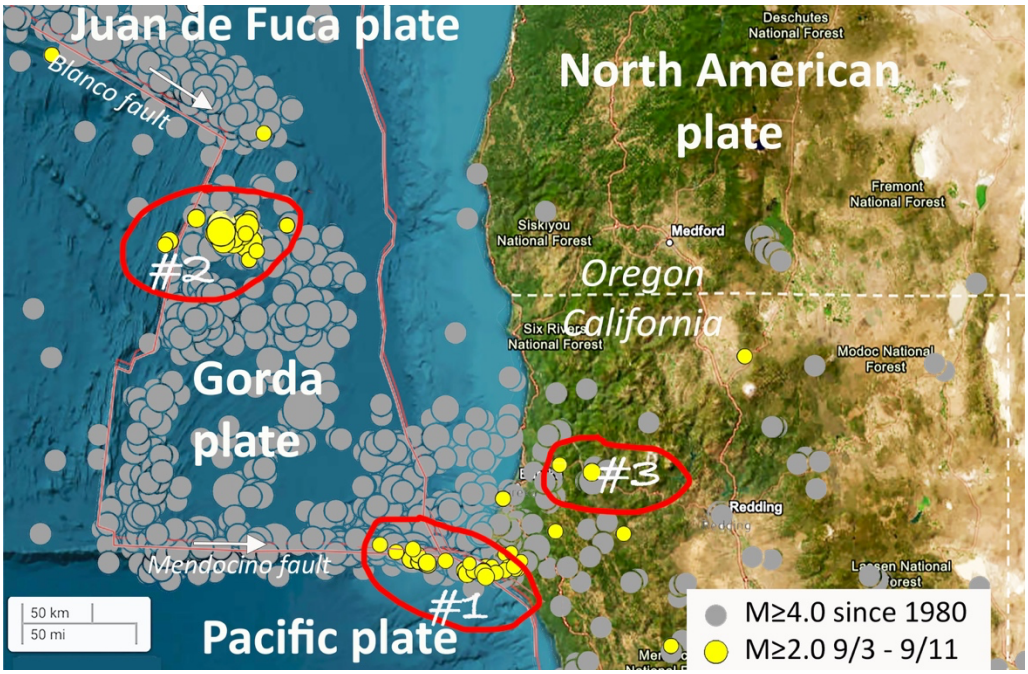
Times Standard

Not My Fault: A week of earthquakes illustrates seismic sources on the North Coast

Lori Dengler for the Times-Standard

Posted September 13, 2025
https://www.times-standard.com/2025/09/13/lori-dengler-a-week-of-earthquakes-illustrates-seismic-sources-on-the-north-coast/



Earthquakes of the past week (yellow) superimposed on North Coast earthquakes of magnitude 4 or larger since 1980. White arrows show the relative fault movement on the Blanco and Mendocino faults relative to a stationary Pacific plate. Circled area #1 are aftershocks of last year's December 5 M7. Area #2 highlights a sequence of earthquakes in the northern Gorda plate that included a M5.8. #3 is a small earthquake near Willow Creek centered within the subducted Gorda slab caused by the downward pull of the subducting plate (USGS data).

The last week has seen earthquakes in the usual places and some in areas not often as active. There were earthquakes on the Mendocino fault, an interesting sequence in the northern Gorda plate, and an onshore quake that caused people to take notice in eastern Humboldt and Trinity County. None of these earthquakes were felt strongly or caused damage but they illustrate the complex nature of our seismic sources and why the next strong earthquake won't necessarily come from southern Humboldt County.

For starters, what is the North Coast region? I include the three Northern California coastal counties and the adjacent offshore area. I also add Curry County south of Cape Blanco in Oregon as it shares the same tectonic setting where the offshore Gorda plate is slowly subducting beneath the coast. North of Cape Blanco, we enter the Juan de Fuca section of the Cascadia subduction zone which, in historic times, has behaved quite differently.

The Juan de Fuca plate, like Gorda, is actively subducting beneath the North American continent. That subduction is responsible for the Cascade volcanoes in Oregon and Washington. But most of this section of the Cascadia region is seismically quiet both on and offshore than Gorda segment during instrumental and written history. While there are plenty of earthquakes on the Blanco fault, the far offshore transform fault between the Pacific and Juna de Fuca plate, the interior of the Juan de Fuca plate is essentially devoid of earthquakes both offshore and in the subducting slab beneath the coast.

What happened in this region over the past week? The USGS noted 56 earthquakes ranging in magnitude from 1.1 to 5.8. It was a somewhat more active week than typical – our weekly totals for the past few months have been in the mid 30s and magnitudes greater than 4 are not frequent.

The Mendocino fault accounted for a third of the weekly total, the largest a M3.9 that was reported felt lightly from Whitethorn to Fortuna. This is the transform plate boundary between the Gorda and Pacific plates. We expect earthquakes to happen here and they certainly do. Since1974 and our first regional seismic network, the Mendocino fault has produced over 370 earthquakes of magnitude 4 or larger including two M7s and three in the M6 range.

