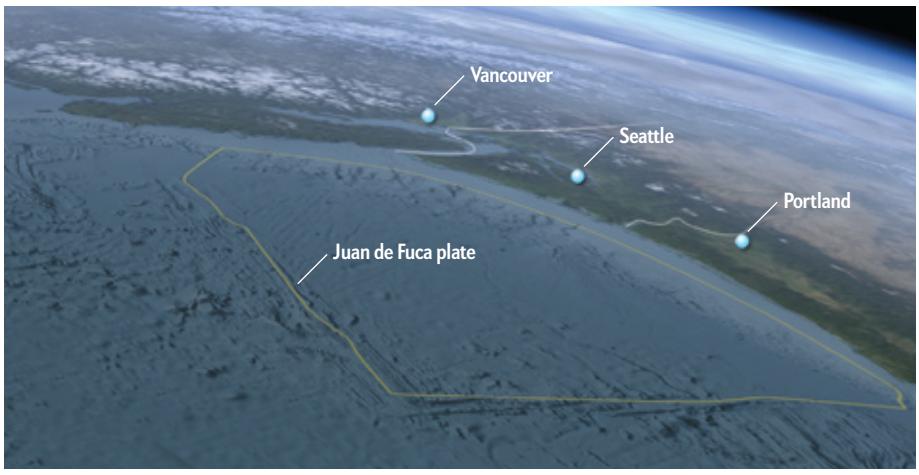
GEOLOGY

Bracing for the Big One

A series of major earthquakes have struck below the Pacific Ocean in less than a year and a half. Could the West Coast be next?



Several devastating earthquakes have rumbled beneath the Pacific in the past 15 months. In February 2010 a magnitude 8.8 temblor slammed central Chile; last September a 7.0 quake walloped Christchurch, New Zealand, leading to a 6.3 aftershock in February. The magnitude 9.0 mega quake that flattened Japan in March is tied for fourth largest in the past 110 years.

These events have led many people to wonder if they are somehow linked. Most likely, scientists say, their near coincidence is merely a statistical fluke. That doesn't mean, however, that it is necessarily safe to come out from under the bed. The best gauge of quake risk is the geologic record. And new data on that record tell a disturbing story, especially in the northeastern Pacific.

Although most people may consider southern California to be the most earthquake-prone region in the nation, the Cascadia subduction zone is arguably the biggest seismic hazard in the U.S. It parallels the coast and poses a seismic threat to cities such as Vancouver, B.C., Seattle, and Portland, Ore. At that subduction zone, the tiny Juan de Fuca plate slides eastward underneath North America between 30 and 40 millimeters a year—but this interface has apparently been locked for centuries. "This subduction zone stands out as the big elephant in the corner," says Chris Goldfinger, a marine geologist at Oregon State University. "It sits quiet for hundreds of years and then goes off all at once."

New data suggest that the northern portion of the subduction zone, from the middle of Vancouver Island to the Washington-Oregon border, has a 10 to 15 percent chance of suffering a magnitude 8.0 or greater quake in the next 50 years. The southern portion, stretching from the Washington-Oregon border to California's Cape Mendocino, has a 37 percent chance of the same-size quake over that same interval. Goldfinger and his colleagues expect to publish the data in an upcoming USGS report. The next big one, he says, "is going to happen. It's just a matter of narrowing down the timeline."

—Sid Perkins

EXPLAINER

How do scientists measure the speed of tectonic plates?

The best way to measure how quickly two tectonic plates converge is to use the Global Positioning System. By repeatedly checking the distances between specific points on two different plates, researchers can assess long-term rates of convergence and measure sudden movements, such as Japan's 2.4-meter (eight-foot) leap eastward during the March 11 quake. Before the advent of GPS, scientists relied on rocks in the ocean floor, which, when they cool, record the direction of the earth's magnetic field. Knowing when and how often the field has flipped in the past enables researchers to calculate the rate at which new ocean crust forms at mid-ocean ridges. Another technique is to sample and map rock formations on both sides of a tectonic interface—especially formations that have a distinctive composition or an unusual assemblage of fossils. *—S.P.*

ENERGY

The Newest Nuclear Plants

As always, safety is a balancing act

The first new nuclear reactor in the U.S. in nearly three decades is taking shape outside Augusta, Ga. Southern Company has dug up a patch of red clay down to bedrock for the foundation of a new AP-1000—a new generation of reactor with passive safety features that keep working even when the power goes out. Southern plans to build two such AP-1000s in the next six years, and other utilities have plans for 12 more, along with another six new reactors of various designs, all of them with passive safety features.

Safety features that operate in the absence of electricity or human intervention were lacking at the Fukushima Daiichi nuclear power plant in Japan, which was built in the 1970s. The March earthquake knocked out the plant's connection to the grid, and the subsequent tsunami damaged backup generators and electrical equipment, crippling cooling systems and allowing reactor cores to heat up. Each AP-1000, in contrast, has a giant tank of water that sits above the reactor core. In the event of a potential meltdown, the heat buildup would trigger a valve, allowing the water to flow into the reactor.

The AP-1000 also has an open-sky design that, in a pinch, uses air currents to cool the reactor. In a departure from standard designs, the outer concrete building that encloses the reactor's primary concrete and steel shell has vents near the roof. In a meltdown, natural convection would pull in air.

Convection would also spread radioactive particles out through the roofline vents, critics point out. Engineers counter that eliminating all risk is impossible; the best they can do is strike an acceptable balance between safety and cost. "With earthquakes, there are limits to what you can do," says Michael Golay, a nuclear engineer at M.I.T. "What risk are you willing to tolerate?" *—David Biello*

Illustration by Don Foley