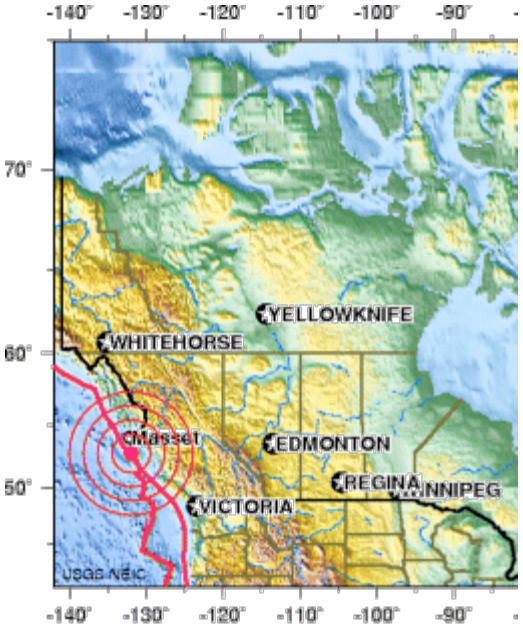
Magnitude 7.7 QUEEN CHARLOTTE ISLANDS REGION

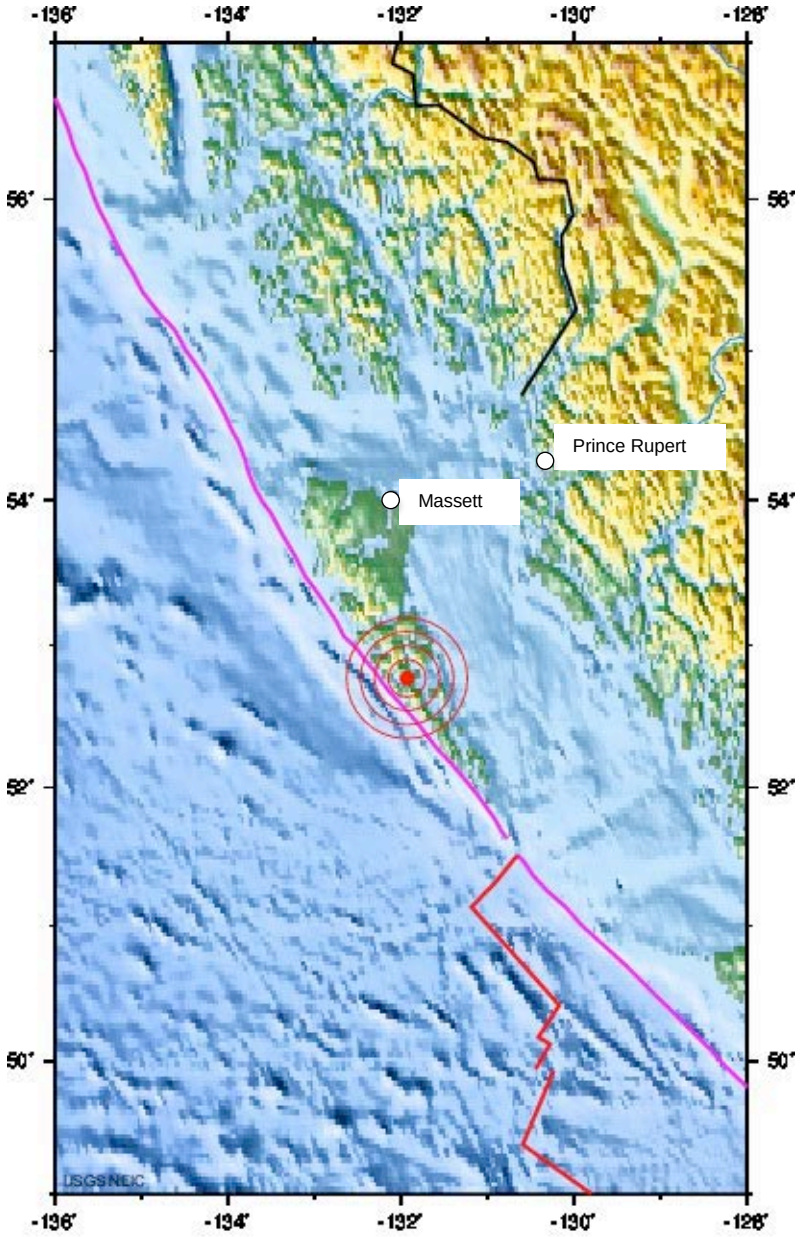
Sunday, October 28, 2012 at 03:04:10 UTC

A major 7.7 magnitude earthquake struck at 8:04 PM local time in western British Columbia, Canada. The epicenter is located on Moresby Island, the southern large island in the Queen Charlotte Islands region. There were no immediate reports of damage or casualties. A tsunami warning was issued following the earthquake.

This earthquake was 139 km (86 miles) south of Massett and 202 kilometers (126 miles) SSW of Prince Rupert.