This week's earthquakes eek are concentrated in an area from the coast to 40 miles offshore. The Mendocino fault is 160 miles long but there were no recent earthquakes centered further offshore. This is also no surprise. We are still in the aftershock window of last year's M7.0 and earthquakes are still concentrated along the rupture zone and near the ends of the December 5th fault slip. The rate of activity has decreased but aftershocks will continue at least through the rest of the year and perhaps longer. It is a certainty that most weeks will produce some M3s and the USGS estimates a 20% chance of an aftershock in the M4 range in the next month.

The second set of earthquakes came from the northern part of the Gorda plate centered far offshore of the southern Oregon coast. Between September 7 – 11, twenty earthquakes were reported in an area 85 to 135 miles west of Gold Beach. The largest in the sequence were a M5.8 on September 8 and a 5.1 the following day. No one in California reported feeling the earthquake but there were a few felt reports on the southern and central Oregon coast and one from Portland.

If the Gorda plate had read the manual on how plate tectonics works, there should be no earthquakes within it. According to theory, the interior of plates is "rigid" and all the deformation occurs along the boundaries. But the theory is a simplification of how the real world works and there are several reasons the Gorda plate doesn't follow the guidelines.

The Gorda plate probably acted in a more rigid manner tens of millions of years ago when it was part of a much larger plate we call the Farallon that covered included most of the central and eastern Pacific. But subduction has consumed most of the Farallon plate in the northern Pacific. What remains of the Gorda plate is much smaller and less resilient to the pressures of plate motion nearby.

A more important reason is the compressional stresses coming from the north and south. Look at the orientation of the Mendocino and Blanco transform faults. Both are transform faults with the northern side moving towards the east and the southern to the west. But they aren't parallel. The Juan de Fuca plate spreads in a southeast direction, the motion compressing

Gorda. Gorda is also experiencing the big squeeze from the much bigger Pacific plate to the south as it continues to move in a northwest direction.

Small Gorda is caught between the proverbial rock and a hard place, the north – south compression causing bending and faulting of the plate's interior. Earthquakes within the interior of the Gorda plate are even more frequent than those on the Mendocino fault. Nearly 500 earthquakes of M≥4 have been recorded since 1974 including two 7s and seven in the M6 range. The fractured fabric is also carried within the Gorda plate as it subducts beneath us, producing strong earthquakes like the 2022 earthquake that caused so much damage in Rio Dell. Large intraplate Gorda quakes both offshore and beneath the coast have been our most frequent source of damage to coastal communities.

Most Gorda earthquakes have been in the southern part of the plate. This week's earthquake spurt was in the north. Again, no surprise. Although not as active as areas further south, the central and northern part of Gorda have produced plenty of earthquakes including a 6.9, 6.1, and 7.0 in July and August of 1991. Fortunately, they have been too far offshore to cause damage, the near coast areas of northern Gorda have been seismically quiet so far. Last week's sequence quit as abruptly as it began and has been quiet since Thursday.

Most intriguing to me was area #3 and the smallest earthquake that I'm highlighting. On September 9, a M3.4 struck near Willow Creek. A 3.4 in Humboldt is not usually newsworthy and this one, while reported felt by 30 people, would not usually have garnered much notice. The 3.4 was relatively deep for our area, nearly 20 miles beneath the surface. This locates it well below the Cascadia subduction zone interface within the subducting Gorda slab. Unlike these slab quakes closer to the coast like the M6.5 2022 earthquake, it was on a north – south oriented normal fault.

Normal faults say extension. To produce a normal fault, east-west stretching has to be stronger than any of the other forces in the area. There's only one likely cause, the downward gravitational tug of the subducting plate to the east. We call this force downslab tension and it occurs in every subduction zone on the planet. Last Tuesday's 3.4 wasn't the first time it's been observed here. Bob McPherson noted these earthquakes in his thesis forty years ago and there were two earthquakes in the M5 range in the vicinity of Willow Creek in 2008 and 2012.

The unanswered question is what threat do downslab tension earthquake pose in our area? Just because we haven't seen a M6 or larger in our short historic record, doesn't mean they can't happen. There have been four downslab events in the vicinity of Olympia Washington in the M6 range, including the 2001 M6.8 Nisqually earthquake that caused over a billion dollars in damages.

A puzzling aspect of these earthquakes is that they are absent in most of Oregon and southern Washington. The downslab pull certainly exists but there have been no earthquakes. The downgoing Juan de Fuca slab seems to be stronger than the Gorda slab and has been able to resist fracturing – at least over the last century. But all materials have a breaking point and because more strain has accumulated, I can also speculate that an upper M6 or 7 might result if it finally does rupture.

September is National Preparedness month and October is ShakeOut time. Southern Humboldt is not the only area that needs to put earthquake preparedness on the front burner.

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/taxonomy/term/5 and may be reused for educational purposes. Leave a message at (707) 826-6019 or email Kamome@humboldt.edu for questions and comments about this column or to request copies of the preparedness magazine "Living on Shaky Ground."