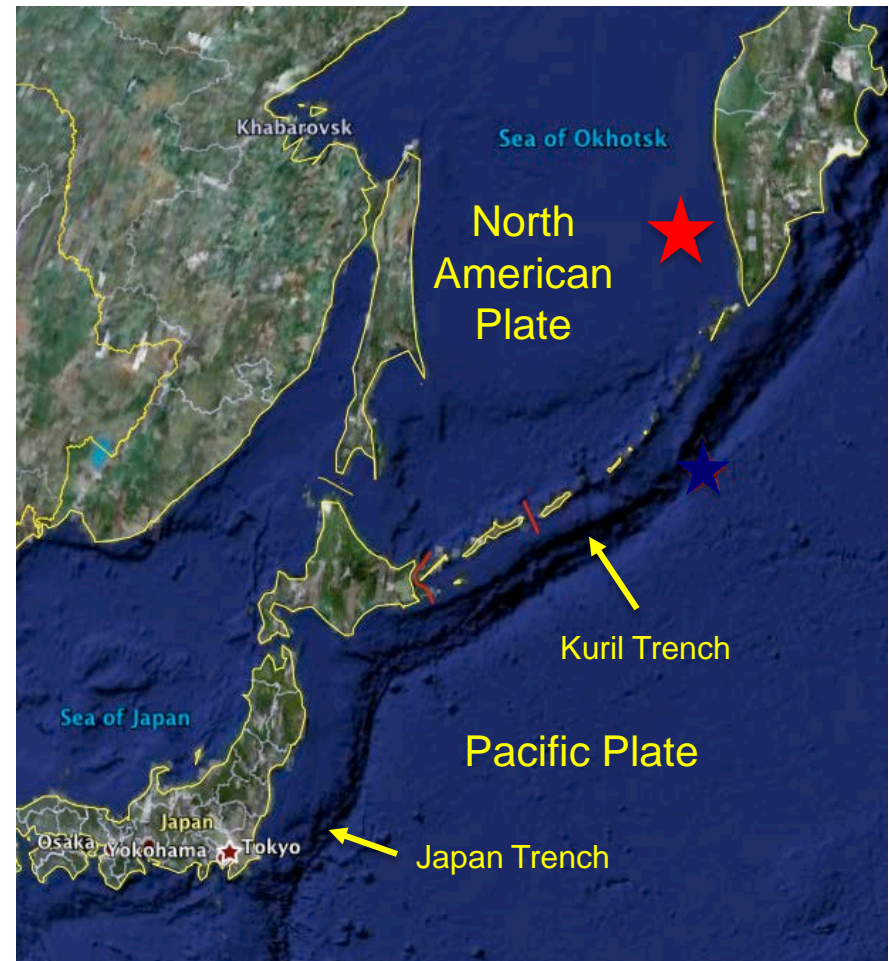




A powerful earthquake in Russia's Far East was felt as far away as Moscow, about 7,000 kilometers (4,400 miles) west of the epicenter, but no casualties or damage were reported.

The epicenter was in the Sea of Okhotsk, east of the Russian coast and north of Japan at a depth of approximately 600 km.

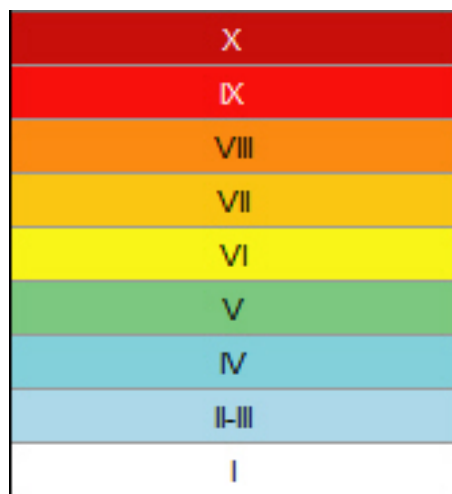
Very large deep earthquakes are quite rare.



