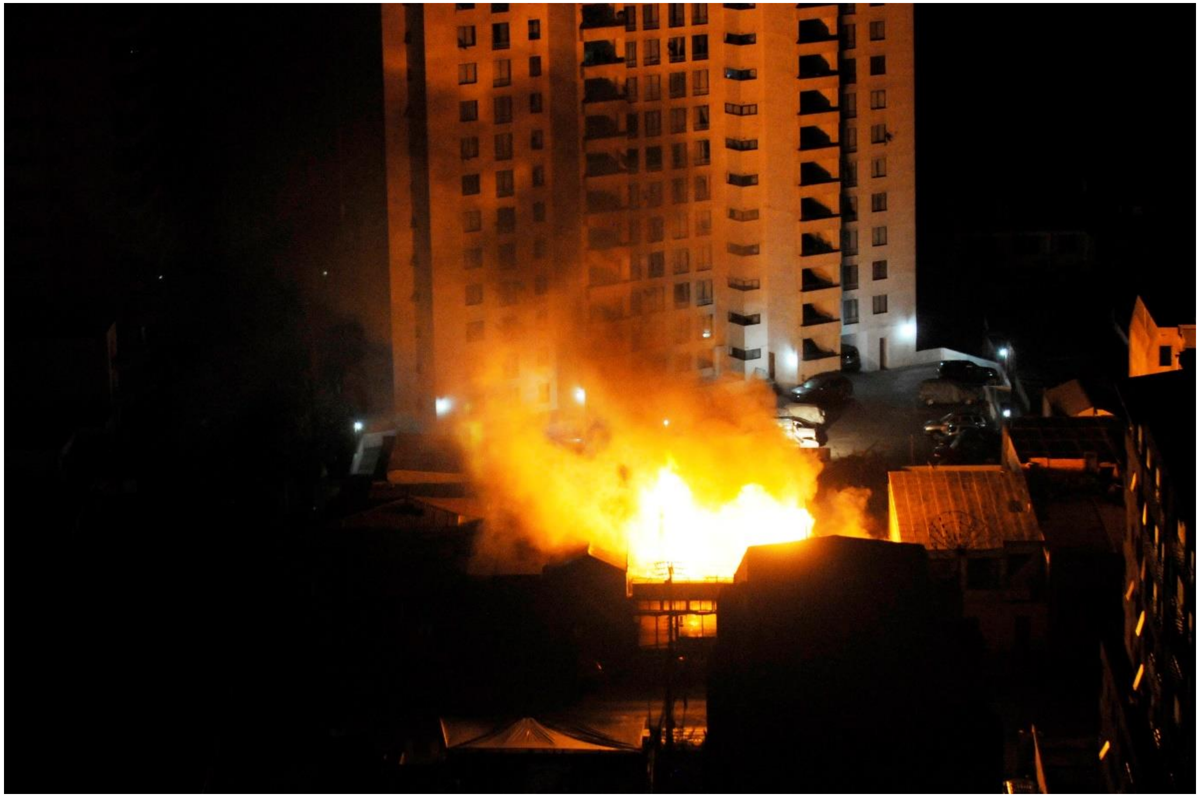
Magnitude 8.2 NORTHWEST OF IQUIQUE, CHILE
Tuesday, April 1, 2014 at 23:46:46 UTC

An 8.2-magnitude earthquake struck off the coast of northern Chile, generating a local tsunami. The USGS reported the earthquake was centered 95 km (59 miles) northwest of Iquique at a depth of 20.1km (12.5 miles).

USGS



A fire burns at a restaurant after an earthquake in Iquique, Chile, Tuesday, April 1, 2014. A powerful magnitude-8.2 earthquake struck off Chile's northern coast Tuesday night. There were no immediate reports of injuries or major damage, but buildings shook in nearby Peru and in Bolivia's high altitude capital of La Paz.

(AP Photo/Cristian Viveros)

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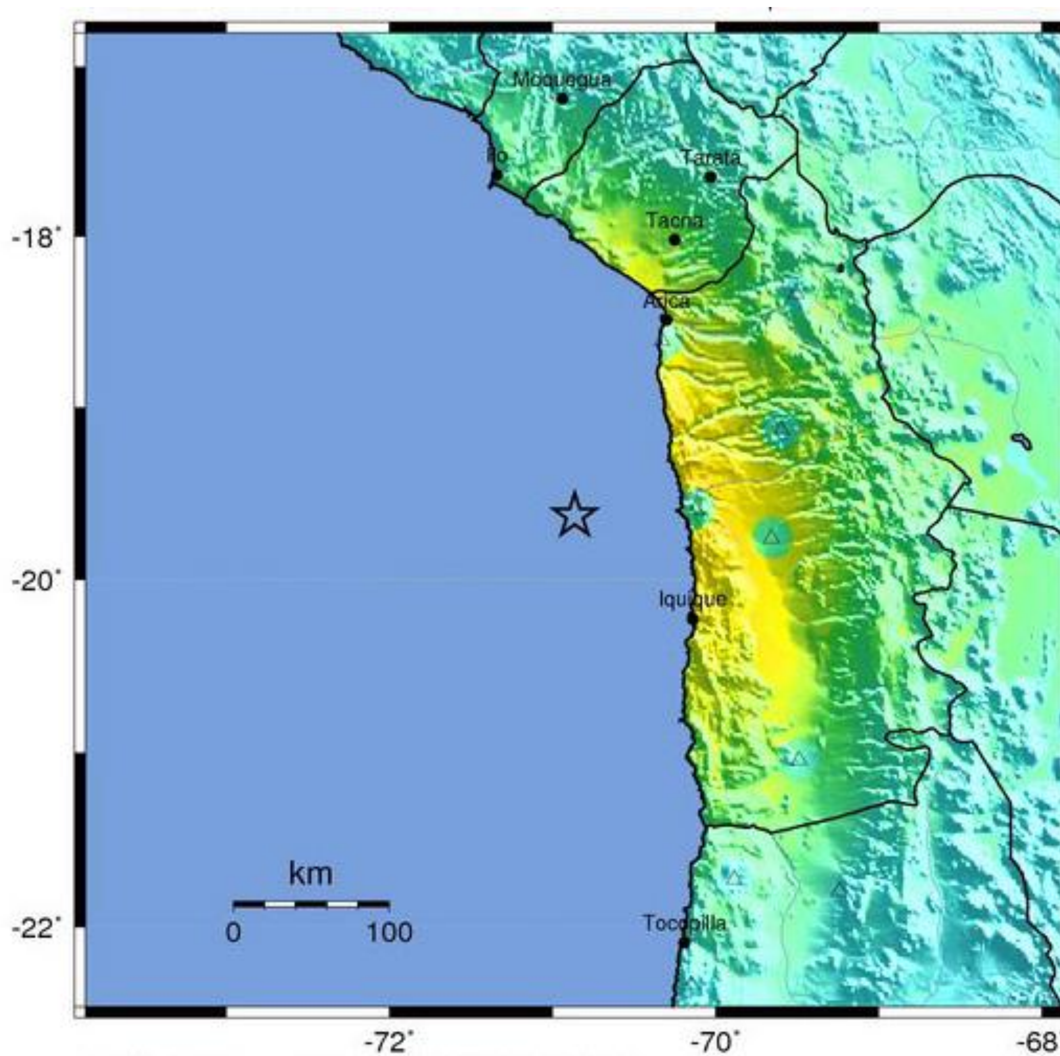
The Modified-Mercalli Intensity scale is a twelve-stage scale, from I to XII, that indicates the severity of ground shaking.

