amount of heat that rises to the Earth's surface from the hotter rock beneath. They then parlayed the results into an estimate of the temperature at the buried plate boundary.

This temperature in turn limits the eastward extent of the locked region; once the descending slab exceeds 350 degrees Celsius, Hyndman says, it becomes too plastic to store stress. The Juan de Fuca slab, Hyndman finds, is hotter than most subducting slabs, perhaps because it is made up of unusually young crust. And that, together with the deformation data, implies that the locked zone is narrow, just 50 to 90 kilometers across.

The next step was to estimate how this skinny, 1100-kilometer-long locked zone would break in an earthquake. To do so, the Geomatrix group surveyed the length-to-width ratio, or aspect ratio, of all recorded subduction-zone earthquakes of M7 or larger. These 53 earthquakes had a typical aspect ratio of 2:1, being twice as long as they are wide, says Coppersmith. The Cascadia zone's aspect ratio is more like 15:1, says Coppersmith, which he thinks would make a rupture along its whole length "bizarre."

But other seismologists aren't sure a subduction zone's aspect ratio can say much about its behavior. "From a geologist's standpoint, I would be reluctant to put those kinds of limits on what the zone is capable of doing," Atwater says. Heaton adds that among the largest subduction-zone earthquakes, with magnitudes of 8 and 9 rather than 7, high aspect ratios are more common; the M9.5 Chile earthquake of 1960—the largest on record—had an aspect ratio of about 6:1. And the M8.7 Aleutian Island earthquake in 1965 had an aspect ratio of about 10:1.

But whether Oregon's seismic future holds an isolated catastrophic quake or a set of merely devastating ones may be an academic issue. Magnitude 9 earthquakes are so rare that no one knows just how acutely they shake the ground or how to design for them. "Designing for an M8 already tests the limits of our knowledge," says Madin. And that's just what Starkey and his colleagues are anxious to do. "There will be problems with retrofit and construction of new bridges," he says, along with tougher building standards for coastal communities, which would bear the brunt of a great earthquake. "I'm assuming that people in Oregon will be adopting this map, will acknowledge the large ground shaking, and do something about it."

–Bernice Wuethrich

Bernice Wuethrich is a science writer in Washington, D.C.

SCIENTIFIC COOPERATION

Cuban Crisis Threatens Joint Research

Marine biologist Michael Smith has long been planning to go to Cuba in November as part of a 12-person expedition to gather data on fragile coral reefs off the island's northern coast. A vice president of the Center for Marine Conservation in Washington, D.C., Smith has visited Cuba several times in the past 5 years. But this time he's worried that his research, along with that of many other U.S. scientists, will become a victim of the latest round of verbal hostilities between the two countries. "I'm afraid this expedition will collapse," he says.

What's troubling Smith is a new U.S. policy that removes scientists from a list of occupations—journalists, diplomats, and humanitarian workers remain on the roster—who are allowed to spend money in Cuba on business-related expenses without prior approval. The new rule, issued on 25 August by the Treasury Department, is part of President Clinton's attempt to tighten the 35-year economic embargo against the Castro regime.

At stake are several dozen research projects now under way between 22 U.S. and Cuban institutions, as well as future collaborations. Many of the projects are designed to plug knowledge gaps in the fields of biodiversity, marine resources, and meteorology. "Cuba is an important part of the Caribbean that we've had very little data from until recent years," says systematist Don Wilson, director of biodiversity programs at the Smithsonian Institution.

Wilson, who has worked with Cuban colleagues for 3 years, plans a trip in concert with Smith's in November to establish several biodiversity monitoring sites throughout Cuba and to collect data that can then be compared to other Caribbean sites. "If we can't do this, we lose some of our ability to predict future problems" in Caribbean biodiversity loss, Wilson says.

The new rule doesn't prevent research collaborations, but it makes them more difficult by requiring scientists for the first time to obtain a license as well as a visa before traveling to Cuba. A Treasury spokesperson says the department will process applications "as quickly as possible," but many scientists fear the licensing process will put a damper on research. "Nobody knows how long these [license applications] are going to be held up in the bureaucratic pipeline," says mammalogist Ross MacPhee of the American Museum of Natural History, who discovered fossilized remains of a giant sloth that lived in Cuba about 18 million years ago, the first Tertiary-period land mammal to be found in the Greater Antilles.

ALFONSO SILVA LEE

Big loss. The endangered bee hummingbird, the world's smallest, is unique to Cuba. It is being studied in a joint biodiversity project.

Smith already knows how slow the government can be. He's been waiting more than 2 months for permission to join the Cuban Zoology Society and to enlist a Cuban scientist as a volunteer field worker. (Such licenses were required even before the new rules went into effect for acts that "form an association" with Cubans and entail spending money.) He's already submitted documentation for the November trip, which is a much more ambitious undertaking.

The new rule also contains a Catch-22 that discriminates against new projects. U.S. scientists must demonstrate that their research is "specifically related to Cuba...and there is a substantial likelihood of public dissemination of the product." To do so, says MacPhee, scientists "are going to have to show that they've made contacts with Cuban counterparts." The problem, he says, is that "the communications are so incredibly lousy in Cuba that it can take years to set up" a collaboration.

One group that has already spoken up against the change is the Inter-American Dialogue (IAD), a high-powered think-tank chaired by Javier Pérez de Cuéllar of Peru, former Secretary General of the United Nations, and Peter Bell, president of the Edna McConnell Clark Foundation. Following a meeting earlier this month of U.S. and Cuban scientists, the group urged the U.S. government to rescind the new rule, declaring that "the new regulations threaten to interrupt the limited though important cooperation between U.S. and Cuban scientists."

Scientists are hoping to persuade officials at the State Department to relax the policy that led the Treasury to issue the new rule. If they are unable to make their case, predicts Smith, "one of the casualties of the diplomatic crisis of the last several weeks is going to be scientific cooperation."

–Richard Stone