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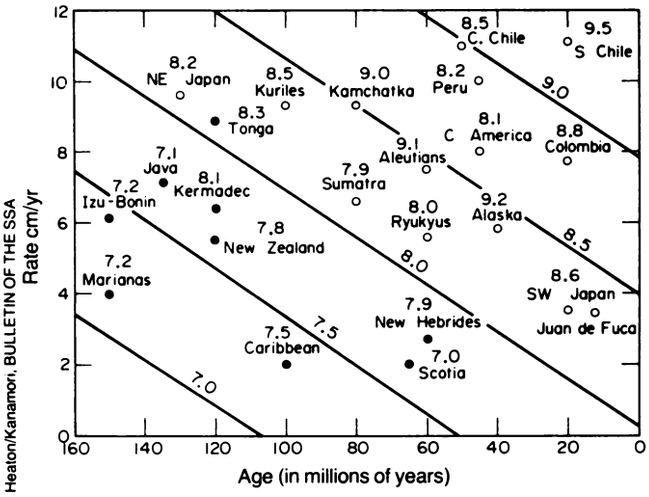
Quake potential in Pacific Northwest

The Juan de Fuca subduction zone off the coast of Washington and Oregon is nestled in the so-called ring of fire, a band of subduction zones extending around the Pacific Ocean that is renowned for large, sometimes devastating earthquakes. Yet the Juan de Fuca zone — where the North American and Juan de Fuca plates are converging at a rate of 3 to 4 centimeters per year, causing the latter to be pushed down, or subducted, into the mantle — has been curiously devoid of earthquakes, at least since historical records for the region began about 200 years ago. This has led some seismologists to postulate that the Juan de Fuca subduction is taking place by aseismic creep — that is, the plates are sliding smoothly past one another without jerks that would rattle the earth.

But now two U.S. Geological Survey scientists think there is reason to seriously consider another possibility: that there have been no earthquakes in this zone during historical times because the two plates have been locked together — but the plates could jerk apart in the future, triggering a potentially huge earthquake in the northwestern United States. The researchers, Thomas Heaton and Stephen Hartzell of USGS in Pasadena, Calif., presented their findings last week at the Seismological Society of America meeting in Austin, Tex.

Heaton and Hartzell arrived at their conclusions by comparing data on a number of features of the Juan de Fuca subduction with other zones around the world. They concentrated on young regions because the Juan de Fuca plate, only 10 million years old, is one of the youngest being subducted. In the past, other researchers argued that Juan de Fuca has been seismically quiet because the plate is very young, and hence still warm enough to bend and flow rather than break under stress. But Heaton, Hartzell and other seismologists who have studied other young subduction zones have found that not only are there earthquakes in these areas, but the quakes are very large indeed and come after long periods of relative quiescence. The southern Chile quake in 1960, for example, which occurred along a 20-million-year-old oceanic plate, had a magnitude of 9.5 on the total energy scale — the largest earthquake recorded in seismological history. By comparison, the 1906 San Francisco quake measured 8 on the total energy scale (the Richter scale, in contrast, is based on the *peak* energy of seismic waves).

Besides its youth, Juan de Fuca shares a number of features with other young subduction zones, like those near southwest Japan, Colombia and Mexico, that have experienced large quakes in the past.



For subduction zones around the world, the younger the subducting oceanic plate and the faster the convergence rate between the plates, the higher the magnitude of the earthquake. Researchers think that because of its similarity with other young zones, Juan de Fuca might experience a large quake within a few hundred years.

Young zones tend to have shallow trenches (long troughs that mark the descent of an oceanic plate) accompanied by a relatively shallow descent of the subducting oceanic plate. Heaton and Hartzell suspect that this shallow descent reflects the buoyancy of the young crust, and that because it is buoyant, the oceanic plate pushes up on the overriding continental plate, jamming the two together. Older crust, on the other hand, has grown dense as it cooled so that it sinks away from the upper plate.

By comparing the lengths and other features of the Juan de Fuca and southern Chile subduction zones, Heaton and Hartzell conclude that "subduction earthquakes in the northwestern U.S. with energy magnitudes in excess of 9 [and] with recurrence times of greater than 400 years cannot be ruled out."

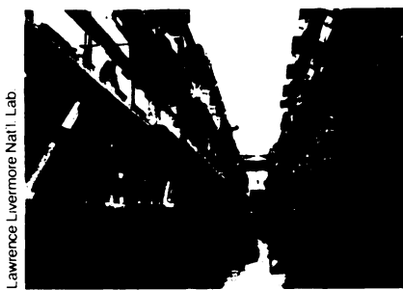
Heaton notes, however, that this conclusion, based on comparisons alone, is not a prediction. "All subduction zones are different from one another, just like people," he says. So it is still possible that Juan de Fuca is subducting aseismically. There is a bit of more direct, albeit shaky evidence that earthquakes occurred there in the past, though. Heaton cities a study suggesting that a number of underwater landslides — which can be but are not necessarily triggered by earthquakes — have occurred simultaneously in the area with repeat times of about 400 years. Moreover, Indian legends describe a tsunami-like occurrence on the Washington coast. Still, a lot more work will be needed to date landslide deposits, look for evidence of large-scale sea level changes on the coast and study other zones in greater detail in order to hash out exactly how Juan de Fuca resembles or differs from other zones.

USGS began this work at the request of the Nuclear Regulatory Commission, which is investigating the siting of power plants in Washington and Oregon. USGS will deliver the researchers' reports to the commission shortly. Included in the reports are studies of possible ground motion that might result from a subduction earthquake in that region; some of these results, also obtained by looking at other earthquake areas, were presented at the Austin meeting as well. — *S. Weisburd*

World's most powerful laser

Ten arms join together to make up Nova, the world's most powerful laser, which was dedicated recently at the Lawrence Livermore (Calif.) National Laboratory. Each of the arms is a laser amplifier chain 137 meters long. The whole arrangement fills a large building.

Nova is a neodymium-glass laser with a fundamental wavelength in the near infrared (1.05 micrometers). The infrared can be converted to green (0.53 micrometer) or blue (0.35 micrometer) by passage through arrays of potassium dihydrogen phosphate crystals. Through an arrangement with mirrors, Nova's arms can concentrate between 80 and 120 kilojoules of energy (in 3 nanoseconds) or between 80 and 120 terawatts of power (in a 100-picosecond pulse) on pinhead-sized targets of deuterium and tritium. Nova will be used in weapons simulation studies and in a program aimed at peaceful use of thermonuclear power.


Lawrence Livermore Nat'l. Lab

Construction of Nova took eight years and cost $176 million. According to a Livermore announcement it surpasses all previous lasers in power and wavelength flexibility. Experiments are expected to start in the summer.