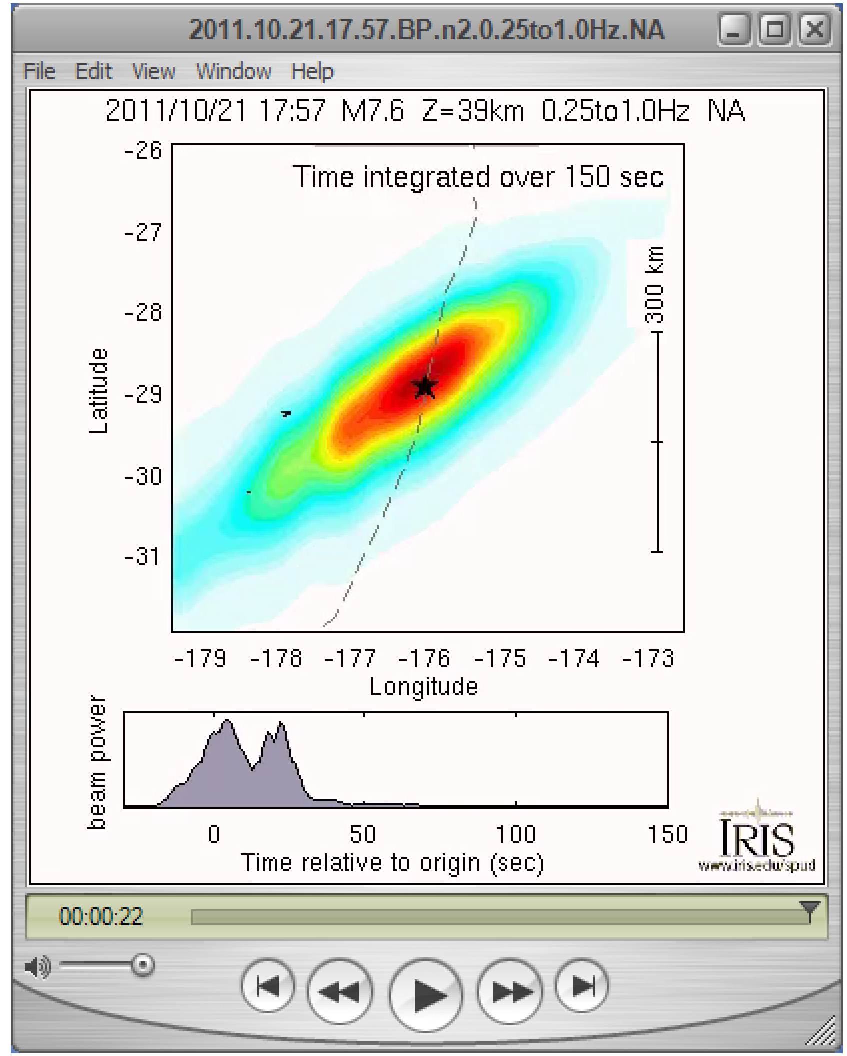
USGS WPhase Centroid Moment Tensor Solution

Magnitude 7.4 KERMADEC ISLANDS REGION
Friday, October 21, 2011 at 17:57:16 UTC

Back Projections are movies created from an automated data processing sequence that stacks up P wave energy recorded on many seismometers on a flat grid around the source region. This grid is meant to be a fault surface and creates a time and space history of the earthquake.

Warmer colors indicate greater beam power. In the movies, a red circle shows the location of the peak beam power when absolute beam powers are low.