The Chilean coastline experienced very strong ground shaking from this earthquake.

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

Image courtesy of the US Geological Survey



USGS Estimated shaking Intensity from M 8.2 Earthquake

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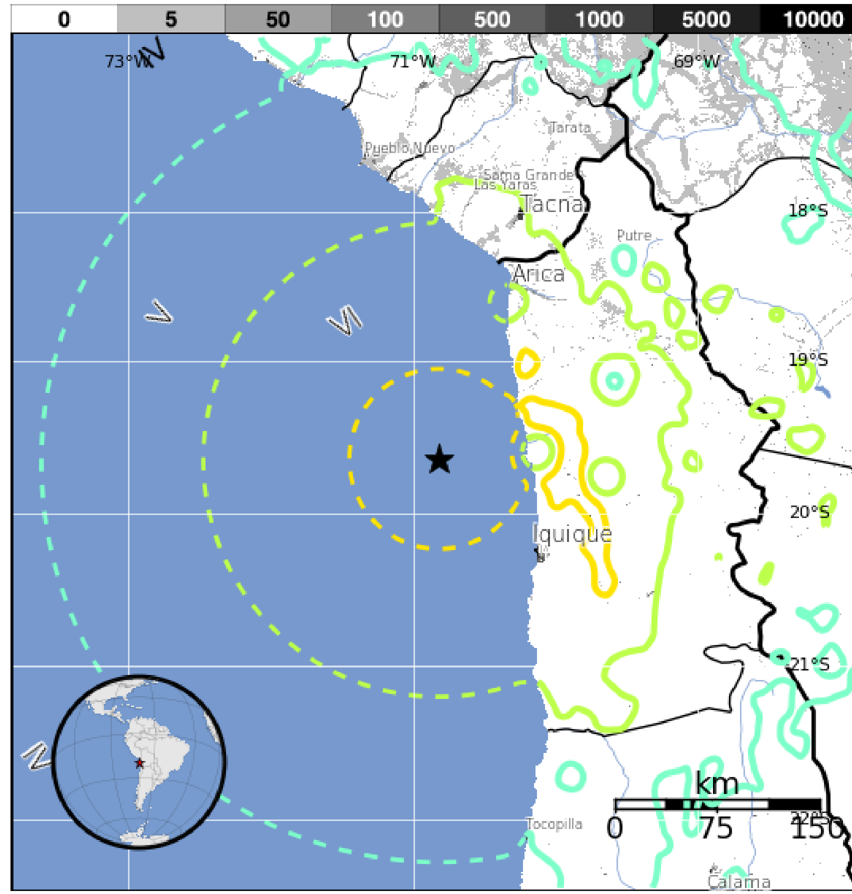
USGS PAGER
Population Exposed to Earthquake Shaking

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

Over 97,000 people experienced very strong shaking and 638,000 experienced strong shaking from this earthquake.



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

Estimated Modified Mercalli Intensity	I	II-III	IV	V	VI	VII	VIII	IX	X
Est. Population Exposure	--*	--*	211k*	455k*	638k	97k	0k	0k	0k
Perceived Shaking	Not Felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme

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This earthquake occurred on the subduction zone plate boundary at the Peru – Chile Trench where the oceanic Nazca Plate subducts beneath the continental South American Plate.

The red star on the map below shows the epicenter of the earthquake while the arrows show the direction of motion of the Nazca Plate toward the South American Plate.

At the location of this earthquake, the two plates are converging at a rate of about 65 mm/yr.

