serious concern for health-care and lab workers. Roberta Black, an NIAID virologist who collaborated on the study, says researchers will also be eager to see if the drug can block HIV transmission from mother to infant. And there's even talk about its potential for preventing infection in high-risk groups. "If HIV vaccine development is moving so slowly, perhaps this would give us another something to look at," says Sarver, who cautions that questions of drug toxicity would have to be solved before it could be given as a prophylactic.

Researchers warn, however, that any such uses are far down the road. Says Black: "I don't want to overinterpret the data. It's very clear-cut, and it's very compelling. But before we can find out what the potential is for human use, there's a lot more that has to be done." Adds Sarver: "People should see the red blinking light all the time."

It may not be long before that potential becomes clearer. Gilead chemist Norbert Bischofberger, a co-author of the *Science* paper, says the company, which is working on developing an oral form of PMPA, hopes to begin human trials next year.

–Jon Cohen

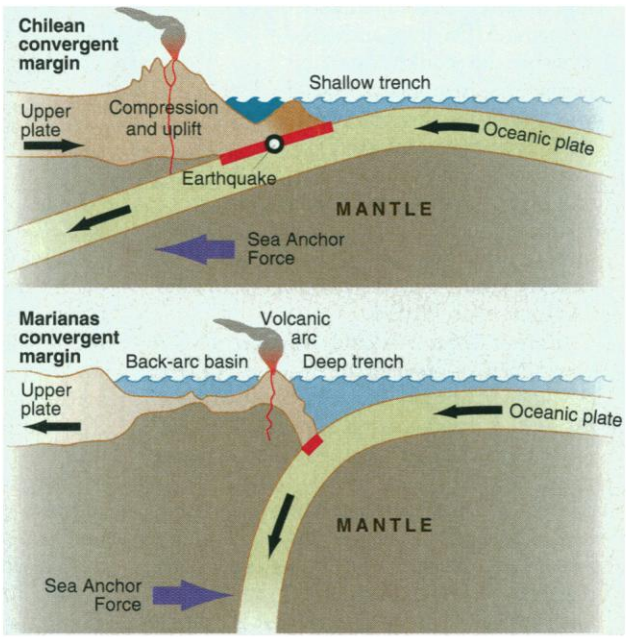
EARTH SCIENCE

How Vanished Oceans Drop an Anchor

The same fate awaits all ocean floor: a plunge into the planet's interior at a subduction zone. But the end doesn't always come in the same way. Off Chile, for example, the ocean floor's descent is punctuated by devastating earthquakes as it grinds under the adjacent plate. On the other side of the Pacific near the Mariana Islands, the oceanic plate glides smoothly into the mantle, generating few earthquakes. Both these extremes, and everything in between, can be found at other subduction zones around the world. Now Chris Scholz of Columbia University's Lamont-Doherty Earth Observatory thinks he can explain this puzzling spectrum of behavior.

Building on a 15-year-old proposal, he and Jaime Campos of the University of Chile in Santiago argue that what determines whether or not a slab of ocean floor slips quietly into the mantle is a "sea anchor" force, named after the canvas drogues that ships once dragged through the water to steady themselves. If the subduction zone migrates over the underlying mantle, say Scholz and Campos, the descending slab sweeps through the viscous mantle rock, generating resistance. If it acts in one direction, this force can bend the slab down into the mantle, turning off earthquakes and pulling apart the overriding crust to form a "back-arc" basin—a nascent ocean next to a subduction zone. If the force acts in the other direction, it can push the slab upward against the overriding plate and set the stage for great earthquakes.

Most seismologists who know of the proposal, which appears in the November issue of the *Journal of Geophysical Research*, are reserving judgment until they can study it in detail. But the prospect of a full explanation of why subduction zones behave so differently is enticing, says Larry Ruff of the University of Michigan, because so far "we've not been able to complete the loop in terms of a comprehensive physical theory." For example, he and other earth scientists have noticed that great earthquakes often strike where the plates are converging fast and the ocean floor is warm and buoyant because it was recently created by volcanic activity. But while these correlations "have stood the test of time," Ruff says, "their physical significance isn't clear."



Major drag. A sea anchor force can press descending ocean floor up against the overriding plate or drag it down, turning earthquakes on or off.

SOURCE: LAMONT-DOHERTY

Scholz himself says he realized the limits of the existing understanding in 1993, when a magnitude 7.8 earthquake struck a subduction zone near Guam. "That was a big shocker," he recalls. Most of the subduction zone—the same one that extends north past the Marianas and on toward Japan—doesn't generate big earthquakes. Now seismologists "had to explain why one part is coupled, generating earthquakes, and the other part is decoupled," says Scholz. What's more, he adds, the situation doesn't fit the traditional picture: "The subducting plate is the same age everywhere, and the velocity isn't that different."

So he and Campos built on an idea originally proposed in the late 1970s by seismologists Seiya Uyeda of Tokai University in Japan, Hiroo Kanamori of Caltech, and others. They had argued that a descending plate is fixed laterally in the mantle by the viscosity of the surrounding rock, rather like a spoon in a honey pot. The anchoring, recalls Kanamori, implied that "the absolute velocity of the upper plate can be a big factor." If the upper plate is moving toward the anchored lower plate, the subduction zone binds and produces earthquakes; if the upper plate is backing away, the zone is quiet.

Uyeda and Kanamori didn't elaborate on that simple picture. But Scholz and Campos have now turned it into a dynamic model of the forces on a subduction zone by assuming that instead of being fixed, the slab sweeps ponderously through the mantle as the upper plate moves—in effect turning the slab into a sea anchor. Unlike earlier ideas, says Scholz, this model can explain that puzzling subduction zone running north from Guam.

Along much of the subduction zone, the upper plate is retreating and the slab is moving along with it, generating a sea anchor force that pushes the slab down into the mantle. To the north, Scholz and Campos's calculations show, the force should be high enough to prevent the slab and plate from sticking and generating earthquakes. At the center of the zone, near the Mariana Islands, a change in slab orientation adds to the force pushing the slab down into the mantle and puts crust near the subduction zone under enough tension to fracture, opening a back-arc basin. But at the southern end of the subduction zone, where the slab shortens and the subduction zone changes direction again, the sea anchor force should drop off. "If you think of the slab as a sail, it's sort of spilling its wind," says Scholz. The result, in the model and in the real world: earthquakes.

The model doesn't contradict earlier correlations between great earthquakes and fast convergence or young crust: Convergence rate depends partly on upper plate motion, and the buoyancy of young crust does enter into the model. But it's more general, says Scholz. When he and Campos applied the model to some 30 subduction zones around the world to see how well it predicted the presence or absence of great earthquakes and back-arc spreading, "it worked for about 80% of the cases," says Scholz. "We think it's a fantastic success. In geophysical models, a global correlation that good is hard to come by."

–Tim Appenzeller