

CASCADIA



As a former citizen of both southern and central coastal California, in my adolescent years and into adulthood, my family lived along the California San Andreas Fault. I learned to respect the power of our planet, in the form of earthquakes. I've experienced "small" window rattlers, in the 4.0 range, up to a VII (7) intensity. I appreciate that when the earth moves, it is sudden and violent. When the very earth beneath your feet begins to move, there is literally nothing you can do to stop it. You can only ride it out. Fortunately I was never present during major quakes which caused great damage. **Yet!**

My largest quake experience was the *Coyote Lake* quake in Santa Clara County, on August 6, 1979. That quake measured a moment magnitude of 5.7 and a maximum Mercalli Intensity of VII (Very strong). (No one uses "Richter Scale" any longer, except perhaps news reporters who didn't get the memo. It's now *moment magnitude* and *Mercalli Intensity*.) At the time, I was working in Santa Clara County and living in a 4 story condo overlooking Monterey Bay, in Santa Cruz. I was very near the epicenter when it hit, [10:05 am] while Donna was home with our young children. Donna had a pretty wild ride, being on the 4th floor of the condo, and we later discovered the building foundation had cracked. In San Jose, I managed to not spill my coffee while I just happened to be standing in a doorway in a large office building, near the epicenter.

Since that time we moved to Oregon, not because of the earthquakes, but because of the economy. Our only quake experience since then was the *Scotts Mills* earthquake, also known as the "*Spring Break Quake*", on March 25, 1993 at 5:34 AM. That one measured a moment magnitude of 5.6 and a maximum perceived intensity of VII (*Very strong*) on the Mercalli intensity scale. We were far enough away from that one (in Aloha), so all we got was a pretty mild movement.



I think we all love to visit the Pacific coast. There's something relaxing about the wind and waves, spectacular sunsets, and yes the rain. Lots of tourist stuff, casinos, hiking, fishing, camping, RV'ing, or simply hanging out. But lurking beneath that serene beauty lies a monster known as the **Cascadia Subduction Zone**. It is a place that stretches from Vancouver Island, B.C., along the west coast of North America, to the Northern California coast. Seismologists, tell us the geological record reveals "great earthquakes," with a **moment magnitude 8 or higher** occur in the zone about every 500 years on average, often triggering tsunamis.

There's evidence of at least 13 events at intervals from about 300 to 900 years, with an average of 570–590 years. Previous earthquakes are estimated to have been in 600 BC, 170 BC, 400 AD, 810 AD, 1310 AD and 1700 AD. The most recent event, the 1700 Cascadia earthquake, occurred along the Cascadia Subduction zone on January 26, 1700 (106 years before the Lewis & Clark Corps of Discovery), with an estimated moment magnitude of **8.7–9.2**. The megathrust earthquake involved the Juan de Fuca Plate from mid-Vancouver Island, south along the Pacific Northwest coast as far as northern California. The length of the fault rupture was about 1,000 kilometers (620 miles), with an average slip of **20 meters** (66 ft).

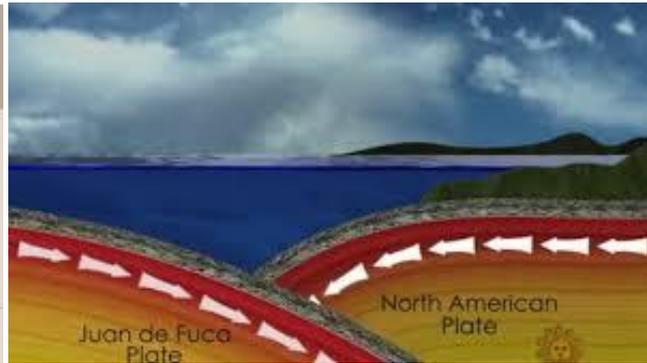
That earthquake caused a tsunami which struck the east coast of Japan. It may also be linked to the Bonneville Slide in the Columbia Gorge and the Tseax Cone volcanic eruption in British Columbia. https://en.wikipedia.org/wiki/1700_Cascadia_earthquake

Subduction zone earthquakes can cause large tsunamis and many coastal areas in the region have prepared tsunami evacuation plans in anticipation of a possible future Cascadia earthquake. However, the major nearby cities, notably Seattle, **Portland**, Vancouver, Victoria, and Tacoma, which are located on inland waterways rather than on the coast, would be sheltered from the *full brunt* of a tsunami. These cities do have many vulnerable structures however, especially bridges and unreinforced brick buildings; consequently, most of the damage to the cities would probably be from the earthquake itself. One expert asserts that buildings in Seattle are vastly inadequate even to withstand an event of the size of the 1906 San Francisco earthquake (estimated moment magnitude of 7.9 and a maximum Mercalli intensity of XI), let alone a more powerful one.