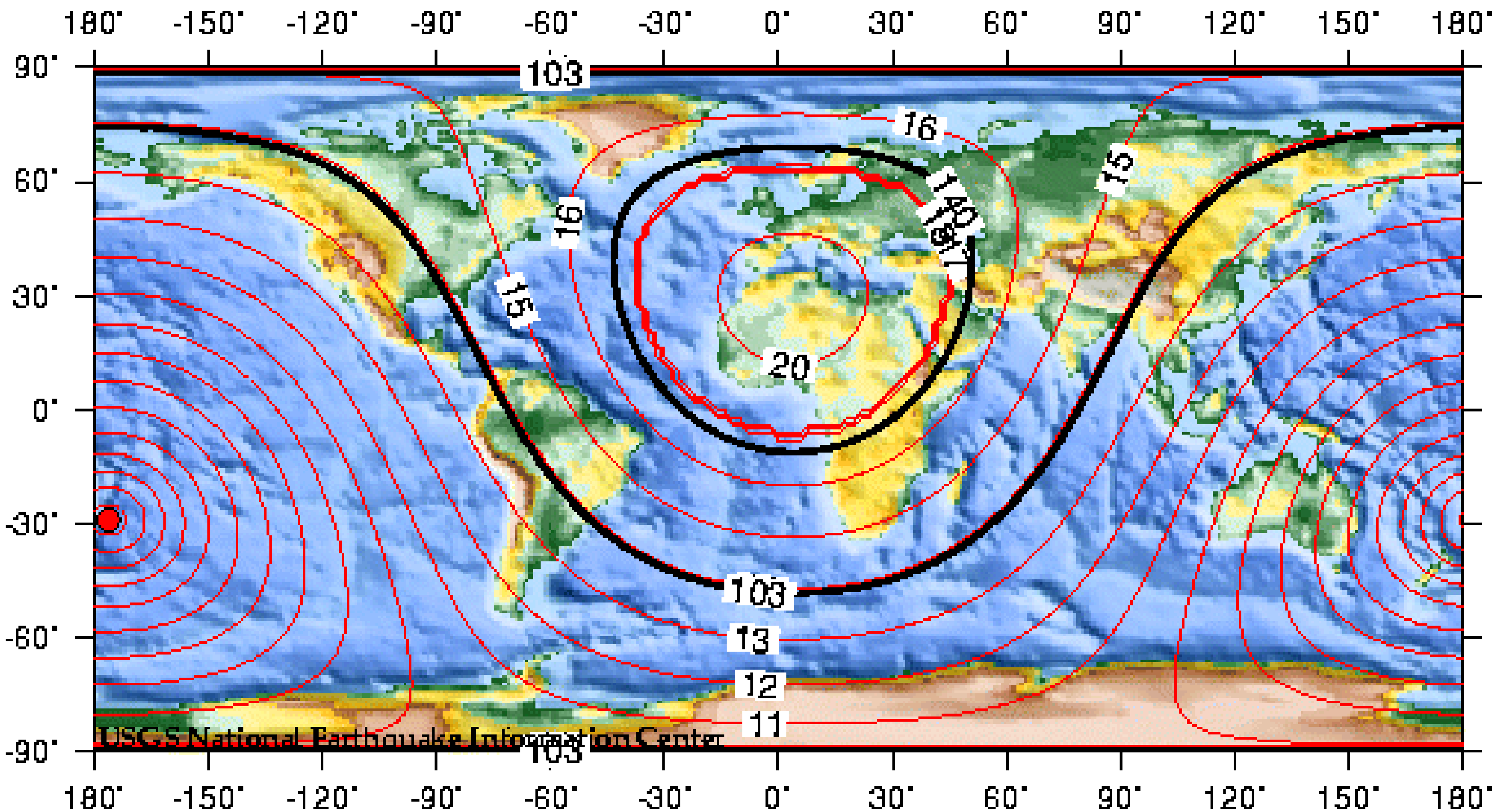
Duration of rupture along the fault can be seen in the graph.



More info: http://www.iris.edu/spud/backprojection

IRIS Teachable Moments

Magnitude 7.4 KERMADEC ISLANDS REGION
Friday, October 21, 2011 at 17:57:16 UTC



The above map shows the predicted (theoretical) travel times, in minutes, of the first compressional (P) wave from the earthquake to points around the globe.

