Earth Science

Oddball quake in Costa Rica

At first glance, the seismic shock that ravaged parts of Costa Rica and Panama last month appears misplaced. Major earthquakes in Central America usually occur along the Pacific coast or in the volcanic highlands, says James Dewey of the National Earthquake Information Center (NEIC) in Golden, Colo. But the magnitude 7.6 quake on April 22 hit neither of these regions, striking instead on the eastern side of Costa Rica.

Geophysicists believe the Pacific coast most often spawns intense shocks because it is here that a piece of the ocean floor, the Cocos plate, crashes into and dives underneath Central America. This disappearing act — called subduction — also feeds the chain of volcanoes running like a twisted spine between North America and its southern sister. The puzzling April earthquake, however, occurred far from the subduction zone, apparently ruling out a direct connection, says Bruce Presgrave of NEIC.

An explanation for this seismic conundrum may lie under the waves of the Pacific ocean along a plateau called the Cocos Ridge. Sitting on the Cocos plate, the raised region is being jammed down into the subduction zone. Yet the ridge appears unwilling to plunge underneath central America, Dewey says. That reluctant subduction, he suggests, may generate stress over an unusually broad region extending to Costa Rica's Caribbean coast, where the recent quake occurred. Records indicate that a similarly sized quake may have struck the same location in 1913. The recent temblor killed 80 people and left almost 70,000 persons homeless, according to NEIC.

Dewey cautions that scientists lack important information about the quake at this time, making it difficult to pin down an explanation. A clearer picture should emerge in the next few months as data arrive from seismic stations around the world.

Clouds keep ocean temperatures down

Wispy cirrus clouds high in the sky's frozen reaches seem insubstantial to the eye, but these collections of ice particles act like a thermostat that keeps temperatures in the Pacific ocean from reaching into the red zone, according to two atmospheric researchers.

In most parts of the globe, the ocean surface does not warm above roughly 31°C, and scientists have long sought to understand what process sets that limit. Looking for an answer, V. Ramanathan and William Collins of the Scripps Institution of Oceanography in La Jolla, Calif. began studying the El Niño phenomenon, a natural warming in the tropical Pacific ocean that occurs every two to six years. Focusing on an El Niño in 1987, the researchers compared measurements of sea surface temperatures with satellite observations of energy entering and exiting Earth's atmosphere. In the May 2 NATURE, they describe a complex series of changes that — for the present — cap the Pacific's temperature.

When the ocean surface warms at the start of the El Niño, evaporation increases, causing the atmosphere's water-vapor content to rise dramatically. The extra vapor strengthens Earth's greenhouse effect, causing ocean surface temperatures to climb even more. If allowed to continue, the researchers say, this self-perpetuating "super greenhouse" could dramatically warm the ocean surface. Ramanathan and Collins find, however, that the additional water vapor and increased convection create massive cirrus clouds that block sunlight and shut down the Pacific super greenhouse.

The new-found cirrus effect could play an important role in the future as greenhouse-gas pollution warms the planet. But because so many interacting elements weave together in the climate system, scientists cannot tell whether such clouds will weaken or boost the warming, says Andrew J. Heymsfield of the National Center for Atmospheric Research in Boulder, Colo.

Physical Science

Ivars Peterson reports from Baltimore at an Acoustical Society of America meeting

Sounding out burning snowballs

Measurements of sound waves traveling through seafloor sediments are gradually enabling researchers to determine the distribution of a peculiar substance known as methane hydrate, which consists largely of high concentrations of methane gas trapped, or dissolved, in ice. Found in deep-sea sediments throughout the world, this material contains so much methane that a flame can readily ignite a chunk brought to the surface.

Researchers are interested in methane hydrate because it poses a potential hazard when drilling for and extracting petroleum — especially as oil exploration heads for deeper waters. For example, hot liquid brought up from great depths could melt the hydrate, destabilizing the platform used to produce the petroleum.

If released to the atmosphere, these stores of methane could also contribute to global warming. At the same time, the deposits may represent a possible source of energy. Recent acoustic measurements indicate that one area off the coast of South Carolina — roughly the size of the state of Maryland — may contain enough methane to supply the United States for 350 years at its present rate of consumption.

"We need to find out where it is and how much there is, and about the only way we have access to this substance right now is through acoustic measurements," says oceanographer Aubrey L. Anderson of Texas A&M University in College Station. "Very few samples have been taken." But interpreting acoustic signals from the seabed remains an inexact science. Anderson chaired a special workshop devoted to a general discussion of how to improve field measurements of "gassy" seafloor sediments.

Recipe for acoustic transparency

A sheet of aluminum immersed in water normally acts as a good reflector of sound waves. But Pieter S. Dubbelday and Forrest M. Eggleston of the Naval Research Laboratory in Orlando, Fla. have developed an aluminum-based material that is practically transparent to sound. This novel composite, which consists of porous aluminum impregnated with polyurethane, has roughly the same density as water. Moreover, sound waves travel through this material at nearly the speed of sound in water.

Researchers are now studying how different combinations of polyurethane and foamed aluminum — characterized by various pore sizes — produce composites with different degrees of transparency. Although unsuitable for use as the skin of a sonar-evading submarine, this "alumer" composite may prove useful as an acoustically transparent backing plate that supports but doesn't interfere with, say, an underwater microphone.

Wine glasses and ringing bells

Any dinner guest who has playfully rubbed a moist finger along the rim of a wine glass to make it "sing" has probably experienced the ethereal sound of vibrating glass. Such sounds also emanate from musical instruments known as glass harmonicas, which generally consist of arrays of wine glasses tuned to produce different notes. Much less familiar are the details of how these glasses vibrate to produce their tones.

To find out, physicist Thomas D. Rossing of Northern Illinois University in DeKalb brought a number of brandy snifters and wine glasses into the laboratory. Using a technique known as holographic interferometry, he produced images, which resemble contour maps, indicating the amount of motion at each point on a given glass. "It sings like a bell," Rossing concludes. As it vibrates, the glass rim repeatedly changes its shape from a circle to an ellipse, displaying a mode of vibration similar to that of a large church bell.