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EARTHQUAKES IN WASHINGTON AND OREGON, 1872–1993

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by
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Earthquakes in Washington and Oregon

In Washington and Oregon the geologic process that causes earthquakes is the slow northeastward movement of the Juan de Fuca plate relative to the North America plate at a speed of about 1 inch (2.5 centimeters) per year. As the plates collide, the Juan de Fuca plate slowly sinks beneath the continent. It is presently under subduction. This accompanying cross-section view is a side-on, diagrammatic representation of what one would see if one could take an approximately east-west vertical slice through the Washington and Oregon coastline. The Juan de Fuca plate is sinking beneath the North America plate.

As subduction proceeds, the overlying North America plate deforms and fractures, causing earthquakes within the body of the plate. Notable fractures for such earthquakes are shown in the diagram by thin red circles (depict North America plate earthquakes). Recently discovered prehistoric landslides that dated 1600 to 1700 years ago in large North America plate earthquakes (probable or most reasonable 7.0+ second near what is now Seattle. The Juan de Fuca plate also deforms as it collides, causing earthquakes (denoted by purple circles) within it. The second and third largest earthquakes in the period 1858–1993 were Juan de Fuca plate events (events numbered 4 or 11 in the table). Over the past eight years seismologists have collected evidence that very large earthquakes (magnitude 8 or larger) occur along the upper portion of the boundary between the North America and Juan de Fuca plates. In this area (dashed "boomy area for subduction earthquakes"). Geologic data suggest that the last such subduction event was about 300 years ago.

Completion of the Washington-Oregon earthquake database

Earthquake epicenters in Washington, Oregon and adjacent regions are shown, in different colors, map for earthquakes occurring within the North America plate and purple for earthquakes within the subducting Juan de Fuca plate. Faint white are for selected larger earthquakes occurring between 1872 and 1909. Reflect the advent of the modern regional seismograph networks in most cases the duration shown for these older earthquakes may be off by 1/2 inches or more. The depths of these pre-1970 events are not known. Golden crosses and red earthquakes between 1970 and 1993 that were located using data recorded on regional seismographic networks. Earthquakes with magnitudes of 1.5 and larger are shown. Most of these earthquakes have epicentral errors of 6 km (3.7 miles) or less. The 1872–1993 catalog is complete at the magnitude 5.0 level over most of Oregon and Washington.

Magnitude				Earthquakes
1.0–3.4	3.5–4.4	4.5+		
		○		North America plate earthquakes (1872–1969)
•		○		North America plate earthquakes (1970–1993)
	•	○		Juan de Fuca plate earthquakes (1872–1969)
•	•	○		Juan de Fuca plate earthquakes (1970–1993)

Base prepared by Mark Crampton of Madrona Graphics using data compiled from the United States Geological Survey's 1:2,500,000 scale digital map series.

Base shaded SRTM Digital Elevation Model image, courtesy Jane Johnson.

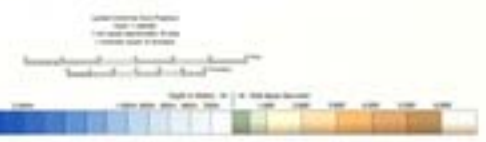
Notable Earthquakes

The following earthquakes are identified on the maps by a table event, tabulated with their reference number.

Number	Earthquake	Magnitude
1	North Cascades, December 15, 1872	7.4
2	Northeast Oregon, November 15, 1873	6.8
3	Hansford earthquake, October 12, 1877	5.5
4	Central Vancouver Island, November 6, 1918	7.0
5	Milton-Freewater, July 15, 1936	6.1†
6	Central Puget Sound, November 13, 1939	5.8
7	Northern Idaho, November 1, 1942	6.5
8	Central Puget Sound, February 13, 1949	7.1†
9	Olympia, Washington, April 13, 1949	7.1
10	Vancouver Island, December 6, 1946	7.3
11	Seattle-Tacoma, April 29, 1965	6.5
12	Elk Lake (via Washington), February 14, 1981	5.5
13	Scotts Mills, Oregon, March 25, 1993	5.6
14	Klamath Falls, Oregon, September 21, 1993 (double event)	5.9, 5.9
15	Juan de Fuca earthquakes with magnitudes 6.5 to 7.5 (unidentified with the 1700 earthquake of Mitchell N. Nelson)	

† Value is for the southwest (largest) main shock.

‡ Large earthquakes in the Juan de Fuca subduction zone (earthquakes 4 and 11) and the 1700 earthquake of Mitchell N. Nelson.



Sources of Data

The date and table of notable earthquakes were prepared by Tom Yelin (USGS) and Susan Cassidy (University of Washington). The earthquake catalog of earthquakes in Washington and Oregon was assembled by Steve Malone using various sources listed and including individuals and institutions:

Various State Universities (station listings)

Geological Survey of Canada
Pacific Geoscience Centre (Station bulletins)

Montana Bureau of Mines and Geology
Montana Seismological Network (Bulletin listings)

U.S. Geological Survey, Northern California
Seismographic Network (Data Bulletins)

University of Washington, Washington Regional
Seismograph Network (Station Bulletins and Research Catalog)

Software used to plot epicenters available map developed by Stephanie Ruhl (USGS, Menlo Park) and Jeffrey Quilty (USGS).