Images courtesy of the US Geological Survey



Magnitude 7.7 QUEEN CHARLOTTE ISLANDS REGION

Sunday, October 28, 2012 at 03:04:10 UTC

The epicenter (yellow star) of this earthquake is shown on a regional plate tectonic map. Bold red arrows show motions of the Pacific and Juan de Fuca plates relative to the North American Plate. The Queen Charlotte fault forms the boundary between the Pacific and North American plates along the western edge of central British Columbia and southeast Alaska. In that region, the Pacific Plate moves approximately north at a rate of 5.8 cm/yr (2.3 in/yr).

Although the Queen Charlotte fault is dominantly a right-lateral transform (strike-slip) fault, there is also compression between the Pacific and North American plates along the southern portion of the fault where three plates converge.

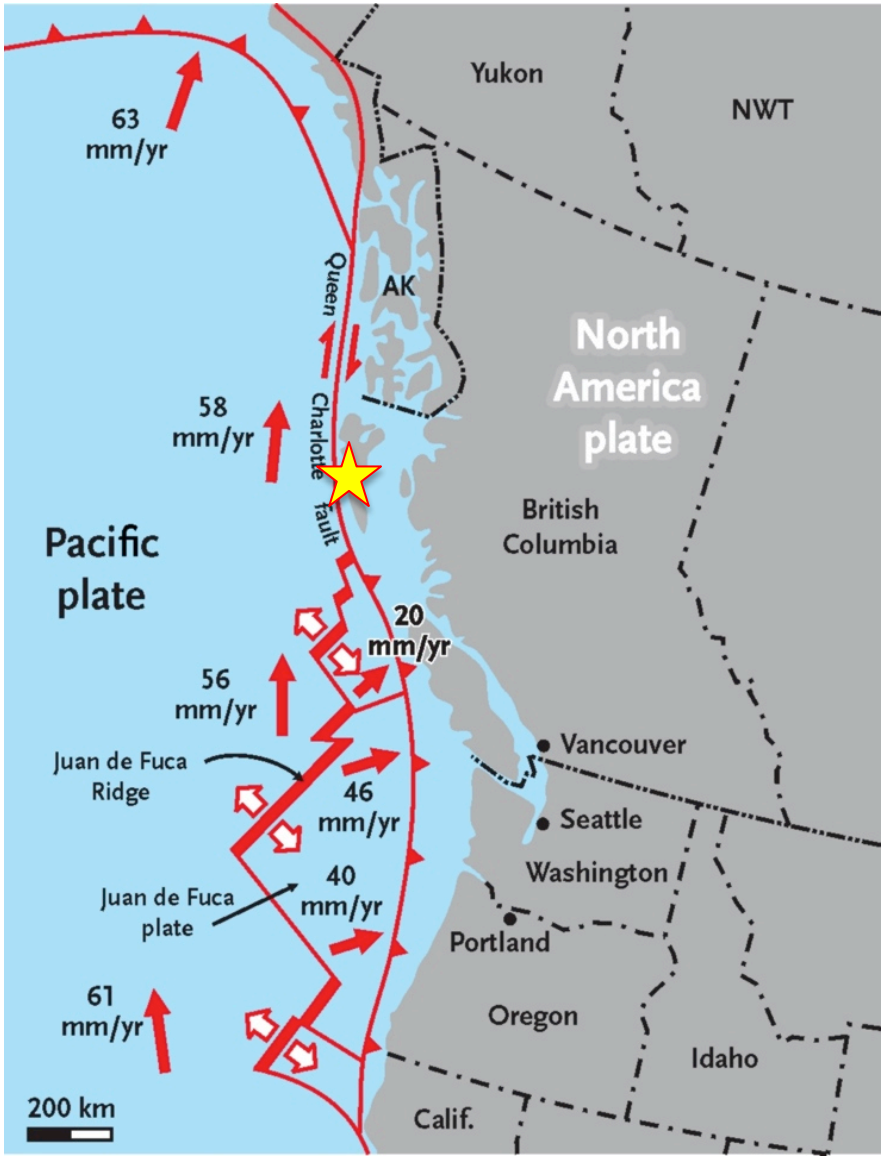


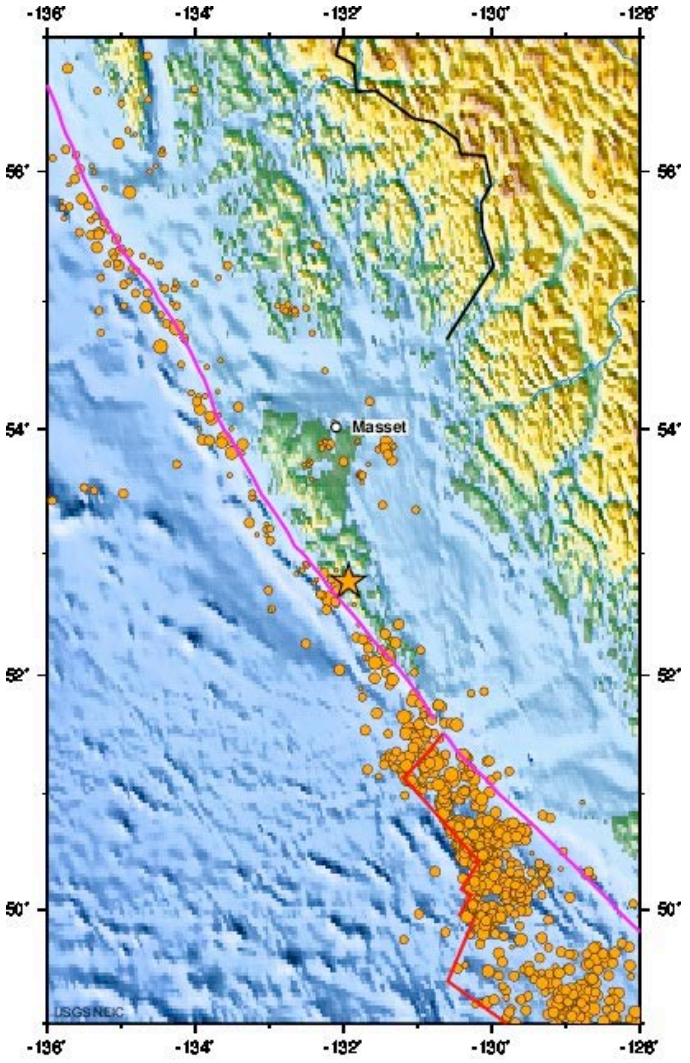
Image from *At Risk: Earthquakes and Tsunamis on the West Coast*