UNAVCO

IRIS Teachable Moments

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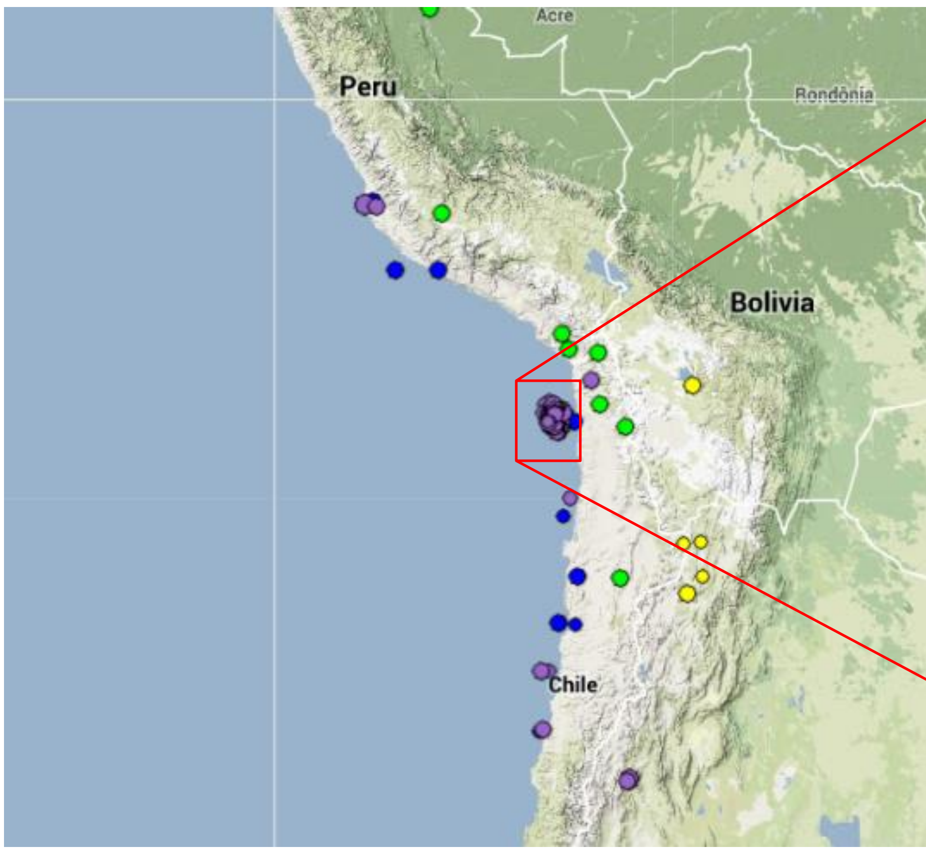
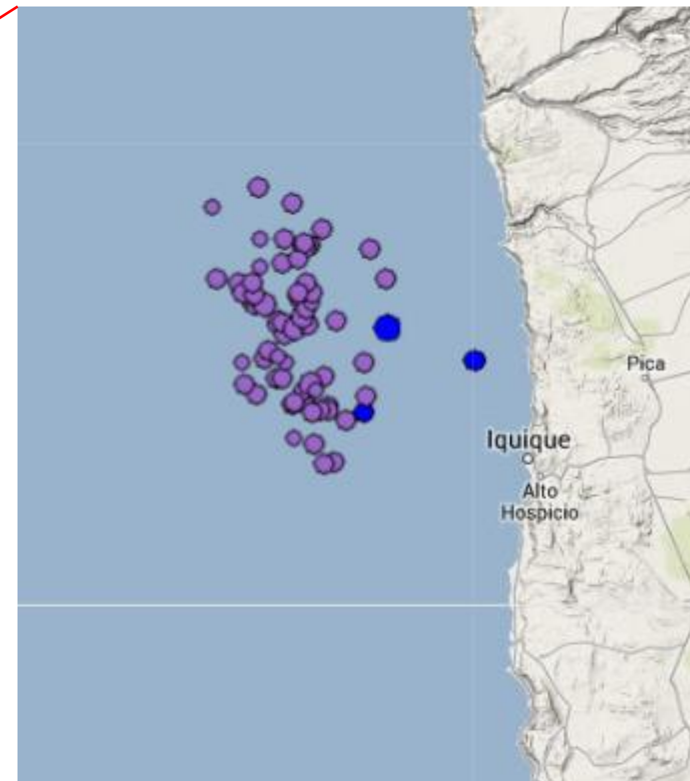
The image below plots earthquakes that occurred in March 2014. A M6.7 earthquake with similar faulting mechanism to the April 1st earthquake occurred on March 16 and was followed by 3 earthquakes ≥ M6, 26 earthquakes ≥ M5, and 60+ earthquakes ≥ M4. We now understand this earthquake sequence to be foreshocks of the April 1st earthquake. Unfortunately, seismologists do not yet know how to determine an earthquake is a foreshock until the mainshock occurs.





