Hawaii's Next Island Suffers Setback

The underwater volcano growing off Hawaii's south coastline collapsed partially during the summer, according to a team of oceanographers scouting the shattered peak from a deep-sea submersible. The cave-in has provided scientists with an unprecedented glimpse into the often tumultuous process that gradually builds up volcanic islands from the ocean floor.

Called Loihi, the submerged mountain is "essentially an island in the womb," says Alexander Malahoff, an oceanographer at the University of Hawaii in Honolulu and a leader of the submersible expedition, which continues through Oct. 12. "It gives us needed access to see how the Hawaiian Islands, the Marshall Islands, Tahiti, or any of the islands in the ocean form. This is the only time we have been able to see one forming in real life."

Situated 17 miles off the coast of the island of Hawaii, Loihi rises from a base located 18,000 feet—more than 3 miles—below sea level to a broad peak at a depth of 3,000 feet. Malahoff estimates it will take another 50,000 years of growth before the summit breaks the waves.

Hawaiian scientists first detected signs of unusual activity at Loihi in mid-July, when a swarm of small earthquakes started to shake the offshore mountain. Over the next 3 weeks, Loihi trembled with more than 5,000 quakes, 100 of which reached magnitude 4 and one of which attained magnitude 5, says Paul Okubo, a seismologist with the U.S. Geological Survey at the Hawaiian Volcano Observatory on Hawaii.

"This is possibly the largest quake swarm to have been recorded on the volcanoes here in Hawaii," Okubo says.

Malahoff and his colleagues first tried to dive to Loihi in August, but they found the water too turbulent. When they returned in late September, the scientists attempted to visit Loihi's peak, a region named Pele's Vents for its superheated geysers surrounded by a rich community of microorganisms. What they found in its place was a new crater.

"This large hole, three-quarters of a mile in diameter, didn't exist before. Instead, it had been a large hill measuring 1,000 feet high," says Malahoff.

The submersible descended along the vertical walls of the crater, past giant obelisk-shaped rocks ready to break away from the cliff face. During one dive, the researchers had to retreat quickly to the center of the crater when they heard the rumble of tumbling rocks.

At the bottom of the crater, they found thriving colonies of bacteria that had taken up residence in the brand-new landscape. Microbial slime in orange and red hues draped over the rock surface, while lettucelike sheets of bacteria fluttered in the currents from the hot water.

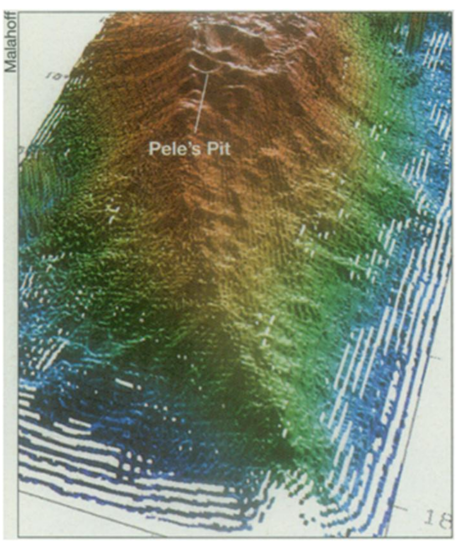
The scientists believe that the collapse took place when lava erupted from deep fractures near the base of Loihi in July. The release of molten rock drained magma from within the mountain, causing the peak to deflate.

Such a giant cave-in should have triggered a large wave, or tsunami, that might have damaged coastal sites in the Hawaiian Islands. But no tsunami developed, suggesting that the collapse occurred over several days instead of instantaneously, says Malahoff.

In the future, Hawaiians may not escape so painlessly. The seafloor around Loihi and the other Hawaiian volcanoes is littered with debris from immense prehistoric landslides, one of which produced waves more than 1,000 feet high (SN: 4/8/95, p. 216).

To monitor geologic unrest on Loihi, Malahoff and his colleagues plan to place seismometers and chemical sensors on a stable section of the summit and connect them to the island of Hawaii via fiber-optic cable. *— R. Monastersky*

Malahoff



A cave-in on Loihi turned its highest peak into a crater, called Pele's Pit. Two other large craters mark the summit.

Turning on a femtosecond X-ray strobe

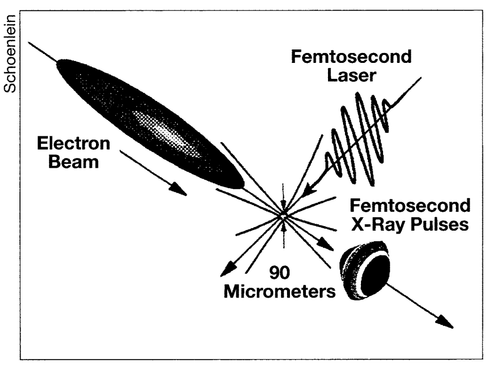
Conventional X-ray imaging can capture the pocket of decay extending into a tooth or the fractured bone in an injured leg. X rays that penetrate crystals can also reveal details of internal structure.

Now, researchers have access to a new type of X-ray source that flashes in strobe-like pulses lasting only 300 femtoseconds. Such ultrashort pulses open up the possibility of tracking rapid changes in the atomic and molecular structures of materials and the progress of chemical reactions.

Robert W. Schoenlein of the Lawrence Berkeley (Calif.) National Laboratory and his colleagues describe their X-ray source in the Oct. 11 SCIENCE. "We've actually been able to observe and characterize the femtosecond X rays," Schoenlein says. "Right now, we're working on the first application."

The researchers generate X rays with a wavelength of 0.4 angstrom by sending a stream of pulsed infrared light from a powerful laser across a beam of tightly focused bunches of high-energy electrons. When an electron collides with an infrared photon at a 90° angle, it gives up some of its energy to the photon, which is converted to an X ray. These interactions produce a cone of X rays that fans out from the electron beam.

Schoenlein



An electron beam collides with a laser beam to generate ultrashort X-ray pulses.

Getting the experiment to work was no simple matter. "The trick is to collide a bullet of electrons with a bullet of light," Schoenlein says. "You've got two things that are moving at the speed of light or very close to it." Moreover, the bunches of electrons and photons are less than 100 micrometers wide and must meet within a time interval of only about 10 picoseconds.

At present, the LBNL team is using the source to study the scattering of X rays by atoms in a silicon crystal. The researchers plan to observe how a crystal lattice breaks apart as it melts.

— I. Peterson