Magnitude 7.7 QUEEN CHARLOTTE ISLANDS REGION

Sunday, October 28, 2012 at 03:04:10 UTC

This earthquake (orange star) is plotted with epicenters of earthquakes in the region since 1990. This earthquake occurred at a depth of 17.5 km (10.9 mi).

According to the USGS National Earthquake Information Center: “This region of the Pacific-North America plate boundary has hosted 7 earthquakes of magnitude 6 or greater over the past 40 years – the largest of which was a M 6.6 earthquake in 2009, 80 km to the south east of the 2012 earthquake. In 1949, a M 8.1 earthquake occurred closer to the Pacific-North America plate boundary, likely as a result of strike-slip faulting, approximately 100 km northwest of the October 28th earthquake, near the northern extent of Haida Gwaii region (formerly Queen Charlotte Islands).”



Seismicity since 1990

Image courtesy of the US Geological Survey

Magnitude 7.7 QUEEN CHARLOTTE ISLANDS REGION

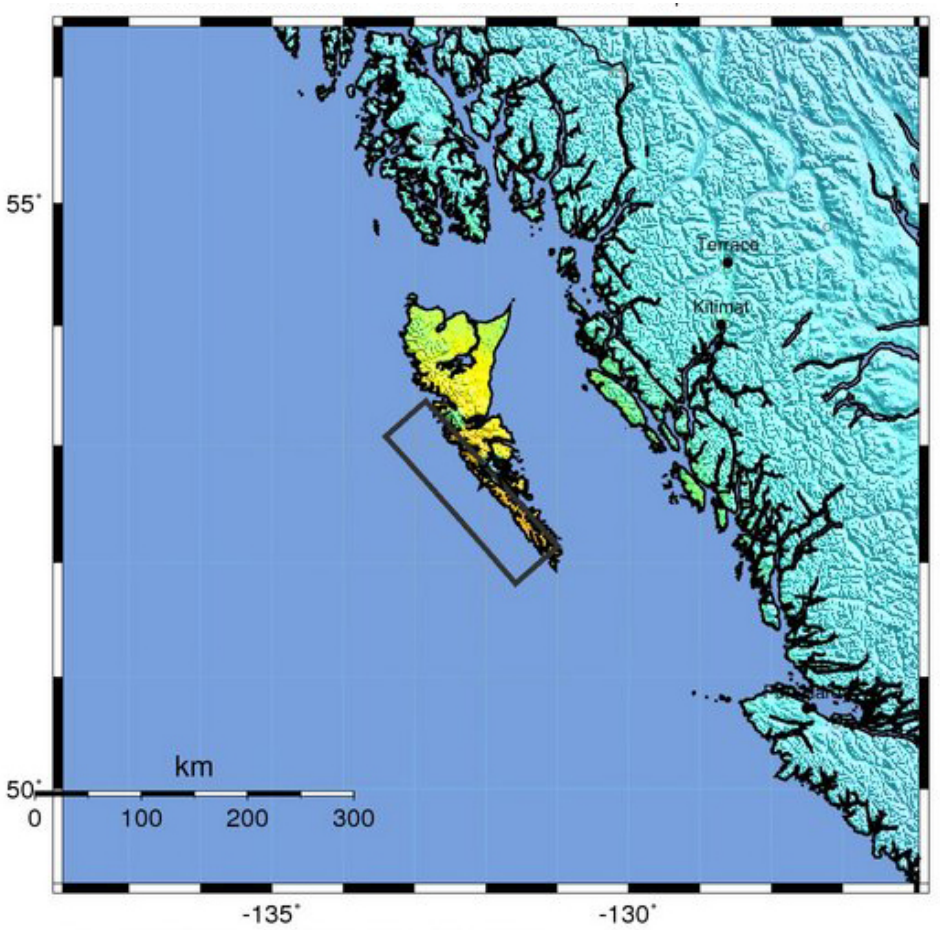
Sunday, October 28, 2012 at 03:04:10 UTC