Explore at www.iris.edu/ieb

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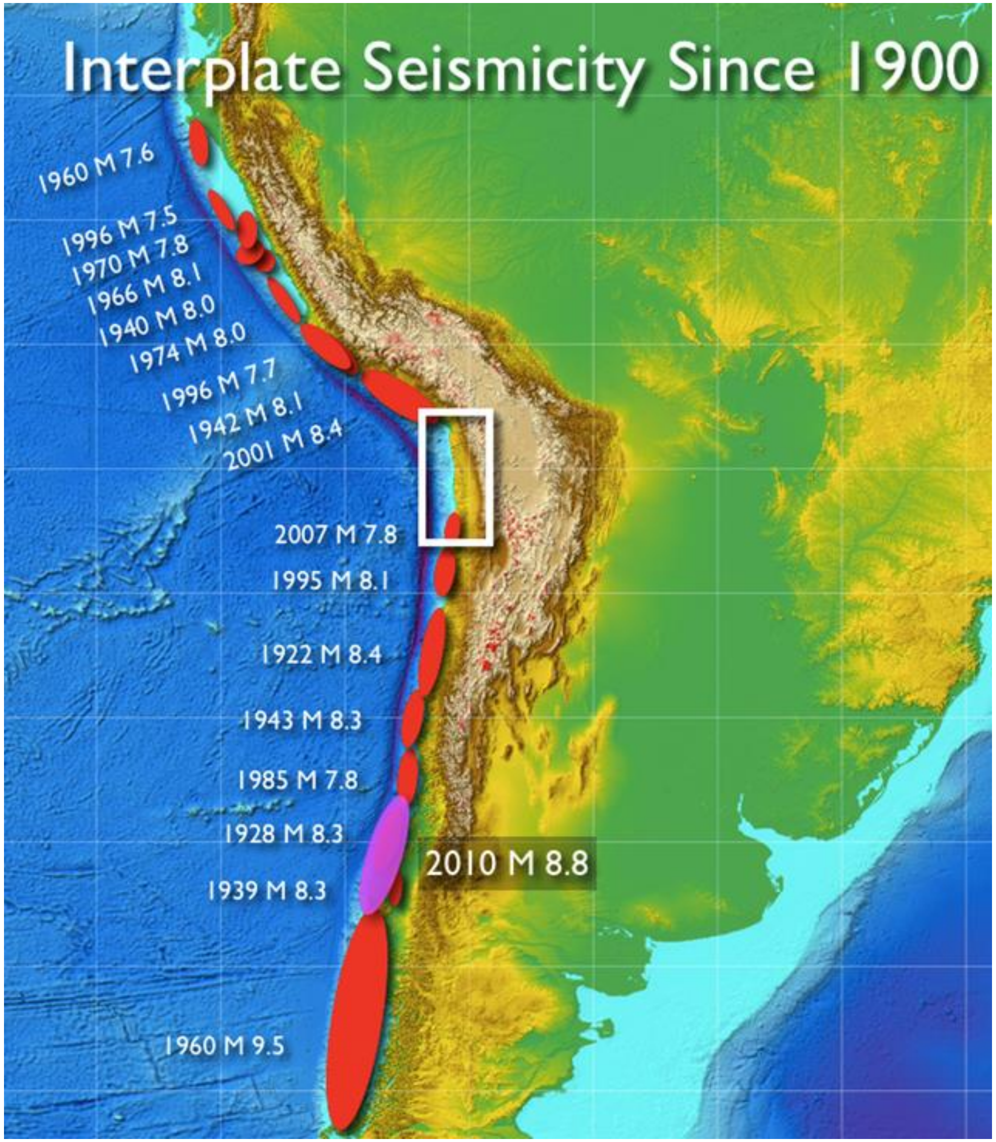

This figure, made prior to this earthquake, shows the approximate locations of megathrust earthquake events along the boundary between the Nazca and South American plates since 1990, based on a compilation from many sources by Matt Pritchard and Richard Allmendinger of Cornell.

The white box highlights the Iquique gap, which had not had a major megathrust earthquake since 1877 and thus had a high probability of rupturing.

Image courtesy Richard Allmendinger

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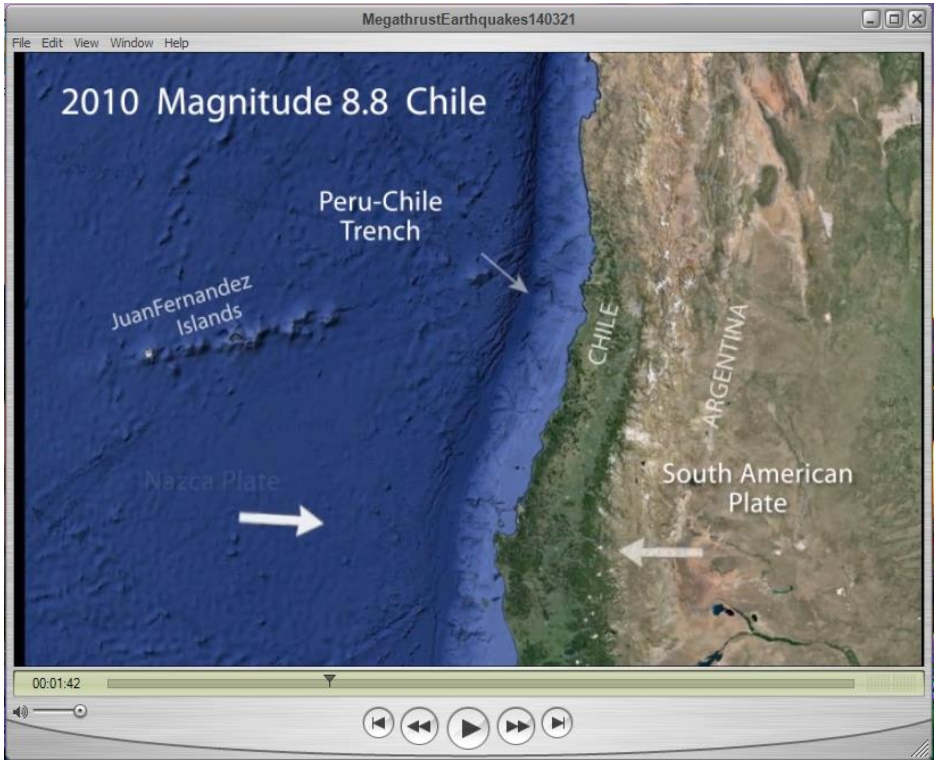
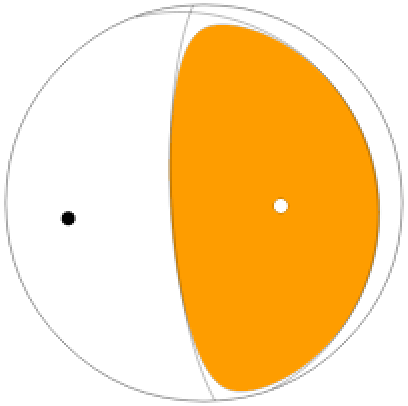
This earthquake occurred as the result of thrust faulting at shallow depths near the Chilean coast. The location and mechanism of the earthquake are consistent with slip on the primary plate boundary interface, or megathrust, between the Nazca and South America plates. At the latitude of the earthquake, the Nazca plate subducts eastward beneath the South America plate at a rate of 65 mm/yr.