The heavy black lines shown are the approximate distances to the P-wave shadow zone (103 -140 degrees)

Image courtesy of the US Geological Survey

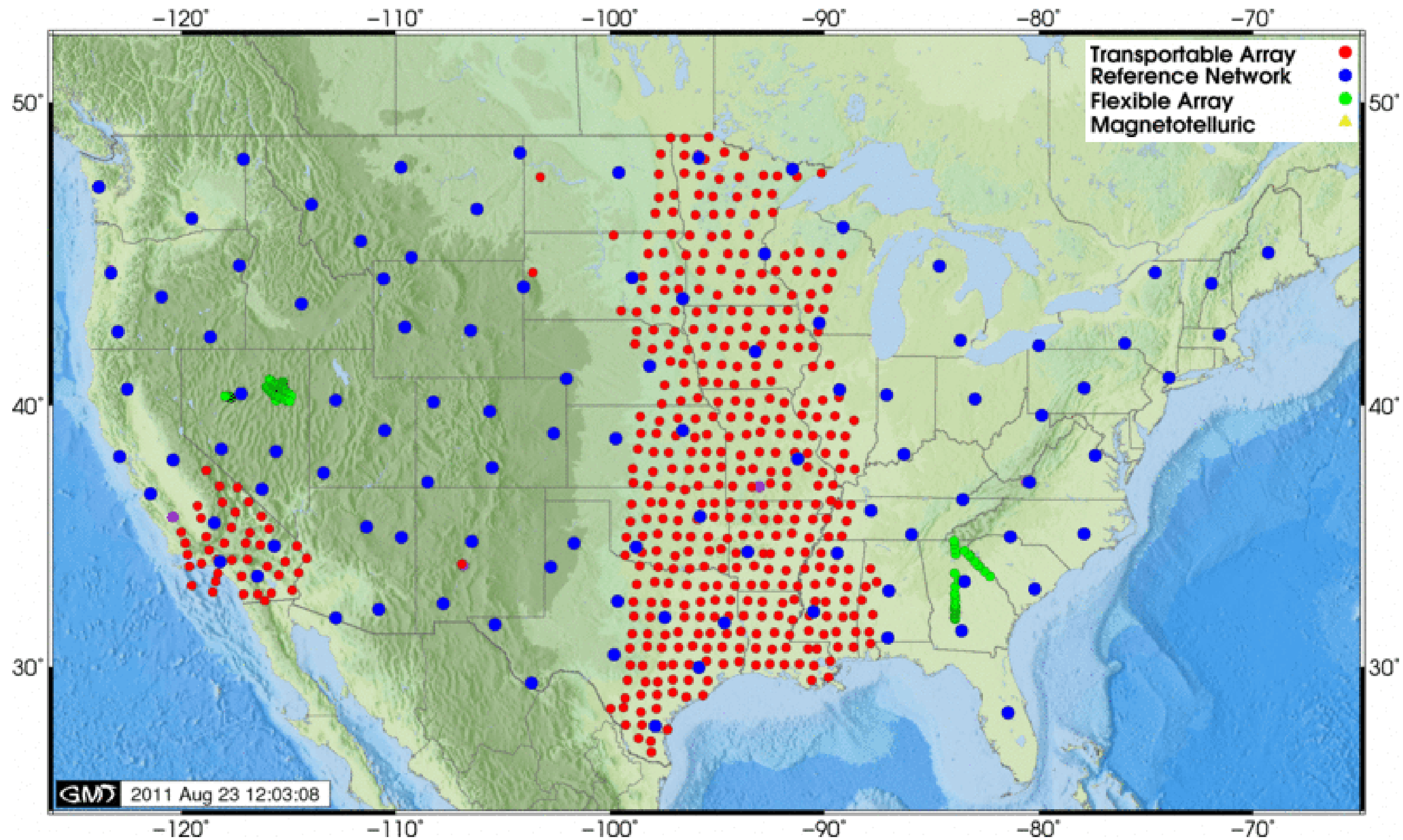
Magnitude 7.4 KERMADEC ISLANDS REGION

Friday, October 21, 2011 at 17:57:16 UTC

USArray: A Continental-Scale Seismic Observatory

USArray's transportable array is a network of 400 high-quality broadband seismographs that are moving (every two years) across the United States from west to east, and Alaska, in a regular grid pattern.

These data are being used to answer questions about the North American continent and underlying mantle.