The Modified-Mercalli Intensity scale is a twelve-stage scale, numbered from I to XII. The lower numbers represent imperceptible shaking levels, XII represents total destruction. A value of IV indicates a level of shaking that is felt by most people. The area nearest the epicenter of this earthquake experienced strong ground shaking. .

Intensity is dependent on the magnitude, depth, bedrock, and location.

	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 7.7 Earthquake (Depth 17 km)

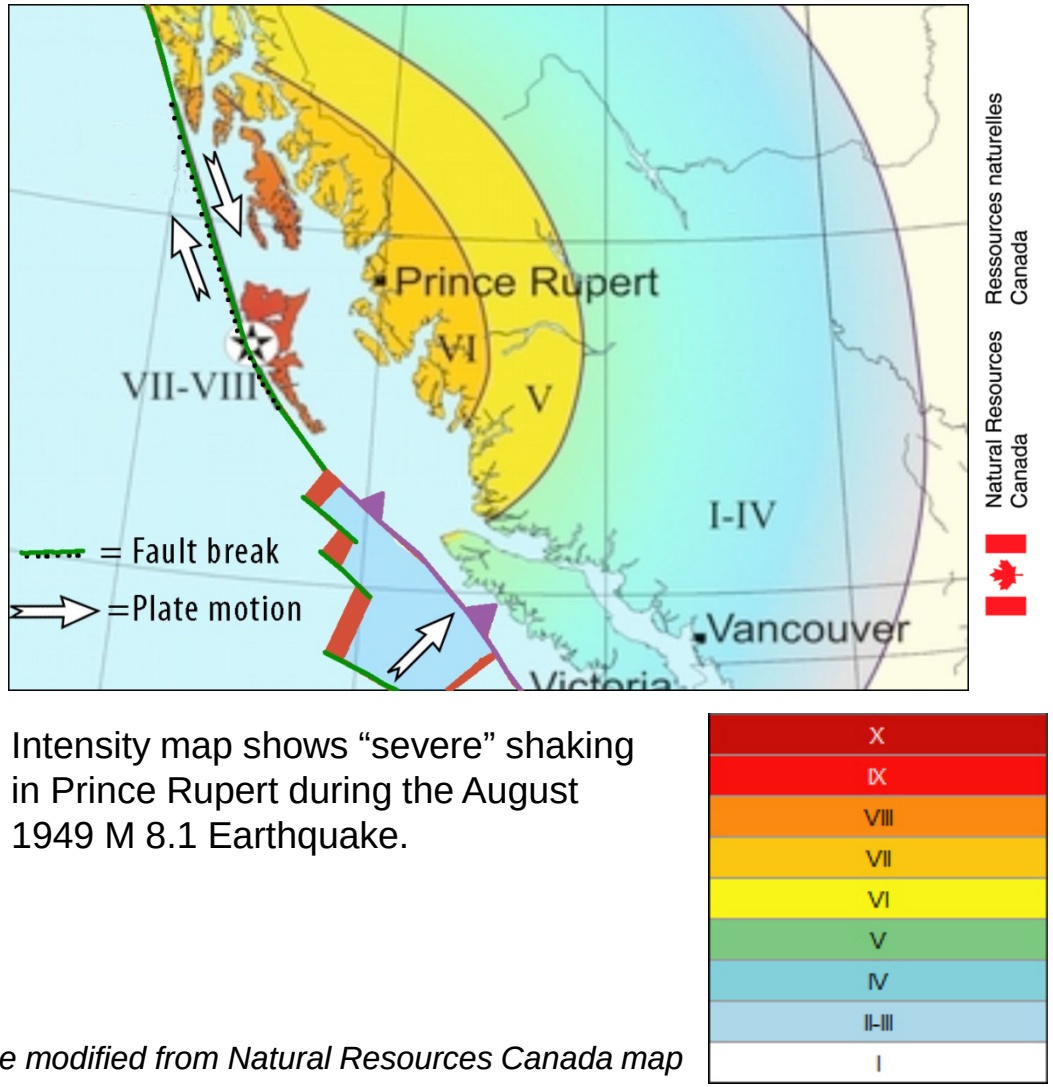
Magnitude 7.7 QUEEN CHARLOTTE ISLANDS REGION

Sunday, October 28, 2012 at 03:04:10 UTC

This region was shaken by a magnitude 8.1 earthquake August 22, 1949.