Ground Shaking Intensity

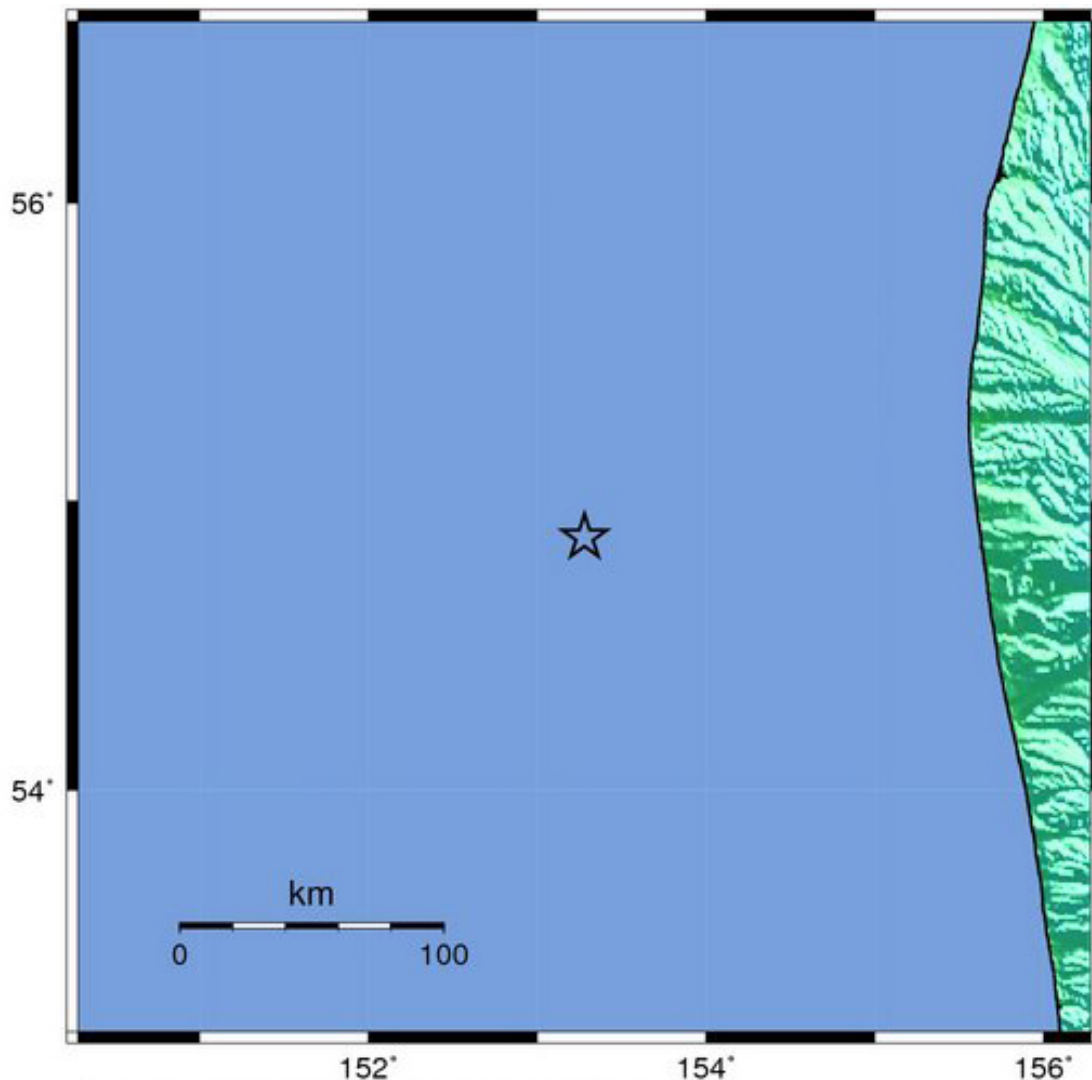
Because this earthquake occurred more than 600 km below the surface of the Earth, no tsunami was produced and only light and moderate ground shaking was felt on the island closest to the epicenter.