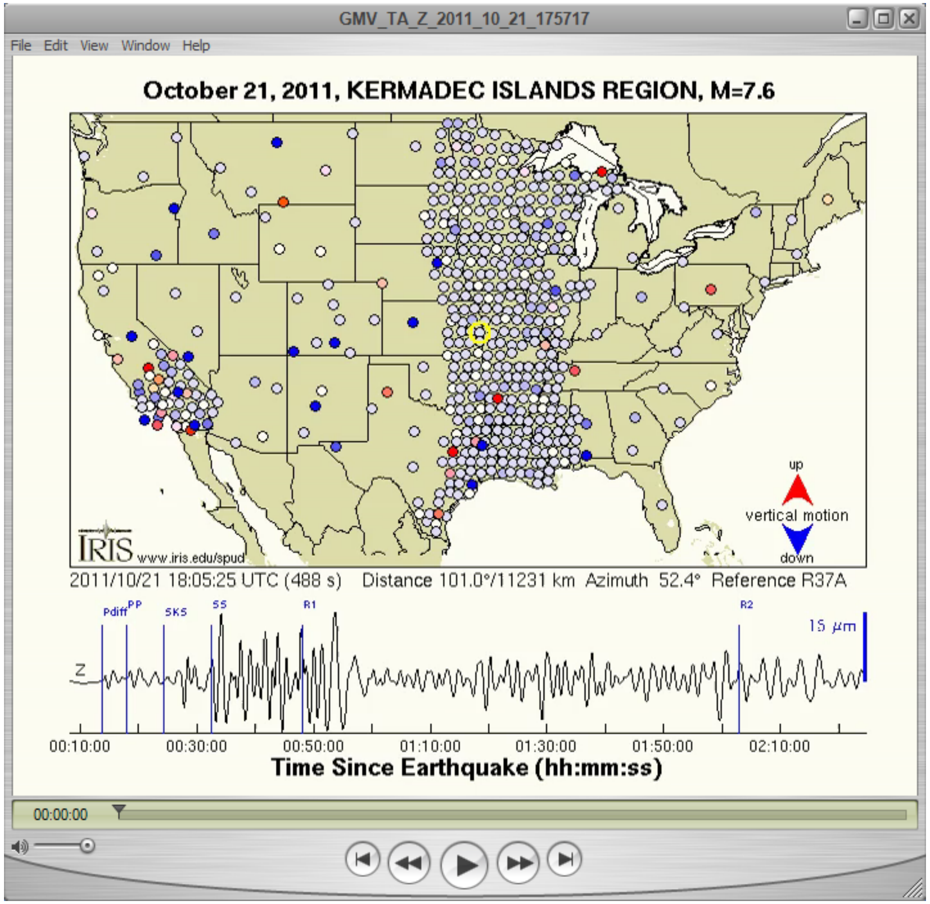
Operating USArray Stations. The 400 active transportable array stations are plotted in red. Permanent stations are plotted in blue.

Magnitude 7.4 KERMADEC ISLANDS REGION
Friday, October 21, 2011 at 17:57:16 UTC

As earthquake waves travel along the surface of the Earth, they cause the ground to move. With the 400 earthquake recording stations in EarthScope's Transportable Array, the ground motions can be captured and displayed as a movie, using the actual data recorded from the earthquake.

The circles in the movie represent earthquake recording stations and the color of each circle represents the amplitude, or height, of the earthquake wave detected by the station's seismometer.

A random representative trace is displayed on the lower part of the animation with its horizontal axis representing the time (in seconds) after the event. Location of the representative station is marked on the map by a yellow circle.