"Our operating assumption is that everything west of Interstate 5 will be toast." The director of FEMA's Region 10, responsible for Oregon, Washington, Idaho, and Alaska.

Recent findings conclude that the Cascadia subduction zone is more complex and volatile than previously believed. In 2010, geologists predicted a 37 percent chance of an **M8.2+** event within 50 years, and a 10 to 15 percent chance that the entire Cascadia subduction zone will rupture with an **M9+** event within the same time frame. Geologists have also determined the Pacific Northwest is not prepared for such a colossal quake. The tsunami produced could reach heights of **80 to 100** feet (24 to 30 m). With a tsunami that powerful, one can't help but wonder if the flow of the Columbia River could resist it. Could the wave make it to our little bend in the river? Would our dikes hold under the pressure?

Are you prepared? Do you know what to do? Do you have a plan?

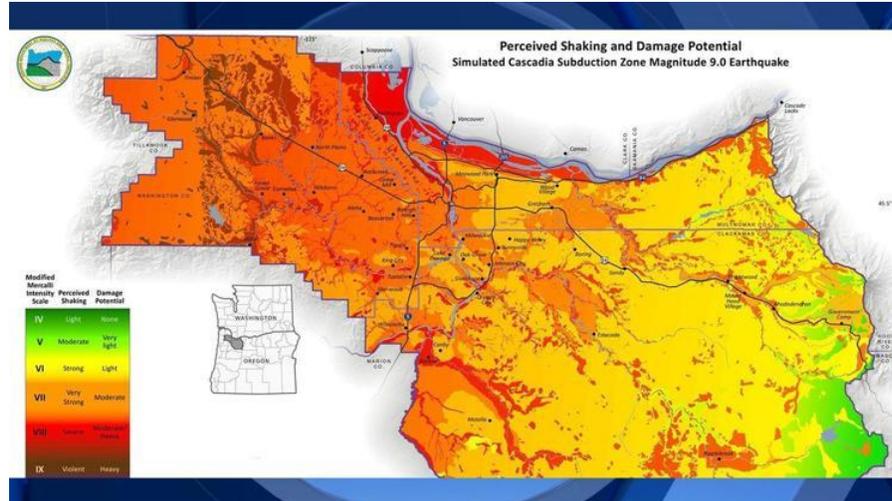


News story with video

<https://www.kgw.com/article/news/new-earthquake-research-shows-where-northwest-big-one-could-strike/283-587244885>

https://www.kptv.com/news/dogami-more-than-could-die-in-portland-metro-in-major/article_f7bbd808-a245-5fb5-bbaf-38d24f504029.html

More than 1,400 could die in Portland metro in major Cascadia quake.



In the past couple years, several massive earthquakes have devastated countries around the globe and for the Pacific Northwest, officials say a giant quake is due and locals need to be prepared.

There has been here constant discussion about when a Cascadia subduction zone quake will hit, and *a new report has explored what could happen to three northwest Oregon counties.*

Oregon Department of Geology and Mineral Industries (DOGAMI) found that if a 9.0 earthquake struck Multnomah, Washington and Clackamas counties, the potential impact could be devastating.

Experts, using infrastructure and population data, determined that a Cascadia quake of that magnitude could cause \$36.7 billion in building damage and could kill 1,473 people in the three counties.

These results were calculated considering the quake would occur during the day and during the wet season, therefore the highest impact scenario.

An earthquake that “happens during the day when many people are at work or in school, and with saturated soils leading to more widespread liquefaction and landslides” could yield this amount of damage, according to the study.

Researchers also considered what would happen if a 6.8 magnitude earthquake struck along the Portland Hills fault.

While much less likely than a Cascadia quake, the study concluded it would cause twice the damage because the area is more developed and more people live there.

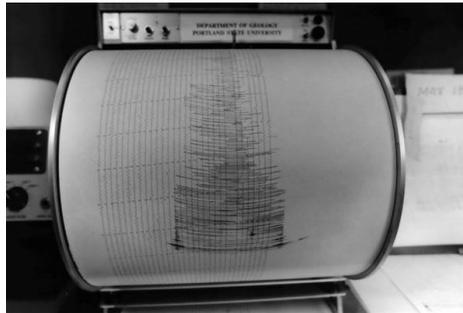
The state of Oregon is using the study to plan how to care for those hurt in an earthquake and how to shelter people who lose their homes and apartments.

