SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY

Press Release

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Scientists Lose Instruments, Gain First Look at Seafloor Formation

THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY - Ordinarily, losing almost all of one's instruments would be considered a severe setback to any scientist. But when Maya Tolstoy, a marine geophysicist at the Lamont-Doherty Earth Observatory, a member of the Earth Institute at Columbia University, recently learned that two-thirds of the seismometers she placed on the floor of the Pacific Ocean were trapped more than 8,000 feet (2500 meters) underwater, it turned out to be an extremely good sign.

Tolstoy and Lamont-Doherty colleague Felix Waldhauser set an array of ocean bottom seismometers along a section of the East Pacific Rise off the coast of Mexico in 2003 to study the little-understood process of seafloor spreading—a process that is responsible for the formation of nearly three-quarters of the Earth's crust. When a team went back in April 2006 to retrieve the instruments, however, only four out of 12 responded to the coded release signal and bobbed to the surface; three more responded to the signal, but did not come up. The rest remained silent.

One of the ocean bottom seismometers trapped in fresh lava on the East Pacific Rise. The flag on top is used to help locate the device when it surfaces. Photo courtesy of Woods Hole Oceanographic Institution, National Science Foundation and Ridge 2000.

Tests of the water temperature and light-scattering near the sea floor revealed signs of a recent volcanic eruption. A second expedition, led by James Cowen of the School of Ocean and Earth Science and Technology (SOEST) at the University of Hawaii, on the research vessel R/V New Horizon in early May lowered a camera that confirmed what the scientists suspected: Their instruments had been directly on top of a section of the East Pacific Rise that erupted and were trapped in fresh lava flows.

Instead of bemoaning their fate, the group celebrated their fortune—no one has ever closely recorded the series of micro-earthquakes associated with the formation of new seafloor. Preliminary analysis of their data appears in an upcoming issue of the journal Science and was released on the Science Express Web site November 23.

"It's amazing that we know so little about something so fundamental to the planet," said Tolstoy. "Even if we don't get the rest of the instruments back we'll have learned quite a bit."

The East Pacific Rise is one of three active seafloor spreading centers targeted by the National Science Foundation's Ridge 2000 program to document the process of crustal formation as it is happening. Ridge 2000 was formed in 2001 as an interdisciplinary effort to study the geology, chemistry and biology of the poorly understood process by which the Earth's crust is formed.

"Discovering new lava so soon after a seafloor eruption is a unique opportunity," said Donna Blackman, current chair of the Ridge 2000 program. "It allows Ridge researchers a rare chance to see how geologic processes affect the deep-sea ecosystems that thrive near hydrothermal vents."

The first underwater eruption was not documented until 1990, even though many probably occur each year, and seismometers on land still cannot detect the many small, distant earthquakes that scientists believe precede a submarine eruption for many months. By comparison, earthquakes often occur only a few days or hours before a land-based volcanic eruption.

“Arguably the most important scientific aspect of the paper is the fact that Maya Tolstoy was able to predict the likely hood of this eruption on the basis of her previous couple of years worth of seismic data of the same type and from same location,” said Cowen. “"In other words, Tolstoy had anticipated this seafloor eruption, and seismic patterns similar to those observed in this exciting data set may be used to predict future eruptions!”

Tolstoy found that seismic activity at the site gradually built up for at least two years leading up to the brief, January 2006 eruption that entombed her instruments, raising the possibility that future eruptions may be forecast a year or more in advance.

"Our success emphasizes the importance of real-time monitoring on the seafloor so that next time we'll be collecting many different types of data the moment an eruption starts,” said Tolstoy. “That way we can really begin to understand this fundamental building block of our planet, from the mantle to the microbe."

Subsequent to the successful R/V New Horizon rapid response cruise, a follow-up expedition was mounted on board the R/V Atlantis with the manned submersible ALVIN, in order to collect some of these recently erupted volcanic samples. Geochemist Ken Rubin, also from SOEST, was one of the senior scientists on this cruise, and is now back in Hawaii analyzing the collected rock samples.

"We are working with various colleagues around the country to make this by far the best studied submarine eruption in history" says Rubin. Part of Rubin's role in the published and ongoing study has been to determine when the new lava flows erupted using the short-lived radioactive isotope 210Po. "The sea floor seismometers provided crucial information that an eruption occurred, but they only tell us about the eruption timing in places near where the instruments were located; the new lava flows are quite extensive and may have not all erupted at once". Rubin's University of Hawaii lab is the only one in the world that does this specific type of dating, which can yield extremely high resolution ages.

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Science Express http://www.sciencemag.org/sciencexpress/recent.dtl

Images are available, http://www.ldeo.columbia.edu/news/2006/11_23_06.htm and

http://www.ridge2000.org/science/tcs/epr_2006_science_supp_material.php

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About the School of Ocean and Earth Science and Technology, University of Hawaii at Manoa
The School of Ocean and Earth Science and Technology (SOEST) was established by the Board of Regents of the University of Hawaii in 1988. SOEST brings together in a single focused ocean, earth sciences and technology group, some of the nation's highest quality academic departments, research institutes, federal cooperative programs, and support facilities to meet challenges in the ocean and earth sciences. Scientists at SOEST are supported by both state and federal funds as they endeavor to understand the subtle and complex interrelations of the seas, the atmosphere, and the earth.

About the Earth Institute at Columbia University
The Earth Institute at Columbia University is the world's leading academic center for the integrated study of the Earth, its environment and society. The Earth Institute builds upon excellence in the core disciplines—earth sciences, biological sciences, engineering sciences, social sciences and health sciences—and stresses cross-disciplinary approaches to complex problems. Through research, training and global partnerships, The Earth Institute mobilizes science and technology to advance sustainable development, while placing special emphasis on the needs of the world's poor. For more information, visit www.earth.columbia.edu.

The Lamont-Doherty Earth Observatory, a member of The Earth Institute at Columbia University, is one of the world's leading research centers seeking fundamental knowledge about the origin, evolution and future of the natural world. More than 300 research scientists study the planet from its deepest interior to the outer reaches of its atmosphere, on every continent and in every ocean. From global climate change to earthquakes, volcanoes, nonrenewable resources, environmental hazards and beyond, Observatory scientists provide a rational basis for the difficult choices facing humankind in the planet's stewardship. For more information, visit www.ldeo.columbia.edu.