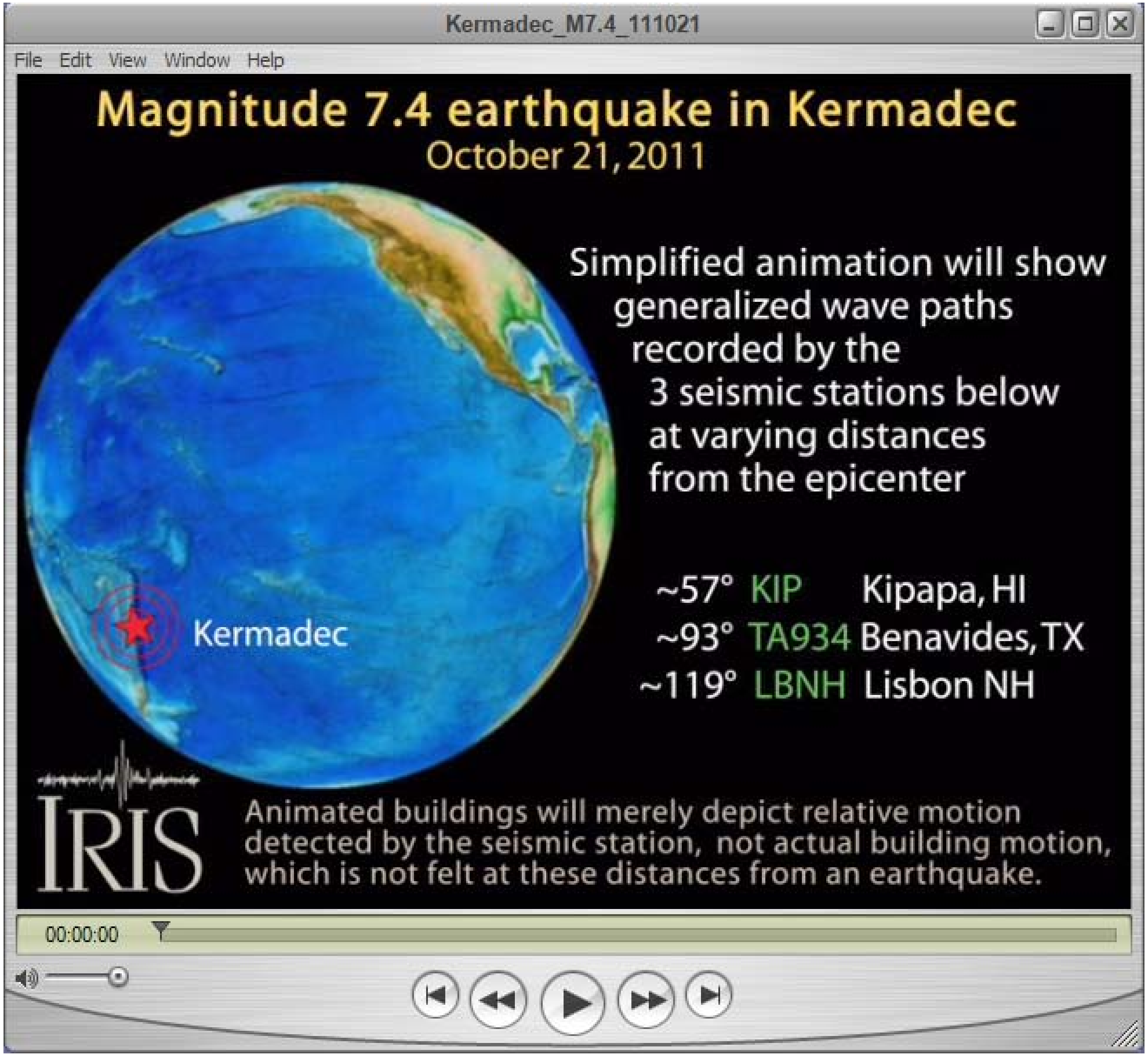


Seismic waves crossing the US recorded by the USArray.