Researchers said the main takeaway is that a Cascadia earthquake will happen and residents need to prepare for it.

https://www.oregonlive.com/trending/2018/07/new_cascadia_subduction_zone_e.html

New Cascadia subduction zone earthquake study 'is worse news for Portland northward to Seattle'

Posted Jul 27, 2018



A seismograph at Portland State University shows a 1993 earthquake centered in Oregon. (The Oregonian)By [Douglas Perry | The Oregonian/OregonLive](#)

The big one is coming. We all know that. We also know the big one might turn out to be the *very* big one. The 700-mile-long Cascadia subduction zone that's just off the coast of California, Oregon and Washington will, sooner or later, produce a mammoth earthquake, scientists say.

"If the entire zone gives way at once, an event that seismologists call a full-margin rupture, the magnitude will be somewhere between **8.7 and 9.2**," journalist Kathryn Schulz [wrote in The New Yorker](#) three years ago. "That's the very big one."

The result, she added, freaking out everyone living in the Pacific Northwest, will be "a seven-hundred-mile liquid wall that will reach the Northwest coast, on average, 15 minutes after the earthquake begins. By the time the shaking has ceased and the tsunami has receded, the region will be unrecognizable."

Of course, the damage won't be equally bad for everyone in the region. After analyzing four years of data from 268 seismometers both on the ocean seabed and on land, University of Oregon researchers have discovered "anomalies in the upper mantle below both ends of the Cascadia subduction zone" that have implications for that next big one -- or the next *very* big one.

"Our study is worse news for Portland northward to Seattle and for southern Cascadia, but central Cascadia is not off the hook," seismologist Douglas Toomey said in a [University of Oregon report](#) published this week at [SciTechDaily.com](#).

What that means: pieces of the upper mantle at the north and south of the zone are rising "because of melting rock and possibly elevated temperatures," said Miles Bodmer, a UO doctoral student who led the study. This could lead to worse quakes in those areas.

Offers a summary of the researchers' peer-reviewed study, which will be published in the journal [Geophysical Research Letters](#):

"Subduction zones typically do not rupture along their full length, instead they release seismic energy over discrete segments. ... We identify two anomalous low-velocity regions beneath the subducting oceanic plate, one below the Olympic peninsula in northern Washington and one beneath northern California. We infer that these are regions where mantle is rising and, due to the presence of partial melt and possibly elevated temperatures, is more buoyant than the mantle beneath central Oregon. These buoyant regions correlate well with areas where the plates are more strongly locked together and where greater seismic tremor occurs."

That is, these regions in northern Washington and northern California are different than the rest of the subduction zone fault, with "increased locking and increased tremor densities." There is less of this tectonic-plate "locking" along the central part of the zone in Oregon.

The researchers say their work highlights the need for an integrated early-warning system for Oregon.

There has recently been [a series of small earthquakes](#) off the West Coast, which is not unusual. The last time the Cascadia subduction zone burped up a massive, zone-wide earthquake was way back in 1700. No one knows when it will happen again: it could be this year or more than 100 years from now.

Read more about the UO research [at SciTechDaily](#), and check out a summary of the academic paper [at Geophysical Research Letters](#).

-- Douglas Perry



The quake-maker you've never heard of: Cascadia

By Michael Martinez, Stephanie Elam, and Rosalina Nieves, CNN

(CNN)Mother Earth slowly reveals her secrets, and this time, it's a fault line deep in the belly of the planet.

Its name is a whopper: The Cascadia subduction zone.

Its gargantuan size and potential power amaze earthquake experts, who say it could cause the worst natural disaster in the history of North America -- if it ruptures entirely.

This quake-maker sits at the bottom of the Pacific Ocean, where the seabed meets the North American tectonic plate. In all, it stretches 700 miles along the Pacific Northwest, from British Columbia's Vancouver Island to Washington to Oregon to northern California's Cape Mendocino.

In fact, "the Cascadia" already has made history, causing the largest earthquake in the continental United States on January 26, 1700. That's when the Cascadia unleashed one of the world's biggest quakes, causing a tsunami so big that it rampaged across the Pacific and damaged coastal villages in Japan.

Now it's a question of when the Cascadia will strike again, scientists say.

