Earth Science

Rubber ducky armada crosses Pacific

The accident befits an oceanographer's dream. During a severe storm on Jan. 10, 1992, 11 huge steel containers fell off a cargo vessel near the international date line. One of the containers burst open, spilling 29,000 plastic bath toys into the middle of the Pacific Ocean. Ten months later, hundreds of brightly colored ducks, frogs, turtles, and beavers started showing up along the shores of southeastern Alaska, providing an unusual but important record of winds and currents in the northeast Pacific.

During typical oceanographic experiments, researchers release only a few hundred to a thousand bottles, of which they usually recover a dozen or two.

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Oceanographers Curtis C. Ebbesmeyer of Evans-Hamilton and W. James Ingraham Jr. of the National Marine Fisheries Service in Seattle used a computer model of ocean circulation to study the bath toys' path, which they describe in the Sept. 13 Eos. The two researchers previously studied the fate of 61,000 Nike sneakers that fell overboard in 1991, not far from the path taken by the toys (SN: 9/19/92, p.189).

The computer model, along with other information, suggests that some of the bath toys will float into the Arctic Sea and end up riding past Greenland into the Atlantic, Ebbesmeyer says.

Icy tales of ancient eruptions

The ice age was a depressing event, geologically speaking. A carpet of ice more than a mile thick weighed down Earth's crust in much of North America and Europe and in parts of Asia. Geologists in the past speculated that the melting of such ice at the end of the glacial epoch could have stimulated volcanic eruptions by unweighting the crust. That theory has now gained support from researchers who read a record of past eruptions stored deep within the Greenland ice cap.

U.S. scientists spent five summers drilling in the center of Greenland to collect information about how climate has changed in the last 100,000 years or more (SN: 9/14/91, p.168). As part of the Greenland Ice Sheet Project II (GISP 2), Gregory Zielinski of the University of New Hampshire in Durham and his colleagues analyzed sulfate ions deposited in the ice in the years following large volcanic eruptions.

At a meeting of the GISP 2 participants last month, Zielinski reported that the period following the ice age had three times as many eruptions as the last two millennia. The early eruptions were also much larger than most modern ones. "This could be crustal adjusting to the unloading of ice, almost like uncorking a bottle," says Zielinski, who described the volcanic record for the last 9,000 years in the May 13 Science.

Looking even further back in time, the ice core team has discovered evidence of a monstrous eruption 68,000 to 75,000 years ago. While most volcanic sulfate layers in the GISP 2 core span only a year or two, this ancient one extends over many years, indicating that debris from this eruption filled the skies for an unusually long time. From the date of the ice layers, Zielinski believes that the prominent sulfate deposit records a well-known eruption of Toba on the Indonesian island of Sumatra. The Toba blast occurred close to the start of the last ice age, prompting some scientists to speculate that it may have helped push Earth's climate into a deep freeze.

Earthquakes: From bubbles born

As any resident of California knows, earthquakes breed more quakes. Following a large jolt, smaller but nonetheless unnerving shocks continue to rattle the region for months, even years. Normally, these aftershocks occur close to the main shock's epicenter. But the 1992 Landers earthquake in the Mojave Desert surprised seismologists by triggering small aftershocks all across the West, from northern California to Nevada, Utah, and even Yellowstone National Park, some 1,200 kilometers away. A team of researchers now suggests that subsurface gas bubbles may have caused such far-flung jitters.

Most aftershocks occur because the main shock increases stress on certain faults in its neighborhood. But this mechanism could not account for the long-distance Landers aftershocks. Instead, seismologists suspect the explanation involves some volcanic element because all of the remote aftershocks occurred in regions that had previously erupted.

More clues to the puzzle came from detailed measurements made at the Long Valley caldera, a giant volcanic crater in the Sierra Nevada mountain range. The U.S. Geological Survey (USGS) installed instruments there in the 1980s because of the potential for a future eruption. According to readings made in the area, the caldera showed many different reactions to the Landers earthquake aside from producing aftershocks. At the same time, the surface of Long Valley tilted, and instruments showed the rock being squashed.

Alan T. Linde of the Carnegie Institution of Washington (D.C.) and his colleagues report in the Sept. 29 Nature that bubbles in subsurface volcanic chambers could explain the Long Valley readings. Molten rock, or magma, in these chambers normally contains small bubbles of gas that attach to the rock surface in the same way that bubbles in soda stick to the side of a glass. As seismic waves from the Landers main shock passed through the magma chamber, they could have shaken free the gas bubbles.

Once free, the bubbles would rise and attempt to expand, increasing pressure on the magma. That surge in pressure would be large enough to cause small earthquakes, as well as tilt the surface and compact the rock. The researchers suggest that this same mechanism could explain aftershocks that occurred at other sites after the Landers earthquake.

Fishing for faults in L.A.

In a turnabout, geophysicists who normally monitor earthquakes will create some tremors of their own in Los Angeles this month. By probing the ground with small blasts, scientists hope to map the hidden faults that underlie the Los Angeles Basin.

The USGS and the Southern California Earthquake Center project will thump the ground along three lines that run primarily offshore to the south and west of Los Angeles. Using an air gun towed behind a ship, the team of geophysicists will shoot vibrations into the crust and monitor the waves reflected off subsurface faults. On land, small chemical explosions will create seismic waves imperceptible to Los Angeles residents. Hundreds of seismographs will record the waves that bounce up toward the surface.

USGS scientists reported in the Sept. 2 Science that a similar experiment in San Francisco in 1991 detected a horizontal fault connecting the San Andreas fault and others in the region.

In the Los Angeles project, researchers will seek to determine the most likely sites for damaging earthquakes and where the ground will shake the hardest. They hope to locate the same sort of hidden faults that produced the Jan. 17 Northridge earthquake.