

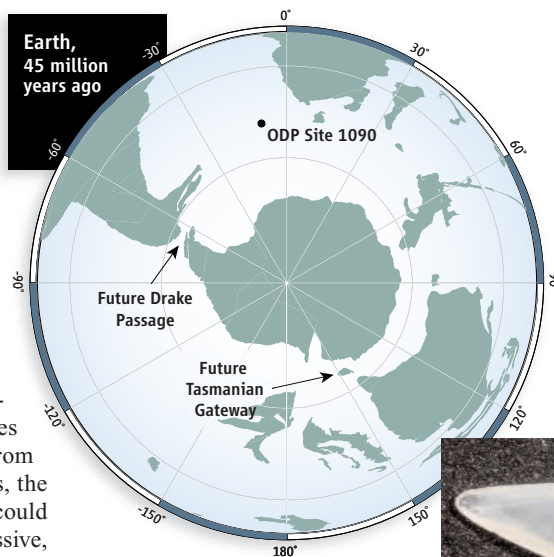
## GEOPHYSICS

## Opening the Door to a Chilly New Climate Regime

Earth's early Eocene epoch 50 million years ago was a paradise for warmth-loving life. Back then, alligators basked in the high Arctic on Canada's Ellesmere Island. Today, for better or worse, they cannot venture farther north than the U.S. Deep South. Why did the planet cool so much?

Many paleoclimatologists suspect at least part of the answer lies in the way the supercontinent Gondwanaland fell apart. As the fragments that became South America and Antarctica dispersed, they opened the way for a climate-making ocean current that now encircles Antarctica. By cutting Antarctica off from warm currents flowing from the tropics, the Arctic Circumferential Current (ACC) could have helped bring on the continent's massive, permanent glaciation, with worldwide consequences. On page 428, paleoceanographers report new evidence that the oceanic Drake Passage between the two continents began opening—and changing climate—twice as long ago as once thought.

Paleoceanographers Howie D. Scher of the University of Rochester in New York and Ellen Martin of the University of Florida, Gainesville, found the clues in fossil fish teeth recovered from sediment cores from the far South Atlantic Ocean. Fish teeth, researchers have shown, absorb the rare-earth element neodymium from seawater shortly after they settle to the bottom. But the proportion of two neodymium isotopes in Pacific seawater differs from that in Atlantic



**Locked tight.** Analyses of fossil fish teeth (right) show that Drake Passage began opening 41 million years ago.



seawater, because rivers carry differing isotopic ratios from the rock surrounding the two ocean basins. A varying isotopic ratio in the Atlantic is a sign that Pacific water has managed to mix into the Atlantic.

Some marine geologists, judging the size of the growing gateway by the crustal record of drifting continents, have argued that Drake Passage did not reach its modern depth and breadth until 20 million years ago. That's the earliest that the ponderous, wind-

driven ACC could have first encircled the continent, they say.

Scher and Martin, however, found isotopic traces of Pacific water leaking through Drake Passage beginning about 41 million years ago. That was the time of a short-lived glacial advance that other paleoceanographers recently discovered, they note. Flow surged again at the time of the first substantial, long-lasting glaciation of Antarctica, 34 million years ago. That step, the researchers say, could have resulted from the simultaneous opening of the Tasmanian Gateway upstream. Opening that gateway would have allowed

more water into the already-deepening Drake Passage and then the Atlantic.

Paleoceanographer James Kennett of the University of California, Santa Barbara, who suggested the gateway-opening hypothesis of climate change 30 years ago, says the early opening in the neodymium record doesn't really contradict the late opening in the crustal record. "I'd prefer to read the [neodymium] record as a more gradual increase in Pacific waters into the Atlantic," he says. "Everything's progressive; it doesn't all happen at once." Twenty million years or more may well have been required to crank up a full-blown ACC, he says, and to help usher in the global chill felt of late. —RICHARD A. KERR

## SOUTHEAST ASIA

## Thai Scientists Secure Royally Inspired Windfall

**BANGKOK**—Thailand's king already enjoys wide popularity among his subjects, but now Thai scientists have an extra incentive to pay homage. To mark the 60th anniversary in June of the reign of Bhumibol Adulyadej, the world's longest serving head of state, the Thai government is launching a \$500 million, 10-year effort to invigorate Thailand's scientific community by training thousands of researchers and funding hundreds of international collaborations.

The jubilee initiative is not expected to transform Thailand into a global scientific powerhouse. But in a region that has largely paid short shrift to R&D, the "Strategic Research Consortiums" project, if fully implemented, could seed the growth of top-notch research groups and serve as a beacon for other Southeast Asian nations. "What we need most is to form a critical mass of scientists," says biochemist Wanchai De-Eknamkul, adviser to

the secretary general of Thailand's Commission on Higher Education.

The pulse of Thai science is weak. In many Asian countries, roughly half of university degrees are awarded in science and engineering, UNESCO reported last year; in Thailand the proportion is just 26%. Less than one in four Thai university faculty members have Ph.D.s. According to the U.S. National Science Foundation's *Science and Engineering Indicators 2006*, Thai researchers published just 1072 articles in citation-indexed journals in 2003—a long way behind its near neighbor Singapore, with 3122. Like oases in the desert, eight Thai universities claim nearly 90% of the country's output. "It's a terrible imbalance," Wanchai says.

Hoping to boost scientific fertility, the higher education commission has laid out 20 strategic research areas, from emerging diseases and basic

physics to high-throughput drug screening and Thai specialties such as silk production. Teams will compete for funds; those with international links will have an edge. The 2006 budget, \$15 million, will jump to \$50 million in 2007. The commission has set ambitious goals. In the next decade, it expects awardees to train 9600 Ph.D.s, hire 2800 academic staff, form 700 international consortia, and establish 60 centers of excellence at Thai universities.

Strengthening Thai science would no doubt please King Bhumibol, who studied science at the University of Lausanne, Switzerland, before ascending to the throne in 1946. During his reign, he has taken a keen interest in agricultural research, setting up six experimental stations throughout the country. Now, the jubilee funds will give Thai researchers a chance to show that the king isn't the only person here with a yen for cutting-edge science. —RICHARD STONE