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Not My Fault: Cascadia Ch. 2 sand and peat deposits

Lori Dengler/For the Times-Standard
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Seismic safety questions about the Humboldt Bay Nuclear Power Plant helped to identify the major active faults of Humboldt County (Not My Fault 1/26). Further north, the nuclear industry helped put the regional Cascadia tectonic picture together.

The 1979 Three Mile Island nuclear accident led to examinations of power plants throughout the country. Professor Tom Heaton, noted seismologist from Cal Tech, was asked by the Nuclear Regulatory Commission to assess seismic analyses of nuclear plants in Washington State. He noted that the Cascadia region bore similarities with subduction zones that had produced very large earthquakes in other parts of the world and in a 1985 report, was the first to use the name, Cascadia subduction zone, in a publication. When asked about the name, Heaton recalled, "I was an outsider with very little knowledge of the local geology. After I had given a couple of talks … I realized that geologists … working in this area called it the Cascadia subduction zone. I was immediately self conscious about giving scientific talks about something whose name I didn't even recognize. I switched to "Cascadia" as soon as this gaff became apparent to me."

About this time, Brian Atwater heard a Heaton talk about the Cascadia subduction zone. Heaton mentioned that Cascadia had similarities to Chile and Alaska where magnitude 9 earthquakes had occurred, but was no historical record or physical evidence of past great quakes. Atwater, with a PhD newly in hand, had recently joined the small USGS office on the University of Washington campus. He had worked on wetlands in the San Francisco Bay area and had an idea how the Washington coast might provide the missing physical evidence.

Armed with a shovel, a hand auger and hip waders, Atwater began exploring the tidal estuaries of Western Washington. Coastal marshes have a unique relationship with the twice-daily influx of salty tidal waters. Some plants can handle the salty deluge twice a day. Others are not so tolerant and live at the edges of the tidal flat where only the highest tides of the month reach. The plants create a biologic marker of the high tide elevation.

Subduction zones cause both slow and rapid changes to coastal elevations. Gravity slowly pulls a massive slab of the earth's outer surface downward, descending into the earth at about the same speed as your fingernails grow – an inch or so a year. The overlying land is stuck to the subducting plate and squeezed by the drag on the subducting plate below. The leading edge beneath the sea floor is slowly pulled down and the coastal land behind bulges up and the marsh plants readily adapt. This slow squeeze can continue for hundreds of years – until so much strain accumulates that the interface between the plates snaps producing a giant quake. The edge beneath the sea floor that had been pulled down suddenly snaps up – pushing the sea above it and initiating a tsunami. The bulged up area drops by as much as several feet, submerging some land that had been high and dry before the earthquake.

Atwater reasoned that a subduction zone earthquake could suddenly submerge marshes creating a buried peaty zone where sea level had been before the quake. He scoured coastal estuaries and found not only the entombed markers of sudden down drops. He also found sand layers directly on top of the buried peat that was thickest at sites close to the coast and thinned landward. Atwater published his work in Science in 1987, arguing that the submergence could have been caused by great Cascadia quakes and the sand deposited by an ensuing tsunami running over the land shortly afterwards. Always the consummate scientist, Atwater was careful not to conclude too much from the limited data available at the time, although many colleagues thought his findings at the time outlandish.

Enter a Humboldt connection. Eileen Hemphill-Haley graduated from the HSU Geology Department in 1982 and landed a tech job at the USGS. She became an expert at identifying diatoms, microscopic animals that live almost anywhere water is present. Distinct species live in fresh, saline or brackish waters and in different ocean conditions and can be identified by the shape of their skeleton. Eileen heard an Atwater talk about Cascadia and that he was interested in having someone look at the microfossils in his study area. With great trepidation, she overcame her shyness to introduce herself. Two weeks later, Brian sent her several baggies of Washington mud samples which became the basis of her PhD thesis and her future career.

After thousands of hours poring over a microscope to identify and count the number of different species in the Atwater cores, her work paid off. She was able to show that the diatom assemblage in the sand deposits contained about 10% deep ocean varieties, strongly supporting a tsunamigenic origin. In 2000, Atwater and Hemphill-Haley received the Geological Society of America's Kirk Bryan Award, the highest honor in geomorphology. Their pioneering collaboration set the standard for the paleotsunami studies of today.

In 2001, Eileen returned to HSU as a Research Associate, teaching students her techniques and continuing to look for evidence of past tsunamis.

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http://www.times-standard.com/opinion/20170208/not-my-fault-the-cascadia-story-chapter-2-sand-and-peat-deposits