Canada's largest earthquake since 1700 occurred on the Queen Charlotte Fault (Canada's equivalent of the San Andreas Fault) that forms the boundary between the Pacific and North American plates.

The shaking was so severe that cows were knocked off their feet. In Prince Rupert, windows were shattered and buildings swayed. In Terrace, 128 km (80 miles) east of Prince Rupert) cars were bounced around, and standing on the street was described as "like being on the heaving deck of a ship at sea"



Intensity map shows “severe” shaking in Prince Rupert during the August 1949 M 8.1 Earthquake.

Image modified from Natural Resources Canada map

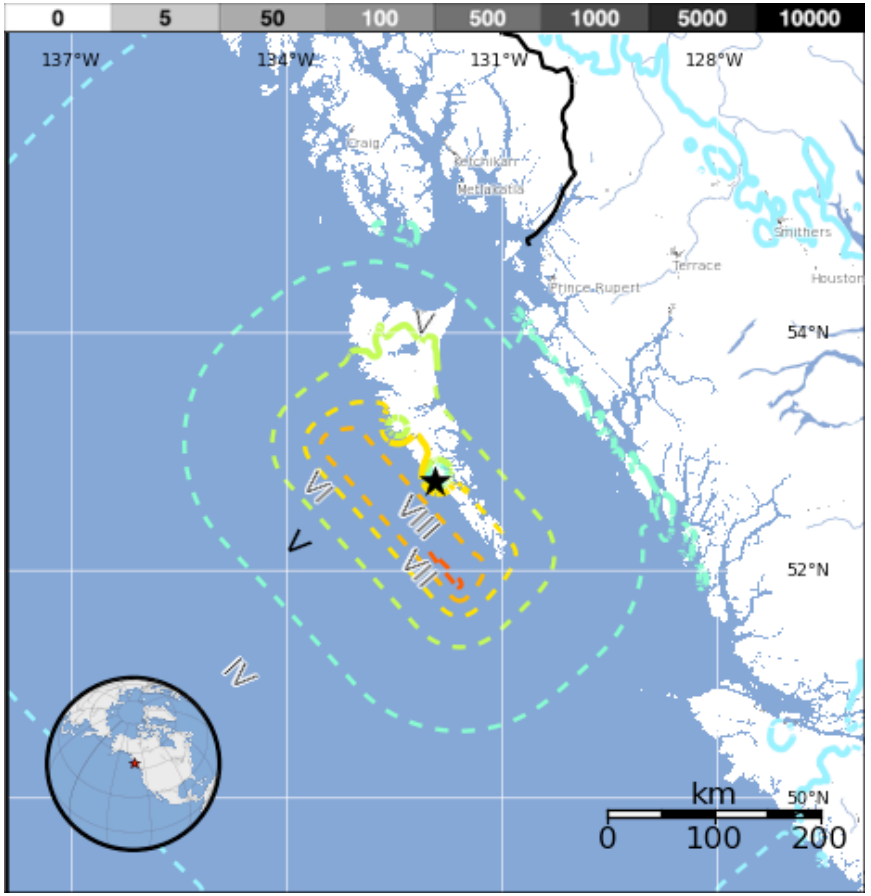
Magnitude 7.7 QUEEN CHARLOTTE ISLANDS REGION

Sunday, October 28, 2012 at 03:04:10 UTC

USGS PAGER

Population Exposed to Earthquake Shaking

The USGS PAGER map shows the population exposed to different Modified-Mercalli Intensity (MMI) levels. MMI describes the severity of an earthquake in terms of its effect on humans and structures and is a rough measure of the amount of shaking at a given location.



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

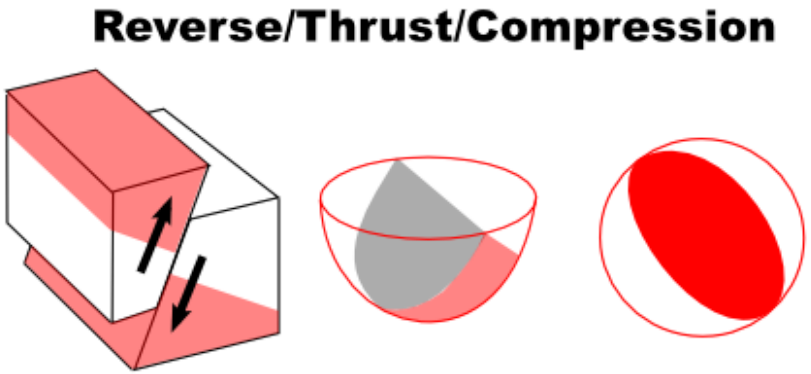
Estimated Modified Mercalli Intensity	I	II-III	IV	V	VI	VII	VIII	IX	X
Est. Population Exposure	--*	6,478k*	15,087k*	4,368k	0	0	0	0	0
Perceived Shaking	Not Felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme

Magnitude 7.7 QUEEN CHARLOTTE ISLANDS REGION

Sunday, October 28, 2012 at 03:04:10 UTC

The earthquake occurred as a result of reverse faulting with a smaller component of strike-slip faulting. This earthquake accommodated the compressional forces between the Pacific and North American plates along the southern Queen Charlotte fault.

