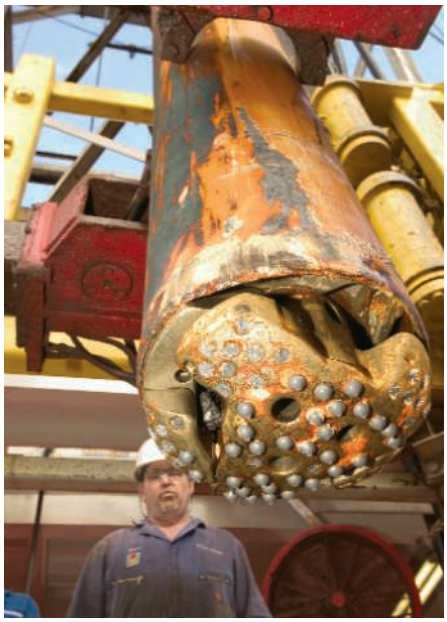
MARINE GEOLOGY

Pursued for 40 Years, the Moho Evades Ocean Drillers Once Again

Hopes were running high early last month that geophysicists had finally come within striking distance of a decades-old goal. Drillers aboard the *JOIDES Resolution* in the mid–North Atlantic were making steady progress down through hundreds of meters of rocky ocean crust toward the legendary Mohorovičić discontinuity, or simply the Moho, the boundary between the thin veneer of Earth's crust and the 2900-kilometer-thick mantle.

But as drilling proceeded with unparalleled ease through 700 meters of crust, then 1000 meters, and even 1400 meters, the Moho was a no-show. Seismic probing had put it at a depth of 1 kilometer or less just off the Mid-Atlantic Ridge, but drilling cores never showed any sign of the predicted fresh mantle rock. It seems Earth is more complicated than the best geophysical tools had suggested, says Jay Miller, the onboard project manager during the 4 months of drilling. But he and colleagues are still game to return to the hunt.



No (drilling) problem. Despite trouble-free drilling aided by new technology, the crust-mantle boundary remains beyond reach.

CREDIT (LEFT): IODP-TAMU

Ambitions of reaching the Moho drove the first scientific deep-sea drilling effort, Project Mohole, in the early 1960s. Funded by the U.S. National Science Foundation (NSF), oceanographers eventually tested a system for drilling to the Moho where it is closest to the surface, in the deep sea. Croatian geophysicist Andrija Mohorovičić (1857–1936) had found that seismic waves moved faster below a depth of about 35 kilometers beneath the European continent than they did above, presumably reflecting the iron-rich mineralogy of mantle rock. But beneath the oceans, where the crust is thinner, the Moho lies less than 10 kilometers beneath unsedimented sea, Mohole researchers pointed out. That might put the mantle—the sole source of the magmas that form the crust—within reach of drilling.

Project Mohole ended in a bureaucratic and fiscal fiasco, but by the late 1960s, NSF had launched a broadly based ocean drilling program that continues in the international Integrated Ocean Drilling Program (IODP) (*Science*, 18 April 2003, p. 410). Since Mohole, oceanographers looking to reach the deep crust or the Moho have taken their drills to places where the crust is particularly thin. One such thin spot lies at the intersection of the Mid-Atlantic Ridge—where new crust forms—and the Atlantis Fracture Zone at about 30°N. The stress and strain of moving tectonic plates has sliced through the upper ocean crust and dragged it off to expose the lower crust.

Seismometers placed on the sea floor above the thinned spot picked up waves from explosive charges set off near the ocean bottom. The waves sped up to mantlelike velocities whenever they passed much below a depth of 700 meters. "My interpretation was they would reach fresh [mantle rock], certainly by a kilometer," says seismologist John Collins of the Woods Hole Oceanographic Institution in Massachusetts (WHOI).

After running through a dozen drill bits in 54 days of drilling through 1415 meters of solid rock, however, scientists onboard *Resolution* had recovered nothing that looked like the underlying mantle. "I'm surprised," says Collins. Possibly, he says, his vertical, two-dimensional seismic picture missed an unexpected deepening of the Moho off to one side: "Perhaps they were unfortunate in where they drilled." WHOI colleague and seismologist Robert Detrick adds that identifying deep rock "is a hard call to make based on seismic velocity alone." Rocks of different compositions can have the same seismic velocity, he notes: "It's a problem that plagues seismology."

Undaunted, oceanographers are ready to try again. The latest drilling shows that "we now have the technology to deliver deep holes," says Miller, who is with IODP at Texas A&M University in College Station. For that matter, the new hole "is just sitting there waiting" to be reentered.

–RICHARD A. KERR

ScienceScope

Forgiving Science Majors

The chair of a House spending panel that oversees several U.S. civilian science agencies says he wants to do something "dramatic" to attract more students into science, math, and engineering.

Last week Representative Frank Wolf (R–VA) won endorsements from presidential science adviser John Marburger and National Science Foundation Director Arden Bement, both new to his panel's jurisdiction, for a bill he's drafting. It would forgive interest on college loans for students earning science-related majors and working for 3 years in the field until their salaries exceeded four times the median U.S. income ($32,000). Borrowing an idea from former House Speaker Newt Gingrich, Wolf said he's looking for ways to reverse the one-way flow of students from engineering to political science or business. "I think it's the right kind of program," said Marburger, calling it a "creative idea." Bement went even further: "I've read Newt's book, and I liked it."

–JEFFREY MERVIS

New Threat to Station Science

An effort to reduce the number of shuttle flights needed to build the international space station could be bad news for researchers. A possible cut from 28 to as few as 15 flights could jeopardize the centrifuge, now being built in Japan and designed to provide important animal data about variable gravity on places such as the moon and Mars. Other animal research facilities also might get the ax, although players on Capitol Hill are gearing up to protect station science.

NASA spokesperson J. D. Harrington says the new science plan will be released next month. In the meantime, he says, "we're assessing all science needs to see if they are aligned with the exploration objectives" set out by President George W. Bush in January 2004. The shuttle is due to resume flying in May after a more than 2-year hiatus following the Columbia tragedy.

–ANDREW LAWLER

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