Animation exploring subduction-zone mega-thrust earthquakes, the most powerful earthquakes in the world.



The tension axis (white dot) reflects the minimum compressive stress direction. The pressure axis (black dot) reflects the maximum compressive stress direction.

USGS Centroid Moment Tensor Solution

Images courtesy of the U.S. Geological Survey

Large shallow earthquakes in subduction zones can produce tsunamis because these events can displace a large area of ocean floor by several meters. 7-foot waves were reported in Iquique, Chile.

Tsunamis can have wavelengths greater than 100 km and periods of tens of minutes. Because the wavelength is more than 20 times the 4 km average depth of the oceans, a tsunami travels as a “shallow water” wave that can propagate across an entire ocean basin with minimal loss of energy.

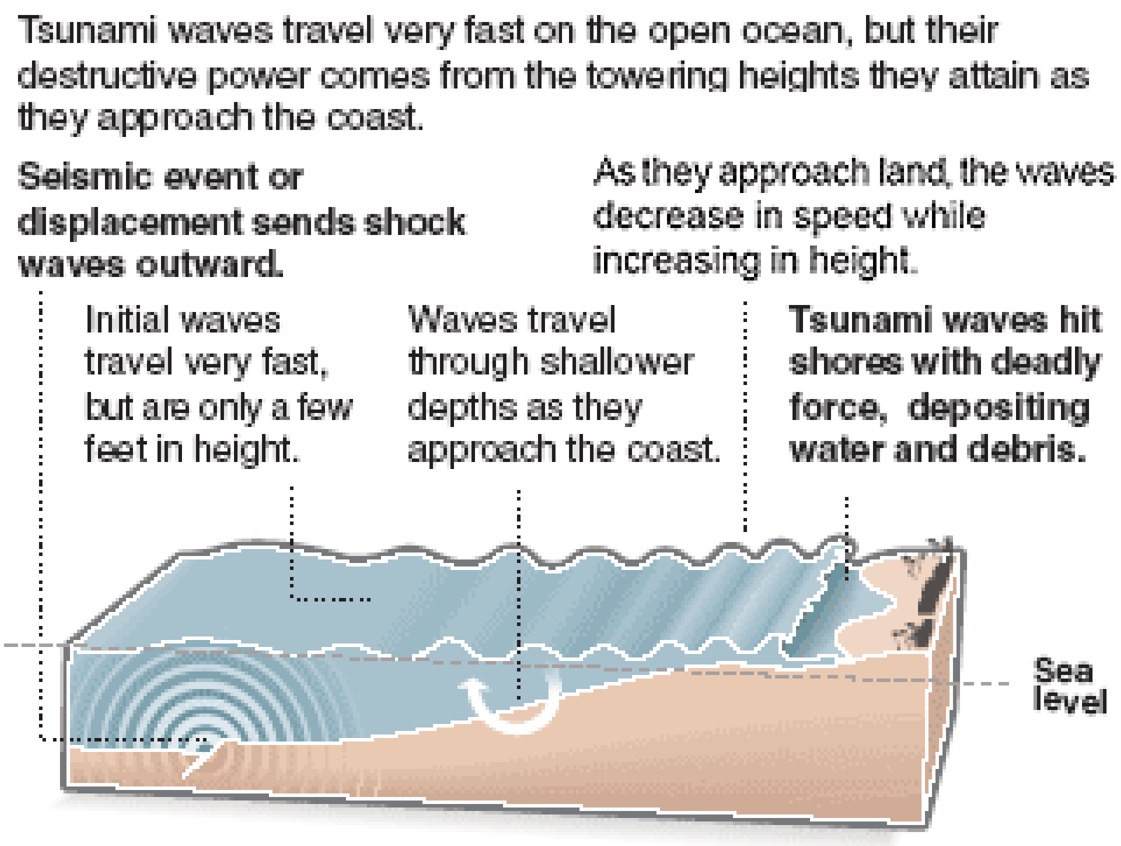


Image courtesy of the U.S. Geological Survey

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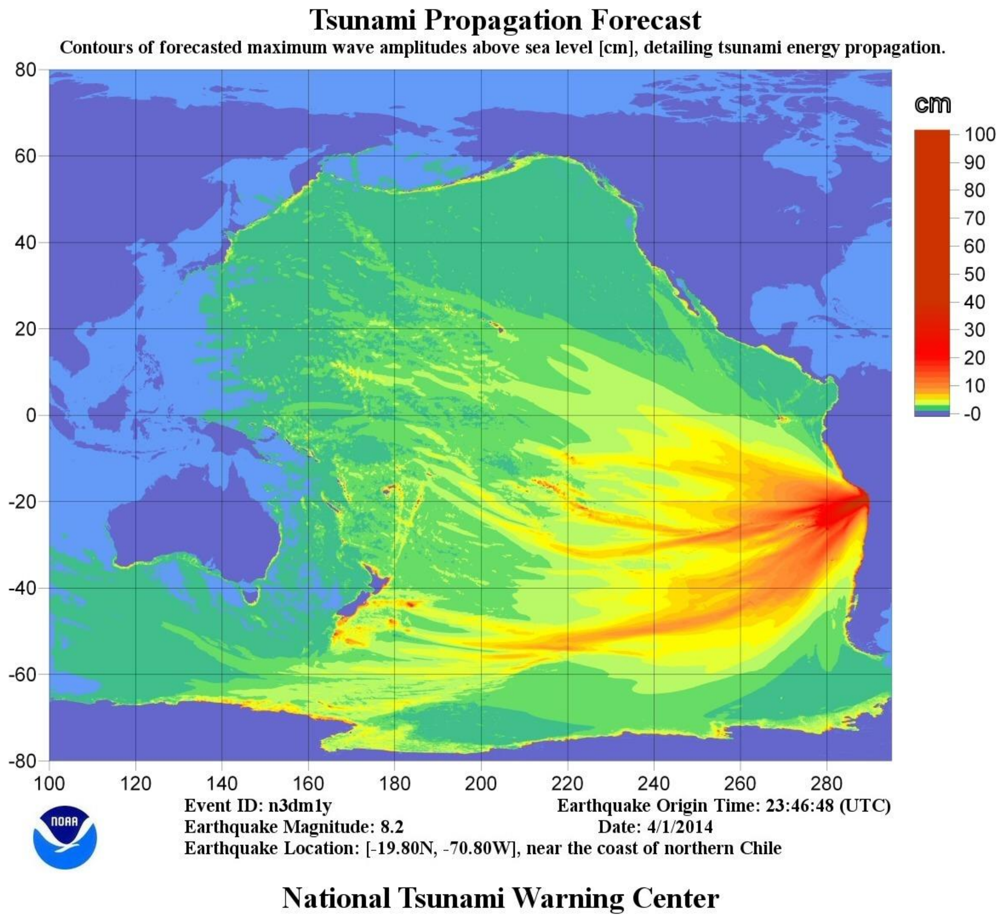
