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Not My Fault: The Cascadia story chapter 3 – The Japan connection

Lori Dengler/For the Times-Standard
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I am a big fan of mystery stories. I love plot twists and unexpected clues. The unfolding of the Cascadia story has many of those same elements. And like many a good mystery, the trail and the tale is not linear. I need to jump back and forth in time with new characters entering the story years before where I last left it.

The 1980s were important for advances in the geology of earthquakes. The coastal faults of Northern California, and the tsunami sands from Washington pointed to very big earthquakes –larger than any in the 150 years of written historic records. But this paleoseismic evidence was incomplete and by itself could only hint at the size, when it happened and how often these big earthquakes recur.

There are many techniques of dating geologic materials but all have challenges and none can provide an absolute date. The most widely known is radiocarbon dating. Carbon is ubiquitous on the earth's surface and the basis of most living creatures including ourselves. But not all carbon is the same. A small percentage is radioactive. We are all just a tiny bit radioactive. As long as we are alive, we keep about the same percentage of radioactivity in our bodies. But death stops the intake and the radioactive portion starts breaking down. The ratio of radioactive to nonradioactive carbon is a clock – the older the material is the smaller the fraction becomes.

Only it's not quite so simple. There is always uncertainty – some due to technical limitations and some because the amount of carbon in the atmosphere is not a constant and has varied in the past. The upshot – radiocarbon dating of the Washington tsunami deposits and the Northern California faults gave dates for our last quake but with quite a bit of uncertainty, falling somewhere in the middle to late 1600s or early 1700s.

Narrowing that uncertainty came from across the Pacific Ocean. Japan leads the world in its investment in seismology and engineering solutions to natural hazards. No surprise given its vulnerability - over 70 deadly tsunamis in the past 300 years and a death toll of nearly 160,000.

The scientific study of tsunamis in Japan began in 1896, following the Meiji Great Sanriku Tsunami, which claimed 22,000 lives and water heights of over 120 feet. By the 1970s, understanding the mathematics of tsunamis and the link between sea floor faulting and tsunami generation resulted in credible numerical models. By the mid 1980s, computer capabilities allowed the testing of those models. One of the modelers was seismologist Kenji Satake who was a postdoctoral scholar at Cal Tech where he became aware of the Cascadia earthquake hazard.

Dr. Satake reasoned that a great earthquake on the Cascadia subduction zone could produce a tsunami large enough to impact Japan. We experienced this "far-field" tsunami effect in reverse on March 11, 2011 when the magnitude 9 earthquake in Japan produced a tsunami that not only hit Japan, but was large enough to travel across the Pacific, reaching California's North Coast nearly ten hours after the earthquake. It was much smaller here than it was in Japan, but still large enough to destroy Crescent City's harbor and cause major damage to other ports on the US West Coast.

Dr. Satake knew from the radiocarbon studies that the last Cascadia earthquake occurred in the late 17th or early 18th century. This was a time of peace in Japan, ruled over by the shoguns of the Tokugawa period. The country was united and civil servants recorded meticulous details of daily life.

Satake and colleagues combed through written records and found many tsunamis – almost all of them explained by a nearby earthquake. The accounts described storng shaking followed minutes to hours later by tsunami surges. But there was one event that was different. It was an orphan – the waves arrived but there was no shaking felt beforehand. It had no clear parent or source in Japan. When Satake published his findings, Brian Atwater was intrigued – he studied Japanese and spent a year in Japan working collaborating with Satake and Japanese historians and linguists. They uncovered seven sites that clearly document a tsunami suddenly arriving with no preceding earthquake.

By carefully deciphering the ancient characters and converting from the traditional Japanese calendar to ours, the uncertainty was gone. The last Cascadia earthquake occurred in the evening of January 26th, 1700. And from the water heights recorded in the Japanese documents, Satake was able to estimate just

how big the earthquake in Cascadia needed to be – about a magnitude 9.

You can read the full story of The Orphan Tsunami of 1700 in the publication of the same name by Atwater and colleagues at
https://pubs.er.usgs.gov/publication/pp1707

Next chapter – the eyewitnesses

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