Modified Mercalli Intensity



Perceived Shaking

Extreme
Violent
Severe
Very Strong
Strong
Moderate
Light
Weak
Not Felt



USGS Estimated shaking Intensity from M 8.3 Earthquake

Magnitude 8.3 SEA OF OKHOTSK

Friday, May 24, 2013 at 05:44:49 UTC

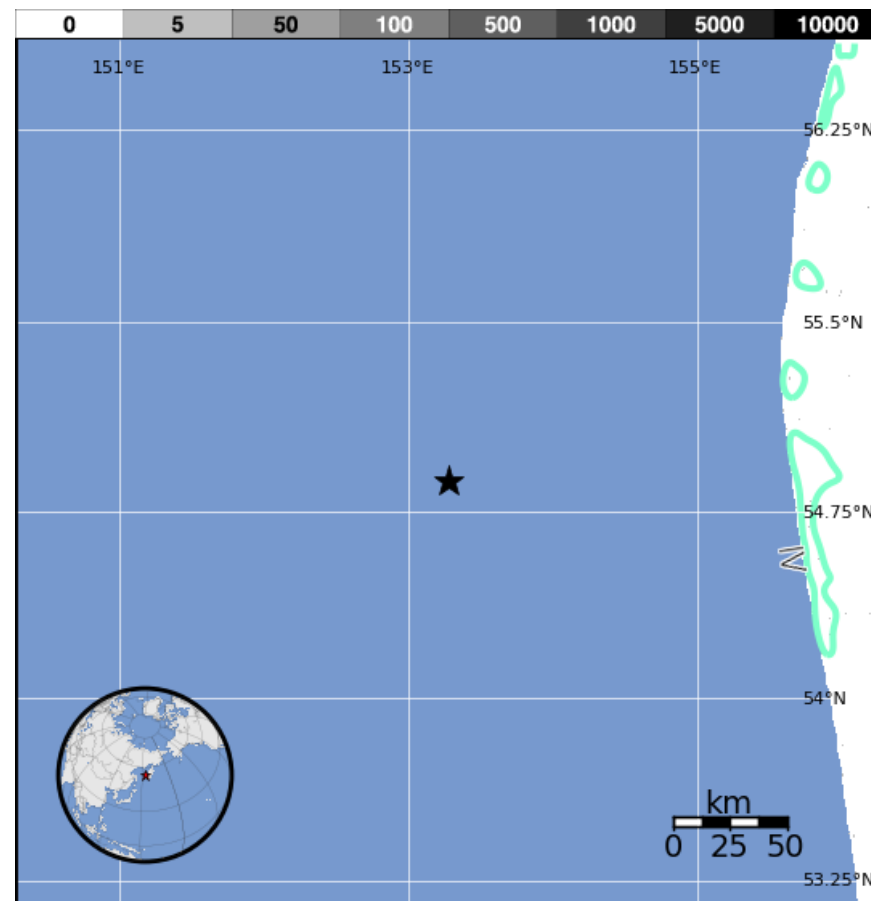
USGS PAGER

Population Exposed to Earthquake Shaking

The USGS estimates that 1000 were exposed to moderate shaking from this earthquake, and an additional 3000 experienced light shaking.

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	--*	--*	3k*	1k	0k	0k	0k	0k	0k
Perceived Shaking	Not Felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme

The epicenter of this deep earthquake is shown by the red star on a map of regional seismicity between 1990 and November 2008.

Also in the Sea of Okhotsk, a magnitude 7.7 earthquake occurred at 630 km depth in July, 2008 (red circle) and a magnitude 7.3 earthquake occurred in November, 2008 at 490 km depth (epicenter shown by purple star).

These earthquakes fit the pattern of earthquakes in this subduction zone where the Pacific Plate dives toward the northeast beneath part of the North American Plate.

