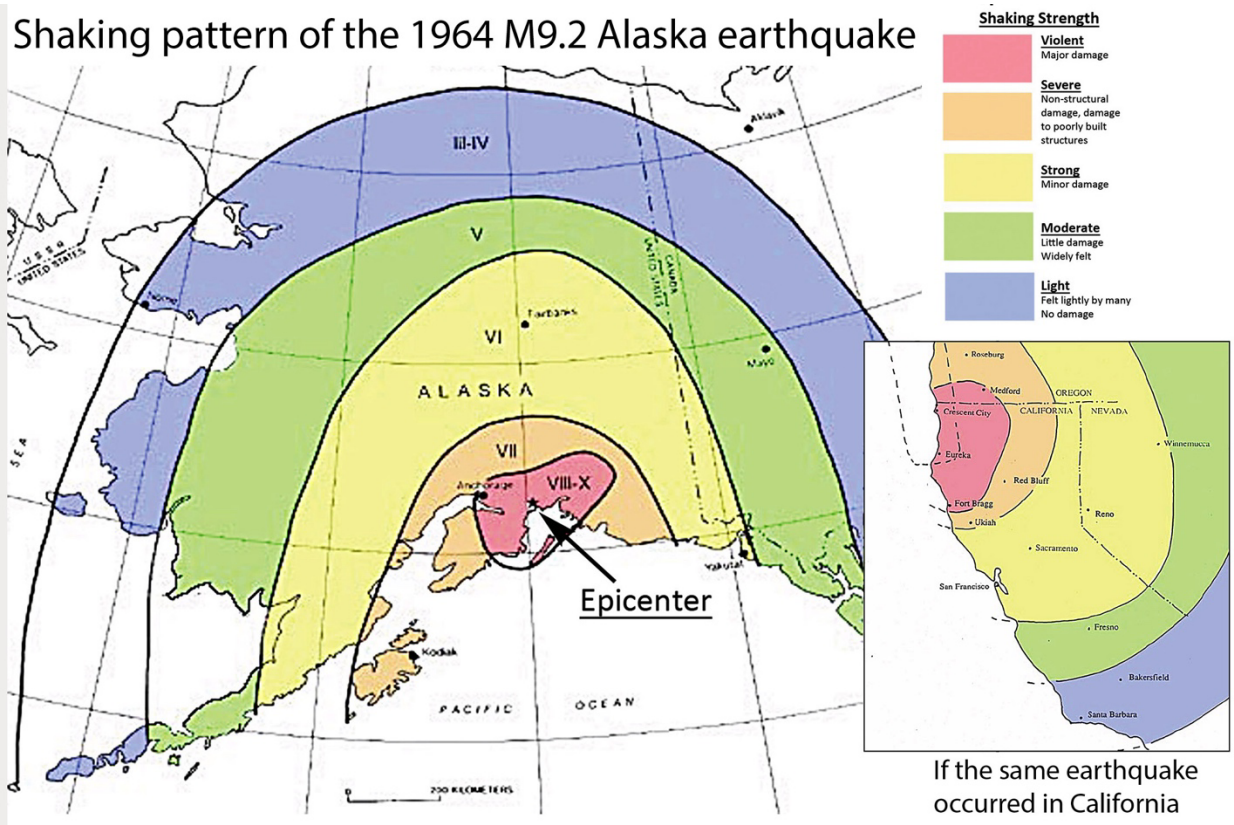
Times Standard

# **Not My Fault: Turkey-sized earthquakes have occurred in California before, what about something even bigger?**

Lori Dengler for the Times-Standard

Posted March 4, 2023
https://www.times-standard.com/2023/03/04/lori-dengler-turkey-sized-earthquakes-have-occurred-in-california-before/




*Shaking pattern (isoseismal map) of the 1964 M9.2 Great Alaska earthquake based on USGS observations. Inset shows what this shaking would look over the State of California if the epicenter was in Humboldt County. The rupture zone is shown by the dashed lines and would continue all the way to Vancouver Island, Canada with strong shaking in Oregon and Washington as well.*

Monday marks one month since the M7.8 earthquake near the Turkey – Syria border. The casualty numbers still slowly inch upwards, but the general scope of the disaster is now clear. 52,000 lives lost, over 122,000 injured and property losses estimated at $84 billion (US dollars). It is the fourth costliest earthquake disaster since loss estimates have been made.

Numbers are a poor way to categorize a disaster. When the numbers are large, we become numb and if the numbers are relatively modest, like those in the December 20th Ferndale earthquake, it minimizes how traumatic and life changing it was for those in the center of it. Any earthquake that causes you loss and pain is a big one in my book.

Last week I compared the Turkey – Syria earthquake to the ShakeOut scenario, a similar-sized earthquake on the southern segment of the San Andreas fault, one of the few places in California where scientists know that earthquakes of a similar size could occur. We know that M 7.8 – 8.0 earthquakes have also occurred on the central segment of the San Andreas, on the Northern segment between Santa Cruz and Cape Mendocino, and on faults in Eastern California.

There is only one place in California with credible scientific evidence for a much larger earthquake and, if you live on the North Coast, it's right beneath your feet. The Cascadia subduction zone (CSZ) is the largest fault zone in the coterminous United States and the only one capable of producing an earthquake in the upper magnitude 8 to lower magnitude 9 range. It marks the compressional interface where gravity is inexorably pulling the subducting Gorda – Juan de Fuca plate system beneath North America.