That big one could "hit at any time," and there's even a website called Aftershock that allows Oregonians to enter their address for a custom report on seismic risks. If the Cascadia were to experience a large-magnitude earthquake, the temblor and resulting tsunami could kill more than 11,000 people and injure more than 26,000, according to one FEMA model.



The fault line called the Cascadia subduction zone lies in coastal waters spanning 700 miles.

Cascadia more fearsome than San Andreas

Everyone knows the Cascadia's cousin in California: the San Andreas Fault. It gets all the scary glamor, with even a movie this year, "San Andreas," dramatizing an apocalypse in the western U.S.

Truth is, the San Andreas is a lightweight compared with the Cascadia.

The Cascadia can deliver a quake that's many times stronger -- plus a tsunami.

"Cascadia can make an earthquake almost 30 times more energetic than the San Andreas to start with, and then it generates a tsunami at the same time, which the side-by-side motion of the San Andreas can't do," said Chris Goldfinger, a professor of geophysics at Oregon State University.

The Cascadia is capable of delivering a 9.0-magnitude quake -- an awesome show of force by Mother Nature.

"You're going to have three to five minutes of shaking, and if you're used to earthquakes in California, they typically last 15 to 30 seconds and before you are really sure of what is happening, it is over," Goldfinger says.

A 9.0 will be different.

"In this case, three minutes -- and I've been in a 9 in Japan -- three minutes is an eternity. It is a very, very long time," Goldfinger says. "We'll lose a lot of bridges. We'll lose our highway routes. The coast will probably be closed by down bridges or landslides or both."

You may as well read this now in case you're ever caught in such a disaster: **Rescue crews will be overwhelmed.**

"Because there will be damage to all of the roadway, the various highways, various infrastructure, and it will be very difficult to get around and assess what is going on and how you might be able to reach people and provide them with some of the resources they may need," said Maj. Richard Ouellette of the Civil Air Patrol's Pacific region.

Revelation of Cascadia's lethality

Prior to the 1980s, the Cascadia was overlooked because it didn't seem to move or cause quakes.

Scientists now know differently.

"The more we learn about it, the less we like it, because it is turning out to be a big hazard as well," Goldfinger says.

To prove that Cascadia has ruptured before, scientists studied the so-called "ghost forests" of the Pacific Northwest.

Underneath the plants and trees, dirt and mud, is a record of changes to the landscape. By digging into it, U.S. Geological Survey geologist Brian Atwater found the proof for one of the world's biggest earthquakes.



USGS geologist Brian Atwater shows a legacy from when the Cascadia ruptured in 1700: It created a tsunami whose impact is marked today by a layer of sand atop what was the forest floor, on a bank near Copalis Beach, Washington.

"The field evidence for the tsunami here is the sheet of the sand that rests on the floor of the forest that these trees are rooted in," said Atwater.

He found that after the earthquake, the coast dropped about 5 feet, and then several minutes later, the tsunami overtook a spruce forest, bathing it with ocean water. The trees couldn't survive in the salt water, but many of their hollowed out, dead trunks still stand today — markers of Cascadia's devastation centuries ago.

Through examining the rings on those remaining trunks and roots, scientists narrowed down when the Cascadia ruptured — between 1680 to 1720.

Armed with this information, Japanese earthquake researcher Kenji Satake turned to diaries and logs from prominent families and temples of the Shogun era that go back to the 600s. The quest was to find a record of a tsunami that wasn't accompanied by a storm or a quake in Japan.

Scientists were already curious about whether a tidal wave could have come from a North American earthquake. After all, researchers concluded that South American quakes caused tsunamis off Japan in 1586, 1687, 1730, 1751 and 1837.

From multiple records, it became clear that an orphan tsunami — devoid of shaking or a storm in Japan — did slam into its coast in January 1700.

"There are fierce debates in the scientific community. You know about lots of details, but not about that main conclusion," Atwater said.

No way to predict the next big one

Unfortunately, you can't see the Cascadia fault as you can the San Andreas, which leaves a visible line in some parts of California.

The Cascadia lies underwater where the oceanic plate actually dives under the North American Plate. The "Cascadia subduction zone" derives its name from the Cascade Range of volcanic mountains that parallel the fault from afar and from how one plate subducts, or goes under, another.

There's no way of predicting when Cascadia will author the next big one, Goldfinger says. "I wish there were, but, no, there isn't," Goldfinger says. "We can't look forward and say we are due or overdue really." Such quakes are the price of West Coast paradise.