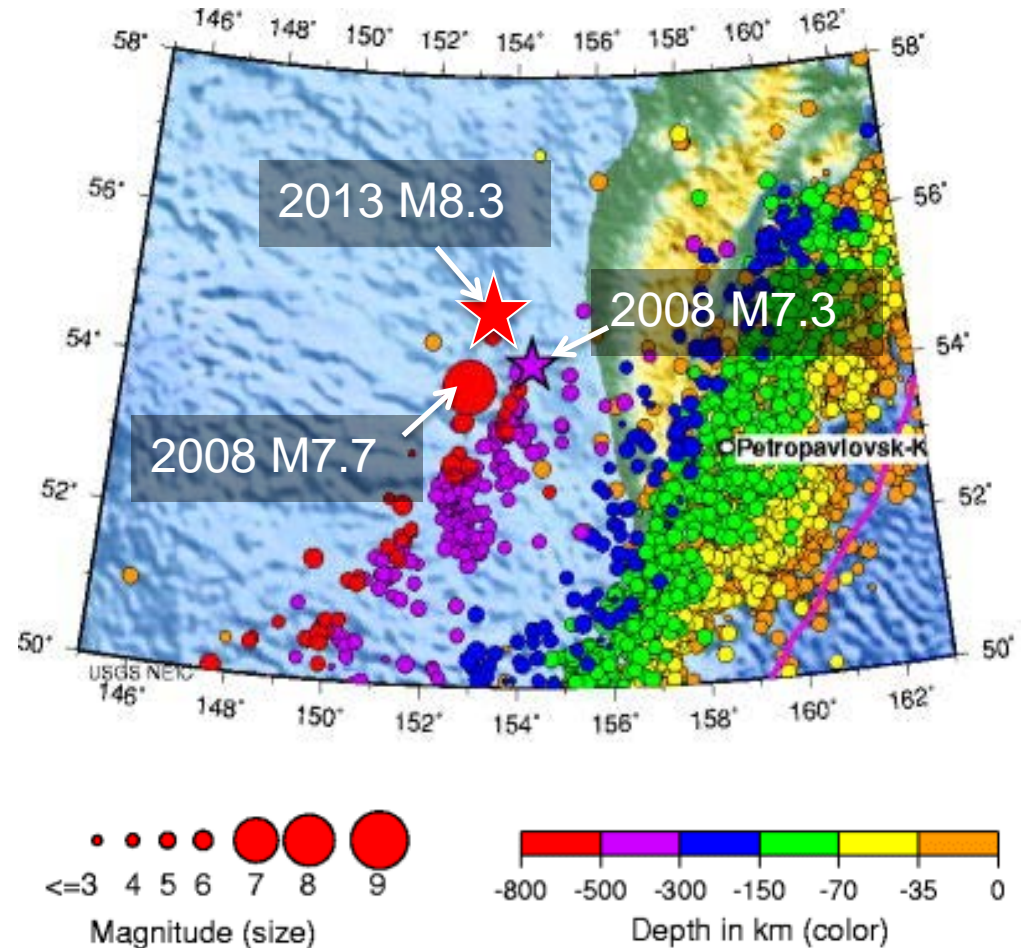
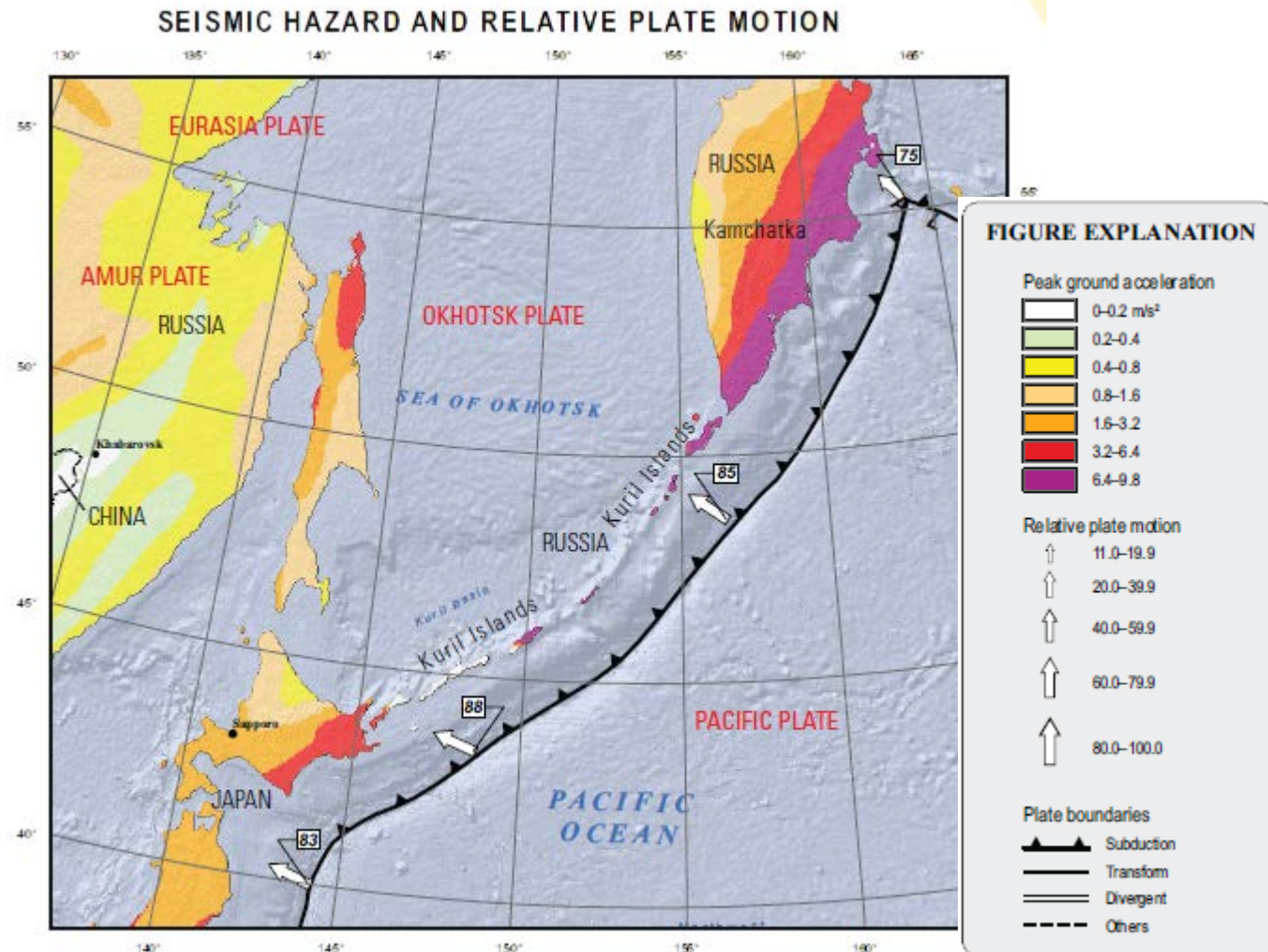


Image courtesy of the US Geological Survey

The Pacific Plate subducts into the mantle beneath the Okhotsk microplate, a part of the larger North America Plate.