In the open ocean, a tsunami travels at a speed of over 700 km/hr (~440 mph) and the wave moves the ocean water all the way to the sea floor. This “shallow water” behavior means that the velocity and projected wave heights of a tsunami can be calculated using a map of ocean depth.

The map on the right is from NOAA’s National Tsunami Warning Center. This map shows the predicted amplitudes of the tsunami produced by the M8.2 earthquake. Since tsunamis have such large wavelengths, they “experience” the ocean as shallow water. This makes tsunamis nondispersive and allows them to propagate without dispersion or significant loss of energy across entire ocean basins.



Preliminary Forecast Model Energy Map

NOAA

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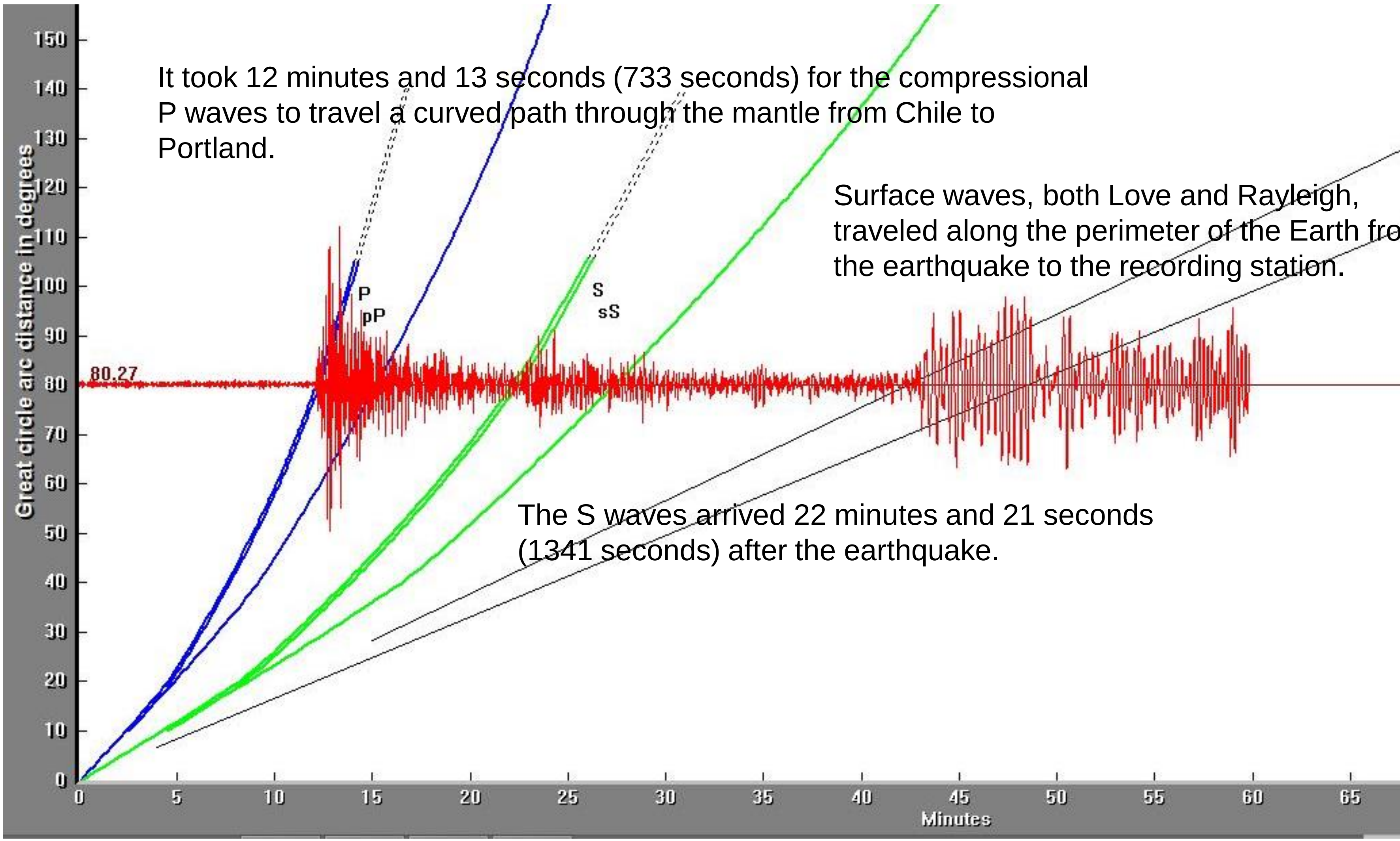
The record of the earthquake on the University of Portland seismometer (UPOR) is illustrated below. Portland is about 8924 km (5546 miles, 80.4°) from the location of this earthquake.



