Earth Science

Spring-loaded corridor connects oceans

Like desert oases, seafloor hot springs support a rich community of animals that could not survive in the otherwise barren depths. Many hot-spring animals in the Pacific Ocean have distant kin in the Atlantic, and researchers have wondered how they got from one side of the world to the other.

A new undersea survey has turned up springs that could act as stepping stones between the two oceans. A team led by Christopher R. German of the Southampton Oceanography Centre in England found the new springs along a ridge in the western Indian Ocean off Madagascar.

This southwest Indian ridge—the only line of hot springs linking the Atlantic and Pacific—could be a corridor for creatures hopping spring to spring, from one ocean to the other, says marine biologist Verena Tunnicliffe of the University of Victoria in British Columbia. She has argued that creatures in the Pacific Ocean might have reached the springs in the younger Atlantic by traveling along ridges, cracks from which magma billows to form new crust. Until now, the Indian Ocean ridge seemed to bear too few springs to make the journey possible.

Hot springs are scarce along ridges that grow slowly, according to German's team, and the southwest Indian ridge is one of the slowest-growing on Earth. The scientists set sail last year expecting to find no more than one murky plume every 200 to 300 kilometers. Instead, they found six plumes at 100-km intervals, they report in the Oct. 1 NATURE.

For geologists, the unexpected springs mean the Indian Ocean may add more heat and chemicals to the global supply than previously thought, says Edward T. Baker of the National Oceanic and Atmospheric Administration's Pacific Marine Environmental Laboratory in Seattle and a coauthor of the report.

For biologists, these springs indicate that unknown animals thriving there may be an elusive evolutionary link. "The next step is to see what's down there," Tunnicliffe says. —*S.S.*

Revived cable sparks seafloor research

A lifeless telephone cable reincarnated as a thousand-mile-long extension cord now connects land-based scientists to experiments at the bottom of the Pacific Ocean.

In mid-September, Alan D. Chave of the Woods Hole (Mass.) Oceanographic Institution and his shipboard colleagues enlisted the help of an underwater robot to splice a giant eight-plug adapter into the twisted coil of telephone wire that once linked Hawaii and California. Made obsolete by the greater call capacity of fiber optic lines, the 34-year-old cable now buzzes 300 watts of electricity from Oahu to a seismometer and an underwater microphone, two of the first instruments plugged into what's known as the Hawaii-2 Observatory.

The hardy, titanium instruments, built to survive under 5,000 meters of saltwater, listen for hints of earthquakes and tsunamis. The cable's two-way signal allows scientists to talk to their instruments from land and receive data around-the-clock. With plugs for six more instruments, this is the first permanent undersea observatory where instruments can be retrieved. Japanese technicians, who were the first to power seafloor observatories from land, don't have this luxury. "They just hardwired seismometers into a cable," Chave says.

The Hawaii-2 Observatory also patches a wide gap in the global network of seismic stations, says seismologist Barbara Romanowicz of the University of California, Berkeley, who heads an international group working to coordinate the installation of more seafloor seismic stations.

Like determining what's behind a dark curtain by looking through a set of pinholes, pinpointing earthquakes depends on stations being evenly distributed around the world. "The more pinholes you have, the better you can piece together the whole picture," Chave says. —*S.S.*

Physics

Brighter bulbs light up cell innards

Biologists spying on the inner workings of cells often attach tiny fluorescent beacons to molecules to track their movements under laser light. The organic dyes used for that purpose, however, typically dim in minutes. Their quick demise frustrates attempts to follow longer-lasting phenomena.

Now, two research groups report fabricating an improved type of cellular lightbulb from clusters of semiconductor atoms known as quantum dots. Quantum dots are remarkable because they confine electrons to an unusually small volume, giving them special light-emitting properties (SN: 11/23/96, p. 327). Researchers at Indiana University in Bloomington say their dots glow 20 times brighter and 100 times longer than dye molecules.

"This is a new class of labels that could replace the organic dyes," says Indiana's Shuming Nie.

The Indiana group and, independently, a team at Lawrence Berkeley (Calif.) National Laboratory report in the Sept. 25 SCIENCE using quantum dots to illuminate molecules in cells.

Electrons in fluorescent materials absorb energy from light and rerelease it as photons of a particular color. Nie explains that quantum dots blaze brighter because, though small, they are much bigger than dye molecules.

At up to 6 nanometers across, the dots can have 200 times the volume of the dye molecules, which are typically less than a nanometer across. Consequently, the dots can absorb more light and, in turn, emit a stronger glow when excited. A protective coating extends their brilliant careers.

Because varying the size of dots forces the electrons in them to absorb and reemit light of different wavelengths, researchers have found they can choose a dot's color by controlling its size. —*P.W.*

Crystal bends light hard, saves space

For air travelers who can't fly direct, landing and transferring to another jet can eat up a lot of the speed advantage of planes. Similarly, telecommunications currently bog down at switching hubs, where optical signals must shunt briefly to less efficient, electronic routing equipment.

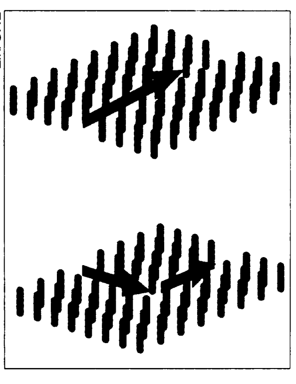
To eliminate the bottleneck, researchers are striving to develop miniaturized, all-optical switching circuits. "To do this, light is going to have to go around sharp corners," says John D. Joannopoulos of the Massachusetts Institute of Technology (MIT).

Current waveguides require roughly a millimeter of turning radius to bend the 1.5-micron-wavelength light used in telecommunications by 90 degrees.

In the Oct. 9 SCIENCE, Shawn-Yu Lin of Sandia National Laboratories (SNL) in Albuquerque, N.M., and Joannopoulos and other MIT researchers describe bending millimeter-wavelength light through a right angle in just one wavelength. They expect the turning radius to remain one wavelength for shorter-wavelength light, saving considerable "real estate," they say.

The researchers accomplished their feat with a photonic crystal (SN: 11/16/96, p. 309)—a compact, orderly array of alumina posts, each about a millimeter apart, in which light travels only where lines of posts have been removed. Already built, they say, are much smaller crystals to be tested at the 1.5-micron wavelength —*P.W.*

Lin/SNL



A missing row of posts in a photonic crystal (top) guides light straight through. When posts are removed to form a right-angle bend (bottom), almost all of the light also makes the turn.