The convergence rate between the Pacific and North American plates increases from southwest to northeast along the Kuril Trench.

Along the segment of this earthquake, the convergence rate is 78 mm/yr (7.8 cm/yr).



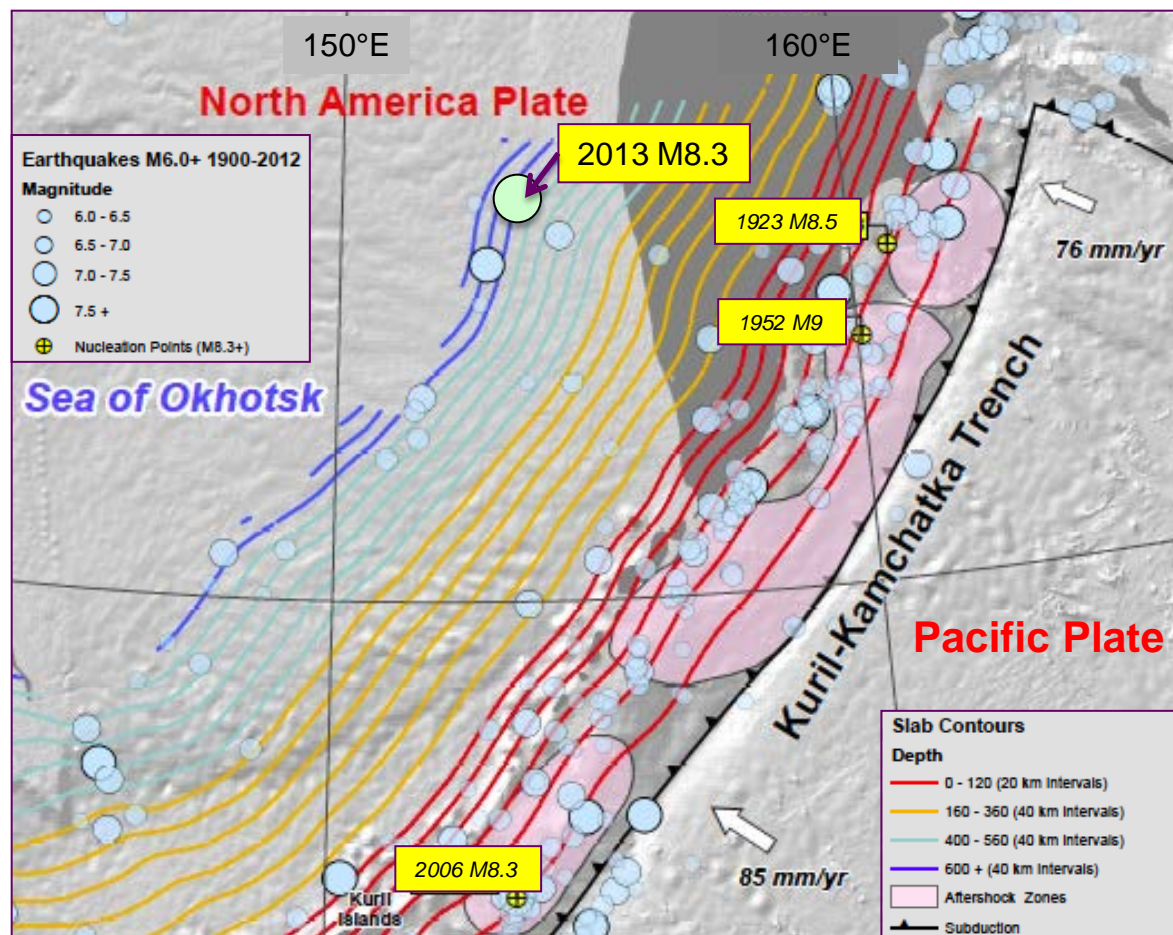
Magnitude 8.3 SEA OF OKHOTSK

Friday, May 24, 2013 at 05:44:49 UTC

This is one of the most seismically active subduction zones on Earth where earthquakes within Pacific Plate extend to depths of about 650 km.

