Times-Standard
Times-Standard / Humboldt Beacon

Not My Fault: Of magnitude, tsunami size and the enigma of the 1946 quake

Lori Dengler/For the Times-Standard
Posted April 11, 2018

The most important legacy of the April 1, 1946 earthquake and tsunami (last week's column) was the first tsunami warning system in the Pacific. It took three years to get it up and running but the system proved its worth in the 1952 M 9 earthquake in Kamchatka and the 1957 M 8.6 in the Aleutians when waves as high as 30 feet struck Hawaii with no deaths.

But this earthquake is not only known for starting the warning system. It remains the subject of research on how earthquakes produce tsunamis and continues to educate and befuddle tsunami researchers even today.

1946 was early days for seismology. What do seismographs have to do with tsunamis? That's how earthquake size is usually measured and magnitude is the key to tsunami potential. The seismographs of the 1940s were marvelous to look at – with springs and pendulums to trick the instrument into staying still to record the shaking ground around it (like the Bosch-Omoris on despaly at the Ferndale Museum).

Charles Richter's magnitude scale was barely a decade old when the 1946 earthquake struck. It was a clever but relatively simple formulation requiring only the amplitude of the largest wave on a standard seismograph and the distance from the source. The caveat was that the entire signal must remain on scale. That was fine for quakes in the magnitude 2 – 5 range but larger earthquakes to exceeded the limits and clipped.

Seismologists eagerly embraced Richter's magnitude concept and adapted it to other types of seismic instruments that were better at recording far away large earthquakes. Most of the seismographs that recorded the 1946 earthquake were similar to the Benioff that is still running in the HSU Geology Department. These instruments are good at measuring the shorter period waves that travel through the earth but not so good at recording surface waves. But this was the data available and the accepted magnitude for 1946 earthquake was 7.4.

For decades, researchers tried to figure out how a M 7.4 earthquake could produce a tsunami exceeding 100 feet nearby and still powerful enough to cause damage in Antarctica nearly 10,000 miles away. Some hypothesized that the earthquake had triggered a major submarine landslide but no physical evidence has yet been found by submarine reconnaissance voyages. Others revisited areas of the Pacific to verify that the tsunami was really as large as the catalogs reported.

It turns out that the biggest culprit was magnitude and the limitations that those 1940s-era instruments put on the ability to accurately measure earthquake size. Today's seismologists no longer use Richter's formulation. By the 1970s a new generation of broadband seismographs were widely deployed. Bandwidth is useful in many ways, but for seismologists, it makes all the difference in being able to determine earthquake size. The springs and pendulums in the 1940s instruments limited the ability to record all the frequencies and periods that the earthquake source produced. The long period signals are particularly important as they provide the indication of the scale of the earthquake source – and the size of the source is what produces the tsunami. Studying big earthquakes with those old seismographs is a little like listening to Beethoven's Ninth when you can only hear the violins, flutes and piccolo.

While it wasn't possible to pull the long periods out of the old seismograms, seismologists Lopez and Okal took another approach*. The old records were perfectly adequate to locate aftershocks of the 1946 quake and the aftershock footprint gives a pretty good estimate of the size of the fault that produced the main quake. When they did this, they were estimated a magnitude of 8.6, an increase in energy of more than 60 times and catapulting the earthquake in to a tie for 11th place on the list of the largest recorded quakes of all time.

The new magnitude estimate does a pretty good job of explaining the size of the 1946 tsunami in Hawaii and other areas far from the source, but it still doesn't completely answer how the surges were so large on Unimak Island. For tsunami scientists, the 1946 earthquake still has a few secrets left to unravel.

* You can read the Lopez, Okal paper at
https://academic.oup.com/gji/article/165/3/835/555752

Note: This month marks five years since Kamome, the small boat belonging to a High School in Japan, beached in Crescent City. To mark the occasion I will be reading "The Extraordinary Voyage of Kamome" and talking about what

has happened to the boat over that time at the Clarke Museum this Sunday at 1 PM in a presentation suitable for all ages.

Lori Dengler is an emeritus professor of geology at Humboldt State University, an expert in tsunami and earthquake hazards. Questions or comments about this column, or want a free copy of the preparedness magazine “Living on Shaky Ground”? Leave a message at (707) 826-6019 or email Kamome@humboldt.edu

http://www.times-standard.com/opinion/20180411/lori-dengler-the-enigma-of-the-1946-quake