Magnitude 7.4 KERMADEC ISLANDS REGION
Friday, October 21, 2011 at 17:57:16 UTC

Quick Time Required

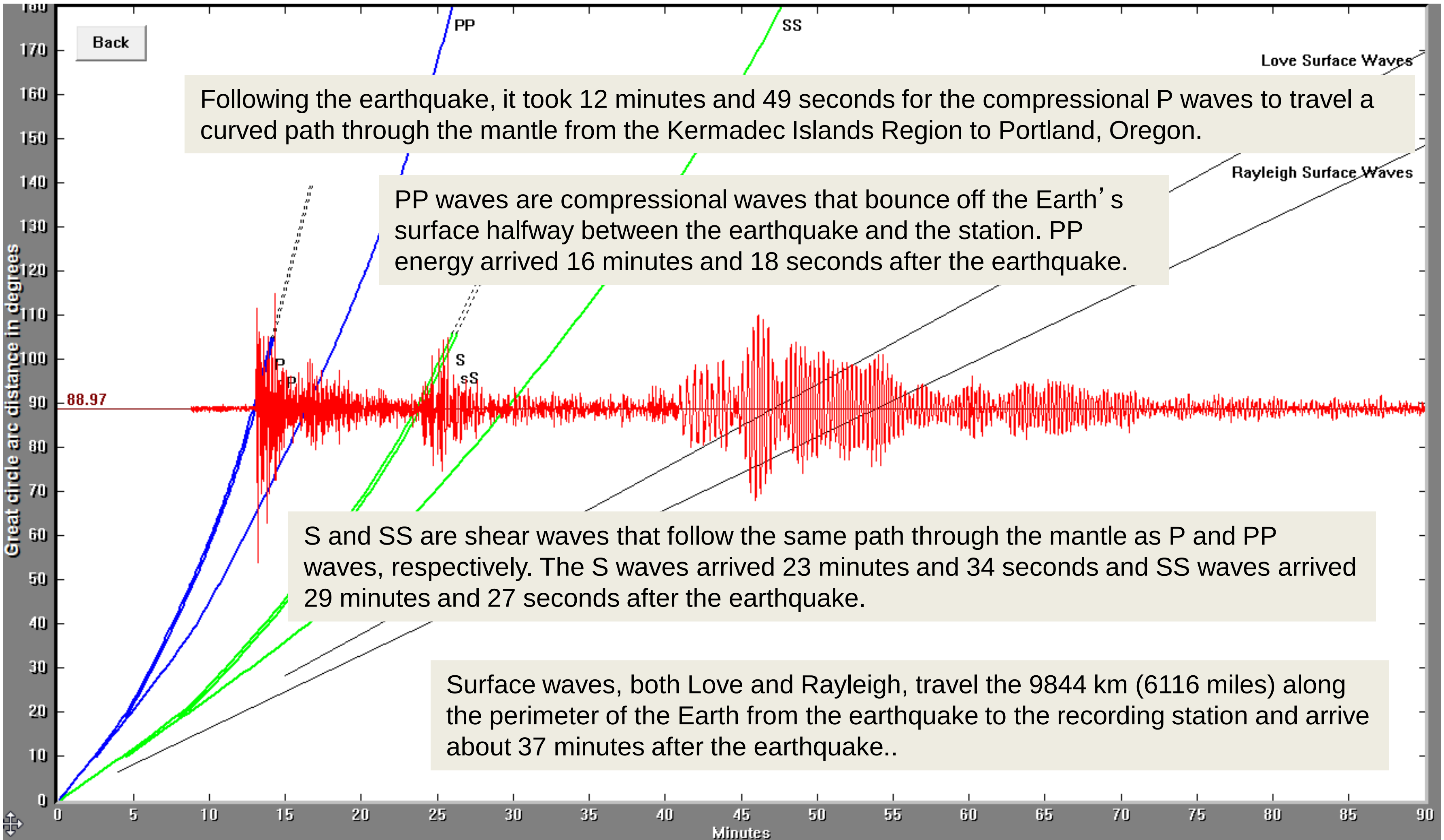
Animation of the generalized paths of seismic waves traveling from the Kermadec Islands Region to three stations at varied distances around the globe.



Seismic Wave Propagation

Magnitude 7.4 KERMADEC ISLANDS REGION
Friday, October 21, 2011 at 17:57:16 UTC

The record of the M7.4 Kermadec earthquake on the University of Portland seismometer (UPOR) is illustrated below. Portland is about 9844 km (6116 miles, 88°) from the location of this earthquake.



Magnitude 7.4 KERMADEC ISLANDS REGION
Friday, October 21, 2011 at 17:57:16 UTC

3 components recorded by SNCC (0.01–0.07 Band Pass (BP) filtered), the closest USArray station to the event.