According to the USGS: “The largest earthquake to occur along the entire Kuril-Kamchatka arc in the 20th century was the November 4, 1952 M9.0 event.

The most recent great earthquake in the region was the November 15, 2006 M8.3 Kuril Island event, located in the central section of the arc. Prior to that event, this part of the subduction zone had been recognized as a seismic gap spanning from the northeastern end of the 1963 rupture zone (south of the map area) to the southwestern end of the 1952 rupture.”



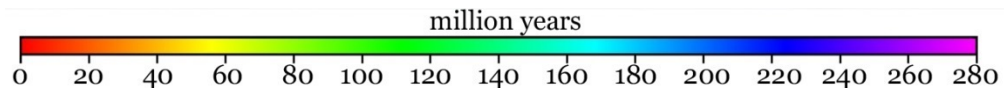
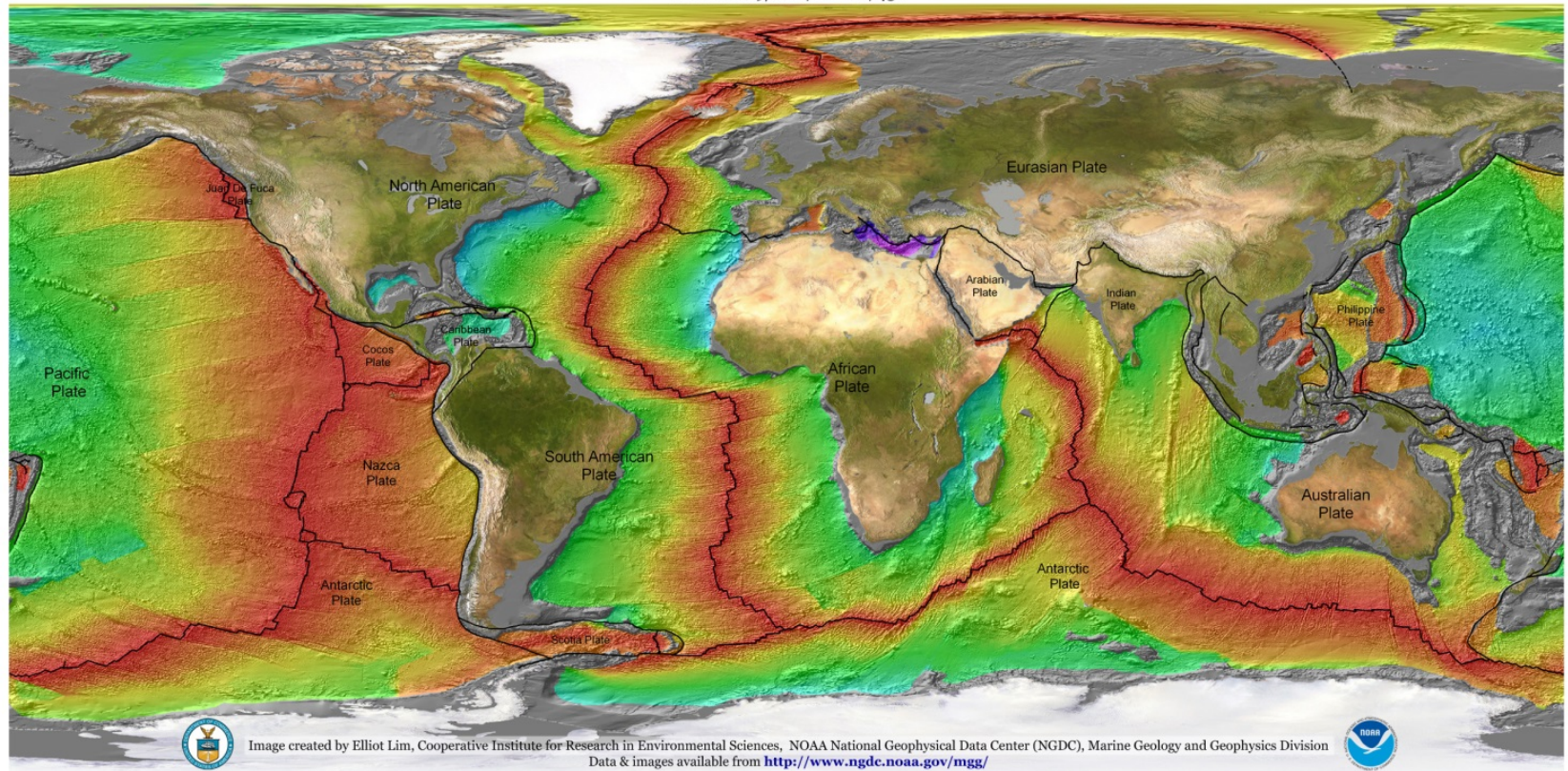
Magnitude 8.3 SEA OF OKHOTSK

Friday, May 24, 2013 at 05:44:49 UTC

Age of Oceanic Lithosphere (m.y.)