The focal mechanism is how seismologists plot the 3-D stress orientations of an earthquake. Since an earthquake occurs as slip on a portion of the fault, it generates quadrants of compression and extension as the two sides of the fault move. 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 pattern of these quadrants allows seismologists to determine the type of faulting that generated the earthquake.



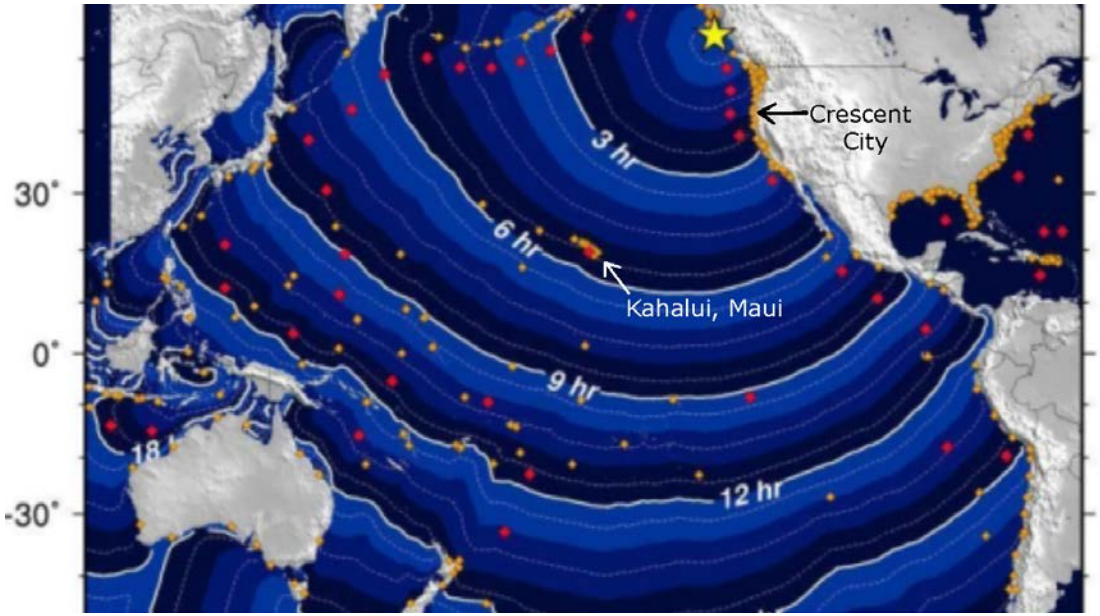
Shaded areas show quadrants of the focal sphere in which the P-wave first-motions are away from the source, and unshaded areas show quadrants in which the P-wave first-motions are toward the source. The dots represent the axis of maximum compressional strain (in black, called the "P-axis") and the axis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

USGS Centroid Moment Tensor Solution

Magnitude 7.7 QUEEN CHARLOTTE ISLANDS REGION
Sunday, October 28, 2012 at 03:04:10 UTC

In the Pacific Northwest coastal areas were alerted to the possibility of slightly elevated wave heights. Wave heights ranged from 0.2 m (0.4 ft) in Sitka, AK to 0.46 m;1.5 ft) in Crescent City, CA.

A tsunami warning was issued for Hawai`i. The warning sent >100,000 people fleeing from shore to higher ground on Saturday, but the evacuation order was canceled after a series of weaker-than-expected waves arrived in the islands. The largest crest was 0.76 m (2.5 ft) at Kahului, Maui.



