Times-Standard
Times-Standard / Humboldt Beacon

Not My Fault: An 'abnormal' subduction zone earthquake

Lori Dengler/For the Times-Standard
Posted: Sep. 13, 2017

It took 90 seconds for the 2017 global earthquake energy release to double. That was the time for a fault to rupture off the coast of the Mexican state of Chiapas a week ago today. The earthquake had a magnitude of 8.1 and was the largest quake to occur anywhere in the world since a magnitude 8.3 in Chile two years ago. In less than two minutes, it released just about the same amount of energy as all the quakes in 2017 up to this moment.

At first glance, this earthquake was no surprise. It was located near the Middle America trench off the Pacific coast of Mexico and Central America and is one of the most seismically active areas on earth, with 32 earthquakes in the magnitude 7.5 to 8.1 range since 1900. The trench is the physical manifestation of subduction as the Cocos plate is pulled by gravity beneath North America.

A closer look reveals surprises. Most subduction zone earthquakes are fairly shallow – between 15 and 25 miles deep – and on thrust faults. Thrust faults are the result of compression with the rock and land on one side being pushed up and over the other.

Only the September 8th earthquake was not on the plate boundary, not a thrust fault and nearly 25 miles beneath the plate boundary. It was on a normal fault – a steeply sloping ramp where one side slides down relative to the other. Normal faults are caused by extension with the opposite type of motion than thrust faults.

What is a normal fault doing near a subduction zone? Subduction zones are complex places and stress is not concentrated just along the plate boundary. The Cocos plate is being bent as it is pulled beneath the surface and the gravitational pull is not uniform. Normal faulting "intraplate" or slab earthquakes are not uncommon in subduction zones. Our own Gorda plate typically produces several each year in the magnitude 3 to mid 5 range. But the Chiapas earthquake is unusual for its size.

There were benefits to the depth. It meant weaker shaking in the epicentral area than a shallow quake would have produced. The initial USGS PAGER casualty estimate based on a source 20 miles deep estimated perhaps 10,000 casualties. As I write this, the death toll stands at 98, still too high but much less than what might have been.

The flip side of deeper earthquakes is that they are felt over a wider area. Over 200 people in Texas reported feeling the Chiapas earthquake, a distance of more than 800 miles away. The effect was even more profound in 2013 when a magnitude 8.3 earthquake centered in the Sea of Okhotsk off of Asia was reported felt in Toronto - a distance of over 4000 miles away! That earthquake was nearly 400 miles deep.

The depth of the earthquake also impacted the tsunami it produced. Field teams have yet to visit the area and measure the tsunami heights closest to the earthquake source, but the tide gauge measurements currently available suggest water heights in the two to three foot range, about half as high as a similar-sized earthquake in 1985.

If you had been in Mexico last Thursday, you would not only have felt long duration ground shaking, you may have gotten notification BEFORE the shaking arrived. This is not voodoo or prediction. Mexico was the first country in the world to develop and implement an Earthquake Early Warning (EEW) system that is able to quickly locate an earthquake soon after the rupture starts and broadcast that information to areas further away.

Last Thursday, instruments along Mexico's Pacific coast detected the weaker P-wave signals from the earthquake only seconds after it began. Oaxaca got a 15 second warning, Aculpulco, 76 seconds, and Mexico City residents received a minute and a half alert before the stronger S-wave shaking occurred. This amount of time may not seem very long – but it is long enough to slow or stop trains and busses, safely shut down power stations or put them in standby mode, power up emergency generators in hospitals and other critical facilities and give people the time to drop cover hold on and mentally prepare for the ride.

California and the US still lag behind both Mexico and Japan in having an operational EEW system – we have the expertise and are getting closer, but need a national commitment for implementation and long term support. The President's budget proposal this year would have ended the program, but California legislators from both parties protested, and it looks like funding will continue for another year. However, this is still far short of the

$38 million needed to build the system – largely to install instruments in remote areas like the northern part of the state - and the $16 million a year to maintain it.

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