Data source:

Muller, R.D., M. Sdrolias, C. Gaina, and W.R. Roest 2008. Age, spreading rates and spreading symmetry of the world's ocean crust, *Geochem. Geophys. Geosyst.*, 9, Q04006, doi:10.1029/2007GC001743.

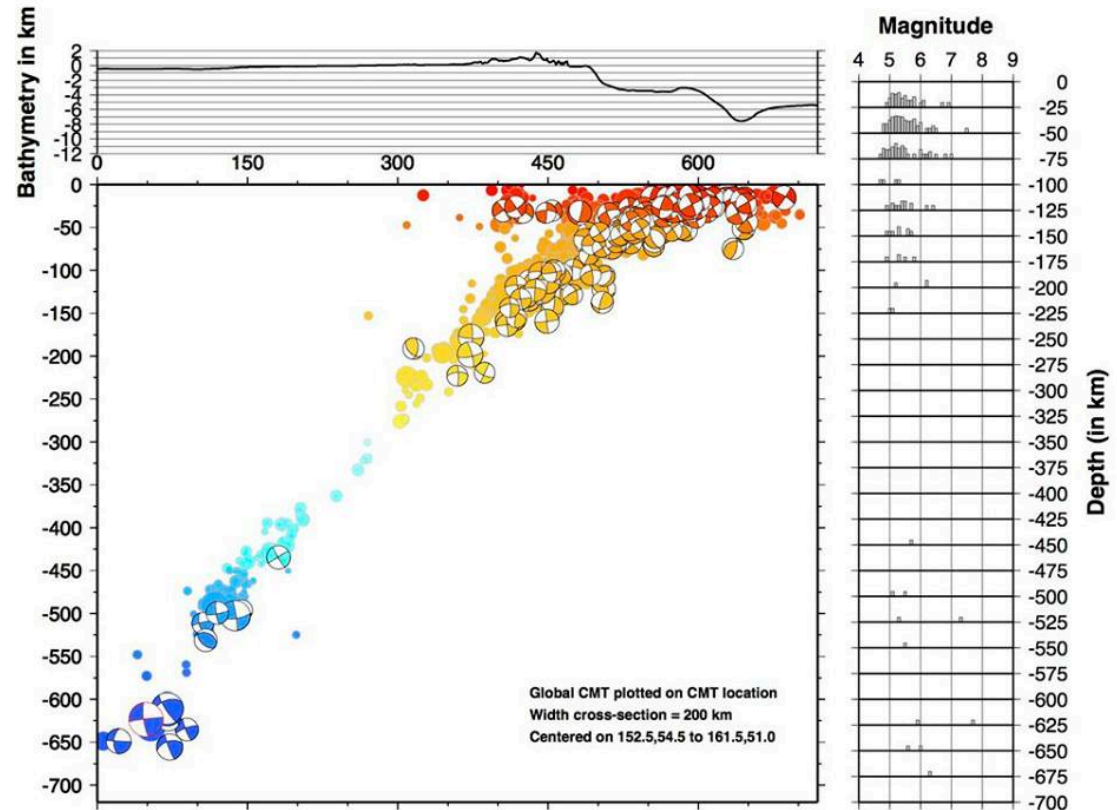


The subducting Pacific Plate adjacent to Kamchatka is more than 100 million years old and is therefore quite cold when it subducts into the Kuril Trench. Consequently, the subducting plate is well defined by seismicity to depths of approximately 650 km.

To produce earthquakes, rocks must be brittle so they can accumulate elastic energy as they bend then rapidly release that energy during earthquake rupture. Rocks are brittle at low temperatures but become viscoelastic when they reach temperatures of about 600 °C.

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.

However, rapidly subducting cool oceanic plates can reach depths up to about 700 km into the hot mantle and continue to produce earthquakes. The deepest earthquakes are thought to be due to phase changes of minerals in the high pressure and temperature conditions at those depths.