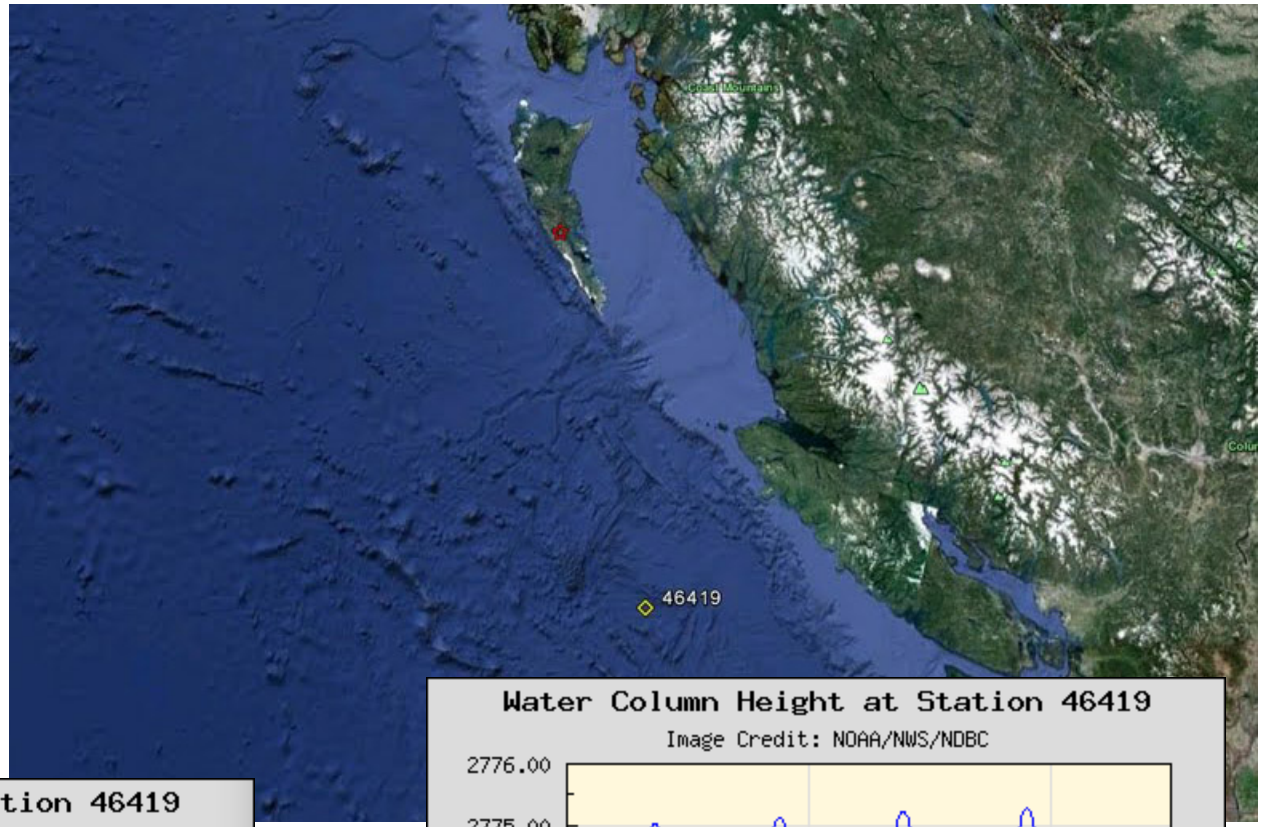
Estimated tsunami travel-time map NOAA

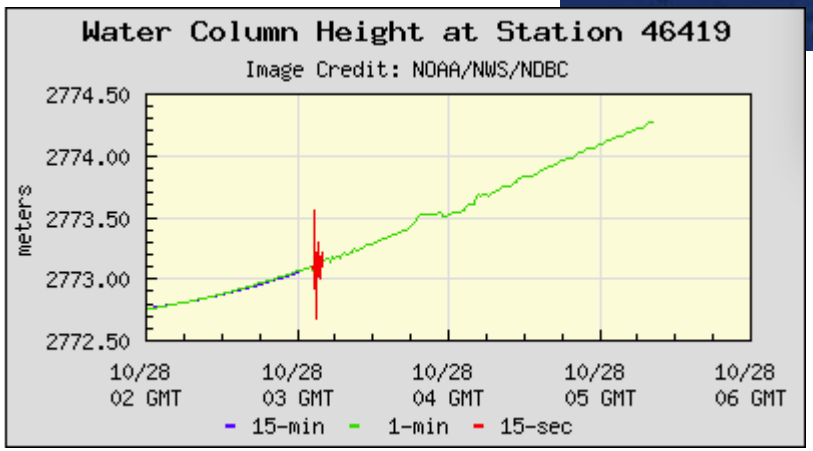
Magnitude 7.7 QUEEN CHARLOTTE ISLANDS REGION

Sunday, October 28, 2012 at 03:04:10 UTC

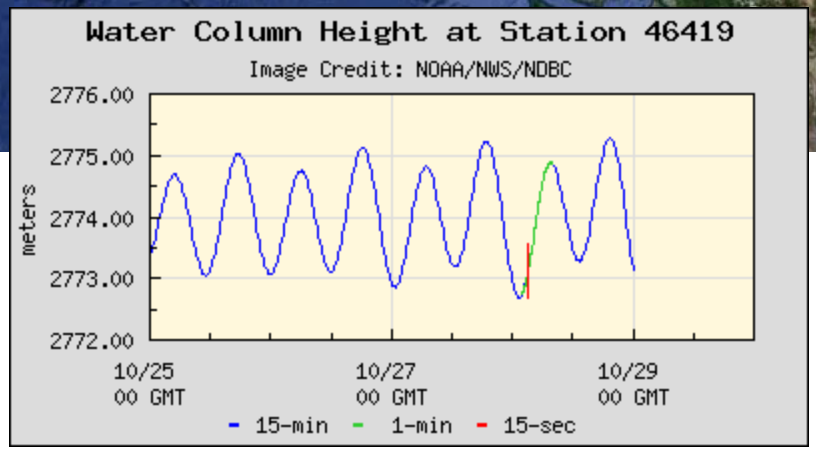
Shallow great earthquakes in subduction zones often cause tsunamis when they offset the ocean floor. This offset generates tsunami waves. This earthquake did produce a small tsunami, which was measured on a nearby buoy.

