

Getting to the bottom of the crust

An international team of scientists has successfully drilled and sampled rocks from the deepest layer of the crust that forms the floor of the world's oceans. In the past this layer, normally covered by 2 kilometers of upper crust, had escaped the reach of even the longest drillhole in the ocean. But during a three-month cruise in the Indian Ocean that ended in December, researchers on Leg 118 of the Ocean Drilling Project (ODP) found a way of bypassing the upper crust.

The scientists found a site along what is called the Atlantis II Fracture Zone, where the lower crust is uncovered. They cored 500 meters of the basement rock and recovered more than 87 percent of the rock, one of the highest rates ever achieved in hard-rock drilling, says Richard P. Von Herzen from the Woods Hole (Mass.) Oceanographic Institute and co-chief of this leg of the project.

The Atlantis II Fracture Zone is part of the midocean ridge that is the boundary between the African and Antarctic plates. Running down the center of this ridge is a feature called a spreading center, so named because it periodically breaks apart, leaving a gap that becomes filled with molten rock from the earth's mantle. As it hardens in place, this rock forms new oceanic crust that joins to the ends of the plates. In this fashion, the plates slowly move away from each other at a rate of a few centimeters a year.

Resembling the steps in a staircase, spreading centers are all short, straight segments roughly parallel to each other. Fracture zones are valleys that connect the adjacent segments, and are comparable to the vertical jumps between the steps.

When the ODP scientists drilled into a level spot on the wall of the fracture zone valley, they found coarsely crystalline rocks called gabbros, which are known to make up the lower segment of the crust. By analyzing the transitions between different minerals in the gabbros and the changes in the crystalline structure, geologists will be able to reconstruct the evolution of the lower crust, says Henry J. B. Dick of Woods Hole, a member of Leg 118. Moreover, the samples will help scientists understand how fracture zones develop and will allow them to take a closer look at the fine-scale processes involved in seafloor spreading.

Last time I looked, north was that way

When volcanic rocks cool, the direction of the earth's ever-shifting magnetic field at that moment becomes frozen into the rocks' atomic structure. Geophysicists have long used this leftover magnetization, called thermoremanent magnetization (TRM), as a tool to trace changes in the earth's magnetic field and as a yardstick to measure the drift of the continents. But recent basic tests of TRM are throwing a wrench into the geophysicists' toolbox.

Joyce Castro and Laurie Brown of the University of Massachusetts at Amherst had originally set out to test the theory behind TRM by measuring the remanent magnetizations in Hawaiian lava flows from 1950 and 1972 and comparing those to the direction of the present magnetic field in Hawaii. Because scientists believe the field changes slowly, Castro and Brown expected all the directions to match within a degree or two. But the lavas turned out to be skewed by as much as 6 degrees, they report in the December *GEOPHYSICAL RESEARCH LETTERS*.

The researchers have yet to pin down the cause of this discrepancy. Some scientists have theorized that the shape of lava flows may affect the TRM, but this phenomenon would only account for a difference of a few degrees, says Brown. One possibility, she says, is that the field has changed rather quickly. To test this possible explanation and others, the researchers next plan to measure the TRM of lava within days of its eruption.

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EPA report irks environmentalists

An Environmental Protection Agency (EPA) report recommending that oil and gas companies remain exempt from strict federal hazardous-waste controls is drawing criticism from environmental groups. The report, which is now open to public comment, was submitted to Congress Dec. 29, more than five years after it was originally due. It was commissioned by Congress in 1980, to determine whether oil and gas drilling wastes — water, mud and brine contaminated with petroleum products and heavy metals — should be regulated as hazardous wastes under the federal Resource Conservation and Recovery Act (RCRA). The wastes have been temporarily exempt from the act while Congress awaited completion of the report.

The report notes that "Documented damages suggest that all major types of [oil and gas industry] wastes and waste management practices have been associated to some degree with endangerment of human health and damage to the environment." It also finds that states have largely failed to enforce existing laws designed to regulate the disposal of petroleum wastes. Nevertheless, it concludes, the wastes should continue to be exempt from existing federal regulations, in part because enforcement would pose a "substantial financial burden" on oil and gas companies and consumers.

"The EPA themselves say that the lack of state enforcement is the main problem," says Jane Bloom, an attorney with the Natural Resources Defense Council in New York City. "They nonetheless argue that the status quo should be maintained and that the federal government should stay out of it."

More than 20 billion barrels of petroleum wastes were produced in the United States in 1985, according to the report. The most common waste by far is "produced water," which is generated from oil and gas wells during production. It contains such poisons as benzene, lead and arsenic.

Under existing state laws, industries may discharge controlled amounts of produced water into surface water, a practice the EPA concedes "may be damaging to aquatic communities." In addition, they may discharge it into large pits or into various types of wells. The report notes that many of these pits and wells are not designed to adequately protect nearby drinking-water supplies.

For years, oil companies in Alaska have discharged produced water into pits, allowed it to settle, and then spread it on ecologically sensitive tundra or sprayed it on roads as a dust suppressant. The EPA notes that such practices are "of concern" to EPA and others. However, the report concludes, it is still not clear "whether or not there are adverse environmental impacts resulting from this practice."

The report concludes that subjecting oil and gas wastes to the RCRA regulations governing other hazardous wastes is "unnecessary and impractical." It says such controls could discourage U.S. oil production, shrinking it by as much as 12 percent, and could boost consumer costs as much as \$4.5 billion per year. Instead, the report says, states should improve enforcement of existing standards.

Such conclusions, says attorney Bloom, "simply reflect successful lobbying by the oil and gas industry. The report never even bothered to determine which of the wastes were hazardous." In addition, she says, the EPA report relies largely on figures provided by the American Petroleum Institute (API), an oil-industry lobbying group. "Congress asked EPA, not API, to prepare the report," she said in earlier, written comments. "The extensive inclusion of API-generated information fatally undermines the credibility of EPA's effort."

The report says API estimates were used because information on oil and gas waste "is not routinely collected nationwide," adding that API figures were subjected to "careful review."

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