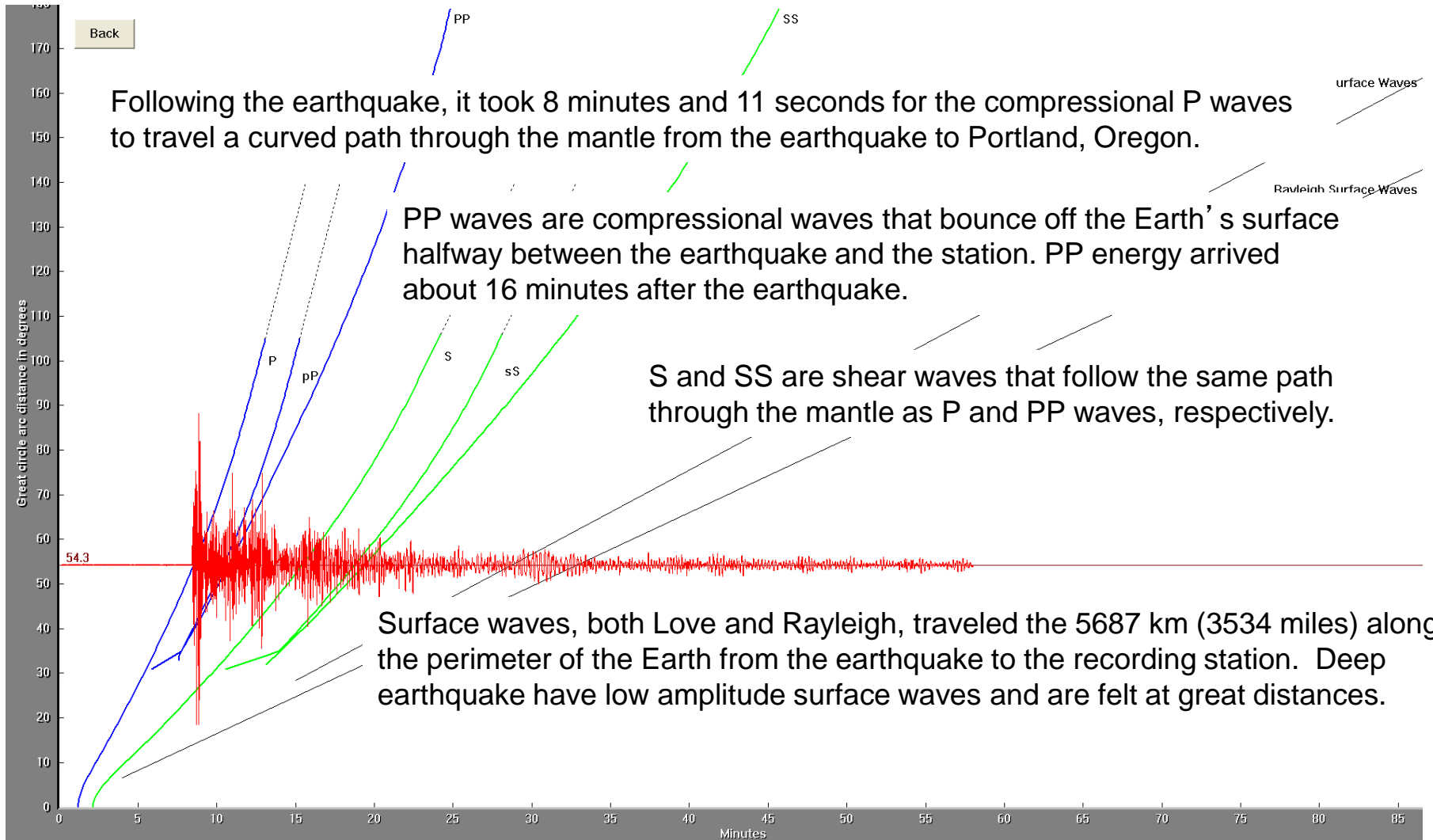


Focal mechanisms of the earthquakes tracking the descent of the Pacific Plate beneath the North American Plate. This earthquake is in the lower blue cluster. (Image courtesy of Jascha Polet)

Magnitude 8.3 SEA OF OKHOTSK

Friday, May 24, 2013 at 05:44:49 UTC

The record of the earthquake on the University of Portland seismometer (UPOR) is illustrated below. Portland is 5687 km (3534 miles, 51.23°) from the location of this earthquake.



Following the earthquake, it took 8 minutes and 11 seconds for the compressional P waves to travel a curved path through the mantle from the earthquake to Portland, 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 after the earthquake.

S and SS are shear waves that follow the same path through the mantle as P and PP waves, respectively.

Surface waves, both Love and Rayleigh, traveled the 5687 km (3534 miles) along the perimeter of the Earth from the earthquake to the recording station. Deep earthquake have low amplitude surface waves and are felt at great distances.

Teachable Moments are a service of

IRIS Education & Public Outreach
and
The University of Portland