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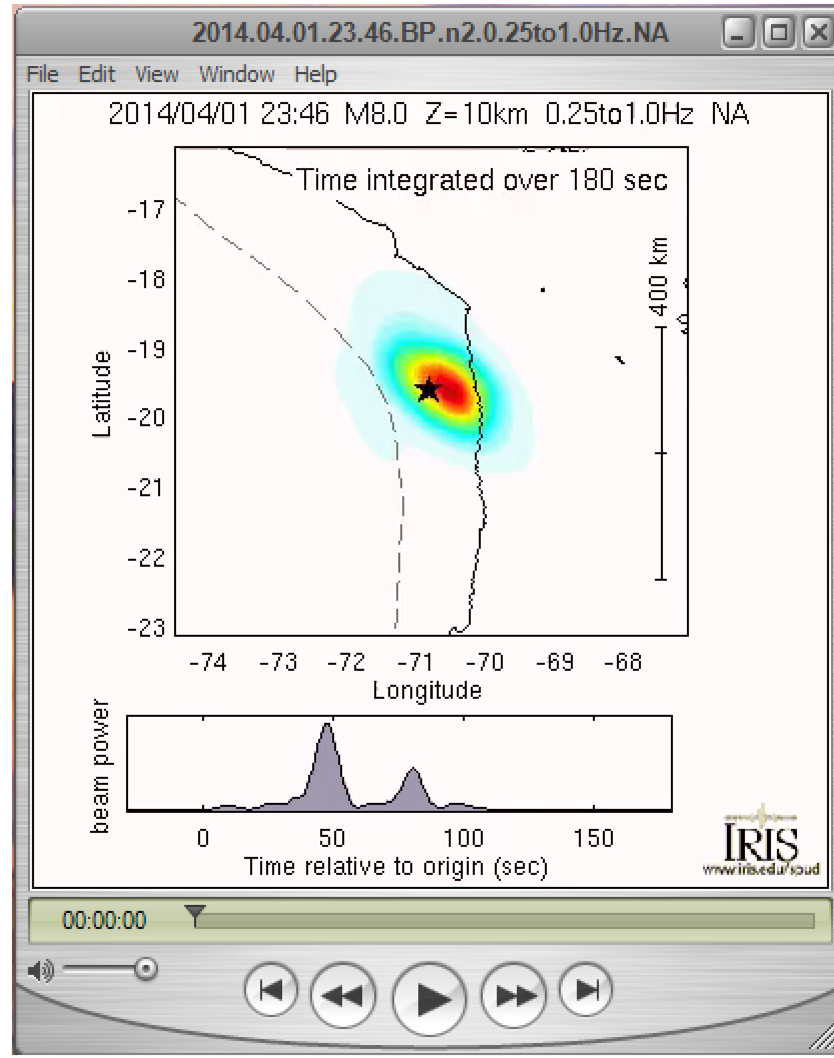
Back Projections are movies created from an automated data processing sequence that stacks up P wave energy recorded on many seismometers on a flat grid around the source region. This grid is meant to be a fault surface and creates a time and space history of the earthquake.

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

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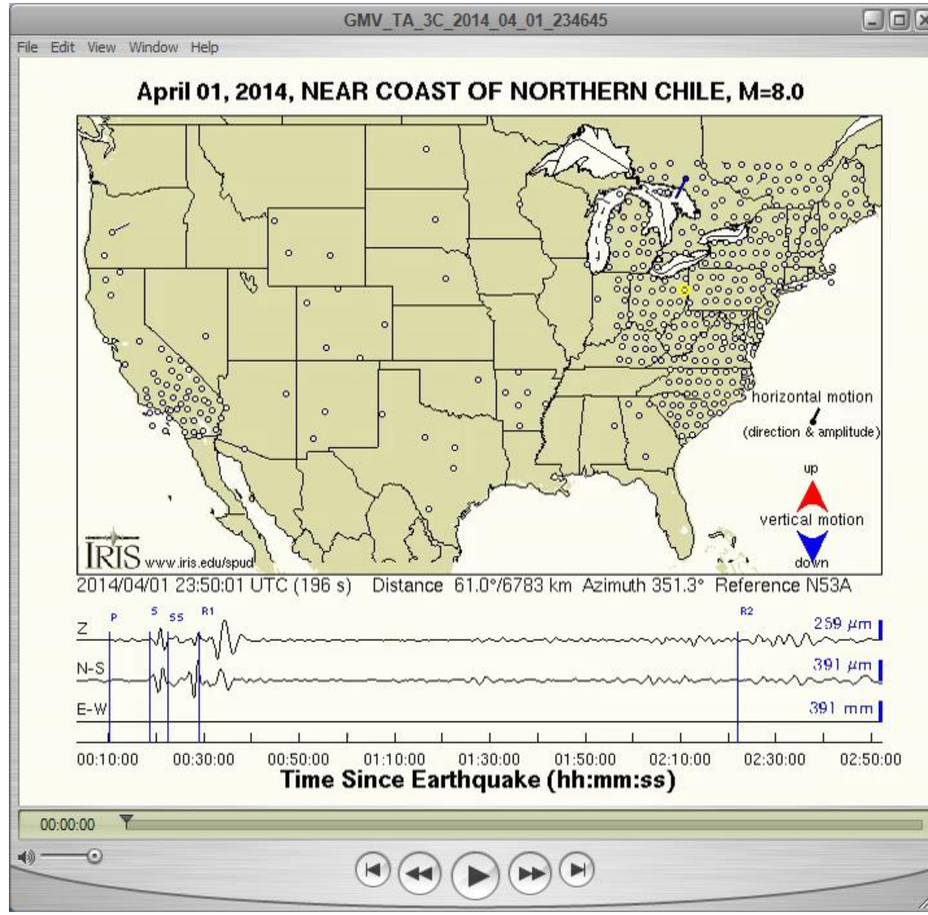
As earthquake waves travel along the surface of the Earth, they cause the ground to move. With the 400 earthquake recording stations in EarthScope's Transportable Array, the ground motions can be captured and displayed as a movie, using the actual data recorded from the earthquake.