The water column height change is graphed below on two time scales.





5 hour plot



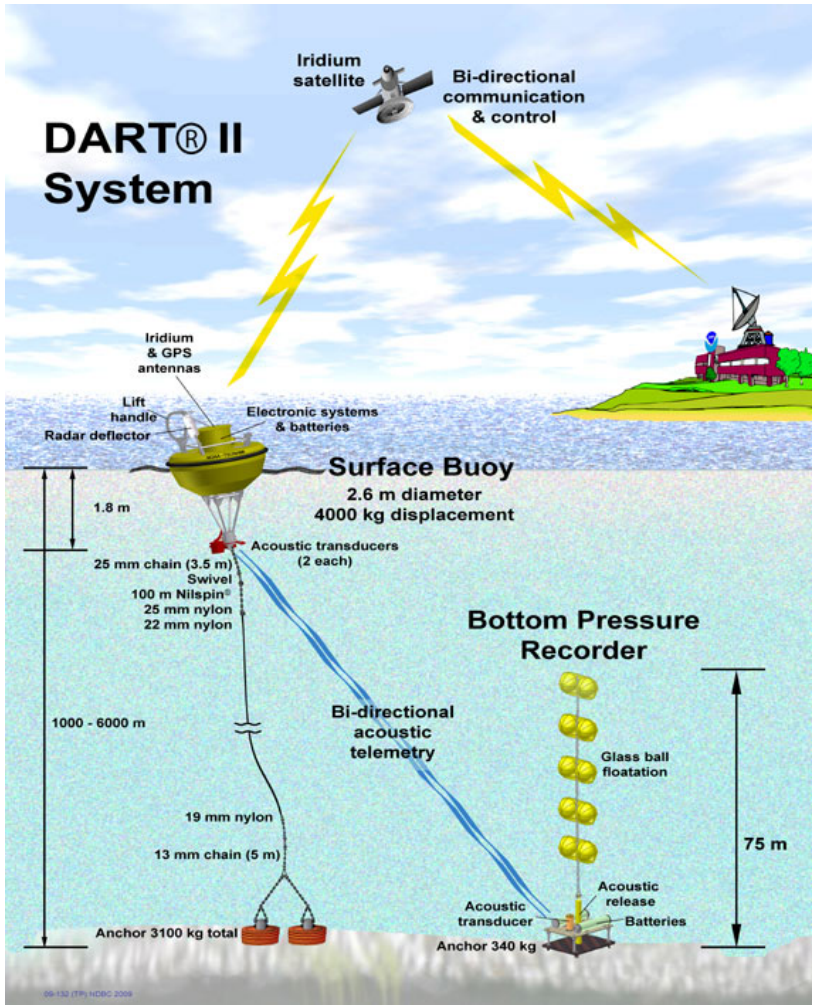
4 day plot

Magnitude 7.7 QUEEN CHARLOTTE ISLANDS REGION

Sunday, October 28, 2012 at 03:04:10 UTC

DART® systems consist of an anchored seafloor bottom pressure recorder (BPR) and a companion moored surface buoy for real-time communications. An acoustic link transmits data from the BPR on the seafloor to the surface buoy. DART II systems transmit standard mode data, containing twenty-four estimated sea-level height observations at 15-minute intervals, once very six hours.

A significant capability of DART II is the two-way communications between the BPR and NOAA's Tsunami Warning Centers (TWCs) using the Iridium commercial satellite communications system. The two-way communications allow the TWCs to set stations in event mode (15-s intervals) in anticipation of possible tsunamis.



Pacific Tsunami Monitoring NOAA

Flash animation of how the DART® system detects ocean waves.

Magnitude 7.7 QUEEN CHARLOTTE ISLANDS REGION
Sunday, October 28, 2012 at 03:04:10 UTC

Since the earthquake, there have been over 50 aftershocks (plotted below), the largest a magnitude 6.3.

The huge amount of strain released in the main shock is variable across the slip surface. Therefore the change in stress resulting from the main shock is variable from place to place over the area of the plate boundary that moved. The aftershocks are basically small earthquakes induced by the redistribution of stress that occurred during the main shock. Accordingly, the aftershock distribution gives us another measure of the area of plate boundary that moved in the main shock. This earthquake's rupture extended approximately 100-150 km along strike, along the shallow extent of the source fault.