The CSZ extends for nearly 700 miles from Cape Mendocino to Vancouver Island Canada. But length doesn't give you the full sense of its size. This fault system is not vertical and shallow like the San Andreas. Dipping like a ramp from the continental shelf offshore to the east at an angle of about 12 degrees, it's about six miles beneath Cape Mendocino, eight miles below most of coastal Humboldt County, 12 miles at Willow Creek and roughly 60 miles beneath Mt. Shasta.

We don't know for sure how much of this dipping plane is likely to rupture in the next Cascadia earthquake. Temperatures increase with depth in the earth and east of Weaverville the interface is too warm to be stuck tightly. It's likely a zone at least 40 miles wide which puts coastal Humboldt and Del Norte counties in a unique spot in global subduction zones. The stuck portion of most subduction zones is offshore. We are on top of it. Sitting at my computer in McKinleyville I am very aware of the lurking monster only eight miles beneath me.

There is no certainly about what the next Cascadia earthquake will be like. We have geologic glimpses through records of ground subsidence, liquefaction, ancient landslides, and tsunami deposits. We have written accounts of the tsunami it produced in Japan and oral history from the First Nation peoples of Northern California and the Pacific Northwest. At least 13 CSZ earthquakes have been documented over the last 7000 years by friend and colleague Harvey Kelsey and his collaborators. They studied deposits left by tsunamis in a lake near Port Orford in Southern Oregon.

Extrapolating what will happen in the next great CSZ earthquake is an iffy game. There is much more data available on the range of impacts produced by earthquakes in the upper M7 to lower M8 range. Every year, about two earthquakes of this size occur offering a rich data set on the range of characteristics. Upper 8 and lower 9s are far rarer. The USGS lists 13 magnitude 8.6 or larger earthquakes since the advent of seismographs and only three since the era of digital instrumentation. The shaking impacts of these quakes vary significantly.

There are a two things I am sure of: the scope of impacts will be unlike any historic California earthquake of the past, and the overwhelming majority of us will survive the earthquakes. That means we really have to double down on the three Rs: resilience, response, and recovery.

The two biggest differences between a Cascadia earthquake and a 7.8 in Turkey or the San Andreas is the size of the impacted area and a tsunami. The February 6th earthquake caused damage in a zone 130 miles from the epicenter and was felt by a few as far away Cairo, 700 miles distant.

Let's compare that to the 1964 M9.2 Alaska earthquake. I did an exercise a number of years ago taking the felt pattern of the Alaska earthquake and overlaying it on California. I arbitrarily put the epicenter near Eureka and oriented the pattern to parallel the CSZ heading north. There is no surprise that Mendocino, Humboldt and Del Norte Counties will all get very strong shaking. What might be a surprise is that areas as far away as Sant Cruz and Central Nevada could get shaking levels sufficient to cause some damage, sleepers in Santa Barbara could be awakened and many people will feel it in the Los Angeles basin.

The Turkey – Syria earthquake did produce a tsunami. It was only about half a foot high, likely caused by subsidence in the adjacent coastal areas. It does illustrate that strike-slip earthquakes can cause tsunamis and shaking should alert anyone to head to higher ground. But a Cascadia earthquake will be a horse of a very different color. The seafloor deformation will produce a tsunami that will arrive in coastal Humboldt County in as little as ten minutes. While the shaking will disrupt infrastructure and cause some damage, it's the tsunami that is likely to strike the biggest blow.

California recognizes the last week in March as Tsunami Preparedness Week. The States two most damaging tsunamis, the ones spawned by the 1964 Alaska and 2011 Great East Japan earthquakes, both occurred in March, so it is a logical choice. In the spirit of tsunami awareness week and recognizing that the next tsunami could arrive at any time the Redwood Coast Tsunami Work Group has scheduled a number of tsunami-themed for the next six weeks.

- Thursday March 16 – Public presentations on the December 20th M6.4 earthquake. Doors open at 5:30 PM at Humboldt Grange 5845 Humboldt Hill Road for talks on the science of North Coast quakes and preparing for future ones, followed by dinner. Free to the public. Call 707-442-4890 for information.
- Monday March 27 – I'm giving a free Zoom lecture at noon on the Tonga volcanic blast and tsunami through Cal Poly Humboldt's Osher Lifelong Learning Institute. All ages invited – visit https://extended.humboldt.edu/event/tonga-volcanic-blast to register.
- Wednesday March 29 - annual Tsunami Communications Test. Between 10 and 11 AM, the Emergency Alert System and county notifications will be tested in Del Norte, Humboldt, and Mendocino Counties. You don't need to do anything; just be aware it is only a test.
- Friday April 14 Kamome Day in Del Norte County – the ten-year anniversary of the beaching of a small tsunami boat in Crescent City. A day of activities in schools and in the evening for the general public. More at https://visitdelnortecounty.com/event/kamome-festival/

---

Lori Dengler is an emeritus professor of geology at Cal Poly Humboldt and an expert in tsunami and earthquake hazards. The opinions expressed are hers and not the Times-Standard's. All Not My Fault columns are archived online at https://kamome.humboldt.edu/resources and may be reused for educational purposes. Leave a message at (707) 826-6019 or email rctwg@humboldt.edu for questions and comments about this column, or to request a free copy of the North Coast preparedness magazine "Living on Shaky Ground."