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Not My Fault: Seismic communication - tricky connections across plate boundaries

Lori Dengler/For the Times-Standard
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I had no intentions of majoring in science. There were many reasons. From my limited highschool science experience, I thought science was done in labs by men in white coats. I was always more interested in art and human culture. The science classes seemed the opposite of art – proscribed, calculating and dull. I also had the distinct sense that most everything had already been worked out. I figured that to be a scientist, one needed to be super smart and spend all the time in labs working with complex equations. Not at all my cup of tea.

My guess is that some of you had similar experiences and the perception of science as the domain of people scribbling incomprehensible equations that seem irrelevant to most of us persists. Fortunately, I was forced by undergraduate breadth requirements to take a few science courses and my intro geology class hanged my perceptions and the course of my life.

It was fall 1965 and the the professor was Howel Williams, one of the most famous volcanologists in the world. It was his last year of teaching and he was on the outs with the department chair and was punished by being assigned the "rocks for jocks" course for the first time in his career. What may have been unpleasant for him was very fortunate for me.

It was the dawn of the era of plate tectonics. Post war advancements made it possible to map the sea floor in detail and three years before I took my seat in Geology 10, Harry Hess published a "History of Ocean Basins" proposing a credible explanation for the much criticized continental drift hypothesis made by Alfred Wegner a half century earlier. The term "plate tectonics" was several years away from showing up in text books and about half of the Berkeley faculty at the time were staunch "anti-drifters" at the time.

Professor Williams took us on an amazing journey. In his first lecture, he explained that to be a good geologist, you needed to be as much an artist as a scientist to be successful. In his numerous slides he waxed on the beauty of the places he had studied. Williams was the first to unravel the story of Mt. Mazama and the catastrophic eruption 6000 years ago that produced Crater Lake. That story required thinking in four dimensions to imagine the formation and evolution of rock units through time. Yes, instruments and laboratory analyses were important but you didn't need to be mathematically brilliant to make lasting contributions. He would argue that anyone could develop adequate computational skills and that having an imagination and being able to think outside the box was far more important in the long run.

Williams also threaded his lectures with the new arguments both for and against continental drift. It was the scientific process in action and we had front row seats. He showed us maps of how the Americas and Africa/Europe fit together and the evidence supporting their one-time connection. He gave us the geophycists' arguments for why drift was impossible. I've always liked puzzles and my Geology 10 epiphany was realizing that the whole planet was a grand puzzle and the most basic ideas about how it functioned were being challenged before my eyes.

After that class, I cautiously explored switching majors. The next semester I took calculus and chemistry. I admit they weren't nearly as fun as geology but I kept Professor William's advice in my mind. I could plod through and do it. And the next semester I officially became a geophysics major.

Throughout my undergraduate and graduate years the plate tectonic story evolved. While the basic framework is well set – lithospheric plates that move relative to one another causing the majority of earthquakes, volcanism, and mountain building along the boundaries where they meet, we continue to learn more all the time. Plate boundaries are much more complex than originally thought and the interiors of plates aren't always as quiet as first believed.

Last December, a study was presented at the Annual meeting of the American Geophysical Union (AGU) that suggests connections between separate plate boundaries. It shouldn't be surprising that a large earthquake occurs on one plate boundary could affect adjacent plates. We had an example of in 1992. A magnitude 7.2 earthquake ruptured a fault within the North American plate in the Mendocino triple junction area near Petrolia. It triggered magnitude 6.6 and 6.7 earthquakes in the adjacent Gorda plate hours later and numerous smaller quakes on the Mendocino fault.

What we've not seen in our 120 year window of instrumental records is a very large earthquake on one plate boundary triggering another great earthquake on an adjacent one. Chris Goldfinger, a professor at Oregon State and an alum of the HSU Oceanography program, proposes that such a scenario may have occurred a number of times between the Cascadia subduction zone and the San Andreas fault system.

Goldfinger's group studies marine sediments and the deposits left by submarine landslides. Very large coastal and offshore earthquakes trigger slides throughout the region of strong shaking. The slides (turbidites) are too thin to be hazardous, but leave a clear and datable record that can be read in the thousands of marine cores he has retrieved in the past three decades. An analysis of cores collected off the Cascadia region of Southern Oregon and Northern California and a second set from offshore the Northern San Andreas suggest some Cascadia turbidites are immediately overlain by San Andreas deposits. Goldfinger argues that a magnitude 8.5 to 9 Cascadia earthquake triggered a 7.5 to 8 Northern San Andreas earthquake days to months later.

The study is controversial and not all scientists agree with the interpretation. The most recent Cascadia earthquake in 1700 did not produce a San Andreas event. And the 1906 San Andreas earthquake did not trigger anything along the Cascadia interface. If such a "double whammy" were to occur, the biggest impact would be the scope of the damage and the economic impacts and recovery challenges of disrupted infrastructure from Monterey Bay to Vancouver Island.

My gut feeling is that it is possible when the stress situation in both systems are near to rupture. The Northern San Andreas appears to have a 200 to 400 year recurrence. The last big quake was just over 100 years ago so I don't think it is primed to go in the near future. I'm glad that I still have a ringside seat to watch the scientific process in action and that there will be many problems for budding geoscientists to work on for a long time.

Note: for more on the Cascadia – San Andreas study, see https://www.nature.com/articles/d41586-019-03769-w

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