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

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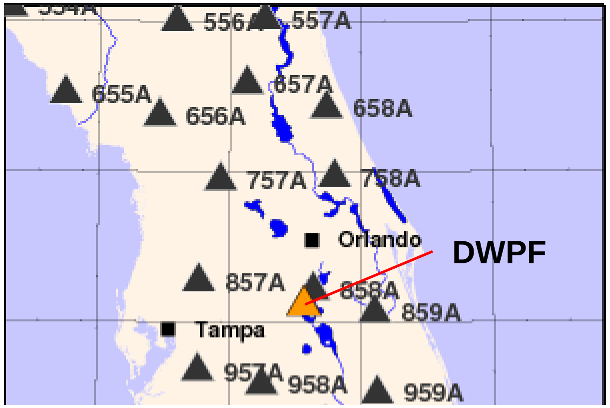
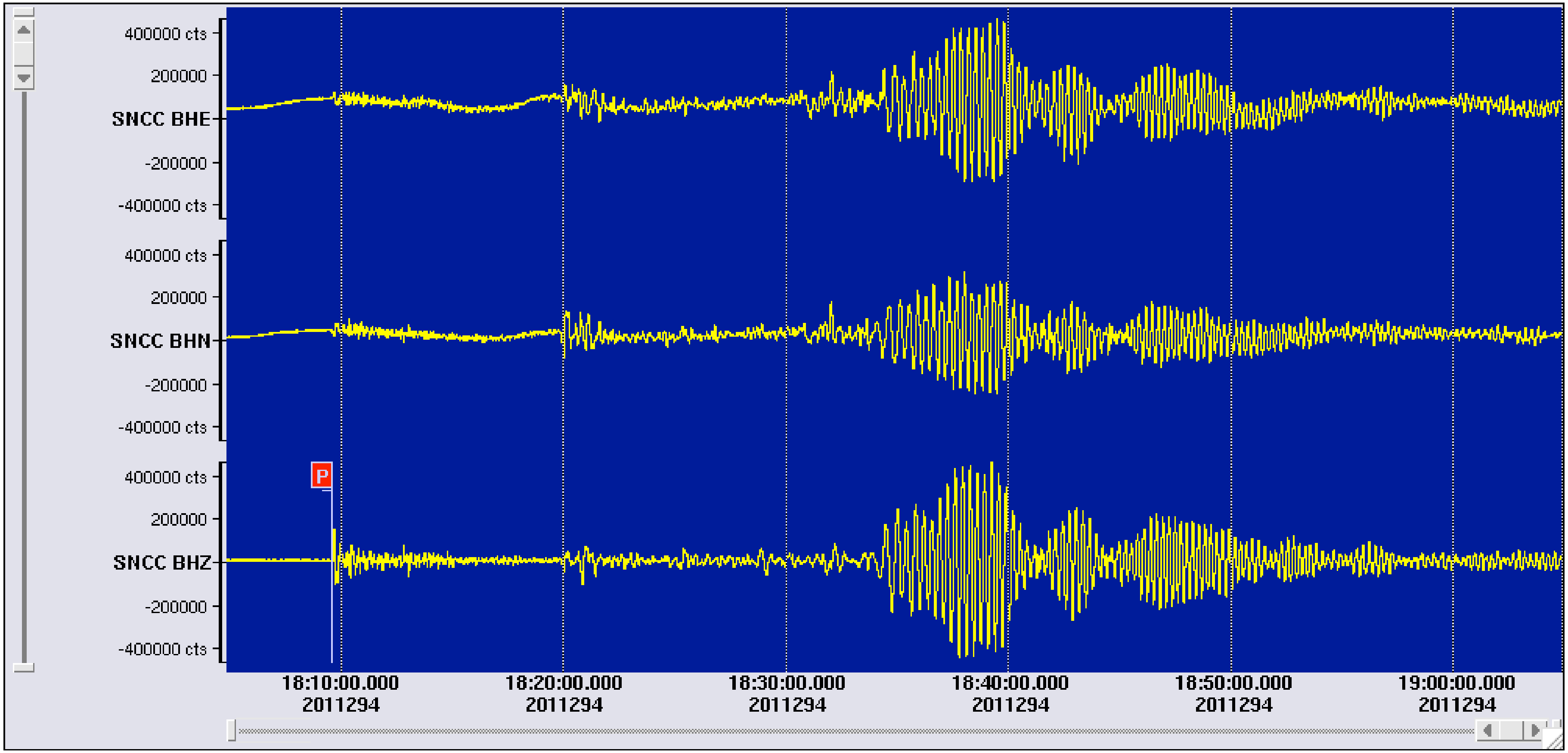


Three components recorded by DWPF (Disney Wilderness Preserve, Florida) (0.01–0.07 Band Pass (BP) filtered), the closest USArray station to the event.



Teachable Moments are a service of

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